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10 CFR Parts 429 and 430
Energy Conservation Program for Consumer Products: Test Procedures for Refrigerators, Refrigerator-Freezers, and Freezers; Proposed Rule

DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[Docket No. EERE–2012–BT–TP–0016]

RIN 1904–AC76

Energy Conservation Program for Consumer Products: Test Procedures for Refrigerators, Refrigerator-Freezers, and Freezers

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

ACTION: Notice of proposed rulemaking and public meeting.

SUMMARY: The U.S. Department of Energy (DOE) today is issuing a notice of proposed rulemaking to amend the test procedures for refrigerators, refrigerator-freezers, and freezers that will be required for the testing of products starting September 15, 2014. DOE is proposing to amend the test procedure to address products with multiple compressors and to allow an alternative method for measuring and calculating energy consumption for refrigerator-freezers and refrigerators with freezer compartments. DOE is also proposing to amend certain aspects of the test procedure in order to ensure better test accuracy and repeatability. Additionally, DOE is soliciting comment on a potential test procedure to measure the energy use associated with making ice with an automatic icemaker. If adopted, that procedure would become effective in conjunction with any parallel energy conservation standards rulemaking that DOE would need to conduct pursuant to the six-year review process mandated under Federal law.

DATES: DOE will hold a public meeting on July 25, 2013, from 9 a.m. to 4 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section V, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants. DOE will accept comments, data, and information regarding this notice of proposed rulemaking before and after the public meeting, but no later than September 23, 2013. See section V, ''Public Participation,'' for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 8E–089, 1000 Independence Avenue SW., Washington, DC 20585. To attend, please notify Ms. Brenda Edwards at (202) 586–2945. See section V, ''Public Participation'' for details.

Any comments submitted must identify the NOPR for Test Procedures for Refrigerators, Refrigerator-Freezers, and Freezers, and provide docket number EERE–2012–BT–TP–0016 and/or regulatory information number (RIN) number 1904–AC76. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal: www.regulations.gov.* Follow the instructions for submitting comments.
2. *Email: #Res-Refrig-Freezer-2012–BT–TP–0016@ee.doe.gov.* Include docket number EERE–2012–BT–TP–0016 and/or RIN 1904–AC76 in the subject line of the message.
3. *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue SW., Washington, DC 20585–0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.
4. *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza SW., Suite 600, Washington, DC 20024. Telephone: (202) 586–2945. If possible, please submit all items on a CD. It is not necessary to include printed copies.

For detailed instructions on submitting comments and additional information on the rulemaking process, see section V, ''Public Participation''.

The docket is available for review at 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 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-2012-BT-TP-0016.* This Web page will contain a link to the docket for this notice on the regulations.gov site. The regulations.gov Web page will contain simple instructions on how to access all documents, including public comments, in the docket.

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

FOR FURTHER INFORMATION CONTACT: Mr. Lucas Adin, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue SW., Washington, DC, 20585–0121, 202–287–1317, email: *refrigerators_and_freezers@ee.doe.gov* or Mr. Michael Kido, U.S. Department of Energy, Office of the General Counsel, GC–71, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 586–8145. Email: *Michael.Kido@hq.doe.gov.*

SUPPLEMENTARY INFORMATION:

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I. Background and Authority

Title III of the Energy Policy and Conservation Act (42 U.S.C. 6291, *et seq.;* ''EPCA'' or ''the Act'') sets forth a variety of provisions designed to improve energy efficiency. (All references to EPCA refer to the statute as amended through the Energy Independence and Security Act of 2007 (EISA 2007), Pub. L. 110–140 (Dec. 19, 2007).) Part B of title III (42 U.S.C. 6291–6309), which was subsequently designated as Part A for editorial reasons, establishes the ''Energy Conservation Program for Consumer Products Other Than Automobiles.'' Refrigerators, refrigerator-freezers, and freezers (collectively referred to below as ''refrigeration products'') are all treated as ''covered products'' under this Part. (42 U.S.C. 6291(1)–(2) and 6292(a)(1)) Under the Act, this program consists essentially of three parts: (1) Testing, (2) labeling, and (3) Federal energy conservation standards. The testing requirements consist of test procedures that manufacturers of covered products must use (1) as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA, and (2) for making representations about the efficiency of those products. Similarly, DOE must use these test requirements to determine whether the products comply with any relevant standards promulgated under EPCA.

By way of background, the National Appliance Energy Conservation Act of 1987 (NAECA), Public Law 100–12, amended EPCA by including, among other things, performance standards for refrigeration products. (42 U.S.C. 6295(b)) On November 17, 1989, DOE amended these performance standards for products manufactured on or after January 1, 1993. 54 FR 47916. DOE subsequently published a correction to revise these new standards for three product classes. 55 FR 42845 (October 24, 1990). DOE again updated the performance standards for refrigeration products on April 28, 1997, for products manufactured starting on July 1, 2001. 62 FR 23102.

EISA 2007 amended EPCA by requiring DOE to publish a final rule determining whether to amend the energy conservation standards for refrigeration products manufactured starting in 2014. (42 U.S.C. 6295(b)(4)) Consistent with this requirement, DOE initiated an effort to consider amendments to the standards for refrigeration products. As part of this effort, DOE issued a framework document on September 18, 2008, that discussed the various issues involved with amending the standards and potential changes to the test procedure. 73 FR 54089. DOE later prepared preliminary analyses that examined in greater detail the impacts amended standards would be likely to have on a national basis. DOE published a notice of proposed meeting (NOPM) to initiate a discussion of these analyses, 74 FR 58915 (Nov. 16, 2009), and held a public meeting on December 10, 2009, to discuss its preliminary findings. At that meeting, and in submitted written comments, interested parties indicated that the energy conservation standards for refrigeration products should address the energy use associated with automatic icemakers. They added, however, that a test procedure to measure icemaking energy use had not yet been sufficiently developed to provide a basis for the standards. (Energy Conservation Standards for Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2008–BT–STD–0012; American Council for an Energy Efficient Economy (ACEEE), No. 46 at p. 1; California Investor Owned Utilities (IOUs), No. 39 at p. 2; LG, No. 44 at pp. 2–3; Natural Resources Defense Council (NRDC), No. 42 at p. 2; Northeast Energy Efficiency Partnership (NEEP), No. 41 at p. 1; Northwest Power and Conservation Council (NPCC), No. 36 at p. 1; Sub-Zero, No. 43 at pp. 2–3; Appliance Standards Awareness Project (ASAP), Public Meeting Transcript, No. 30 at pp. 28–29; Association of Home Appliance Manufacturers (AHAM), No. 37 at p. 2; General Electric, No. 40 at p. 1)

DOE also initiated a test procedure rulemaking to help address a variety of test procedure-related issues identified in the energy conservation standard rulemaking's framework document. Taking these issues into account, DOE published a notice of proposed rulemaking (NOPR) on May 27, 2010. 75 FR 29824 (hereafter referred to as ''the May 2010 NOPR''). The May 2010 NOPR proposed to use a fixed value of 84 kWh per year to represent the icemaking energy use for those refrigeration products equipped with automatic icemakers. The NOPR also indicated that DOE would consider adopting an approach based on testing to determine icemaking energy use if a suitable test procedure could be developed. Id. at 29846–29847. A broad group of stakeholders [1] submitted a joint comment supporting DOE's proposal to use a temporary fixed placeholder value to represent the energy use of automatic icemakers. It also urged DOE to initiate a rulemaking no later than January 1, 2012, and publish a final rule no later than December 31, 2012, to amend the test procedures to incorporate a laboratory-based measurement of icemaking energy use. The joint comment further recommended that DOE publish a final rule by July 1, 2013, amending the energy conservation standards scheduled to take effect in 2014 to account for the differences in energy use of icemakers measured using the new test procedure as compared with the 84 kWh per year fixed placeholder value. (Test Procedure for Refrigerators, Refrigerator-Freezers, and Freezers, Docket Number EERE–2009–BT–TP–0003; Joint Comment, No. 20 at 5–6)

In keeping with the timeline suggested in the comment, AHAM provided DOE in early January 2012 with a draft test procedure that could be used to measure automatic icemaker energy usage. (AHAM Refrigerator, Refrigerator-Freezer and Freezer Ice Making Energy Test Procedure, Revision 1.0—12/14/11,[2] No. 4) Subsequently, consistent with the suggestions made by commenters and DOE's previously stated intentions, DOE initiated work to develop today's notice. On July 18, 2012, AHAM provided DOE with a revised test procedure. (AHAM Refrigerator, Refrigerator-Freezer and Freezer Ice Making Energy Test Procedure, Revision 2.0—7/10/12,[3] No. 5) Today's notice, which is based in part on the approach suggested by AHAM, is designed to help the agency improve the accuracy of certain aspects of the test procedure that it recently promulgated. To ensure that any potential technical issues are addressed, DOE is soliciting

[1] The signatories to these comments included the Association of Home Appliance Manufacturers, the American Council for an Energy-Efficient Economy, the Natural Resources Defense Council, the Alliance to Save Energy, the Alliance for Water Efficiency, the Appliance Standards Awareness Project, the Northwest Power and Conservation Council, the Northeast Energy Efficiency Partnerships, the Consumer Federation of America, the National Consumer Law Center, Earthjustice, and the California Energy Commission.

[2] Subsequently referred to as ''AHAM Draft Test Procedure''

[3] Subsequently referred to as ''AHAM Revised Draft Test Procedure''

comments from the public on the potential adoption of the icemaking energy use measurement test that is detailed in today's notice. The procedure would be added as a new and separate section to the test procedure. Based on the comments received, DOE may adopt this testing approach (along with any necessary modifications) as part of the overall procedure but would require its usage to occur in parallel with any energy conservation standards rulemaking that would result from the mandatory review required under EPCA. See 42 U.S.C. 6295(m).

DOE does not anticipate, based on collected preliminary data that its proposed changes to the current procedure would be likely to require an adjustment to those standards that manufacturers must meet starting in 2014. Additional details regarding these adjustments are detailed below and explain why an adjustment to the 2014 standards will not be necessary.

General Test Procedure Rulemaking Process

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

In cases where DOE is considering amending a test procedure (or adding a new one), DOE publishes a proposal and offers the public an opportunity to present oral and written comments. (42 U.S.C. 6293(b)(2)) When considering amending a test procedure, DOE must determine the extent to which, if any, the proposal would alter the measured energy use of a given product as determined under the existing procedure. (42 U.S.C. 6293(e)(1)) If DOE determines that the amended test procedure would alter the measured energy use of a covered product, DOE must also amend the applicable energy conservation standard accordingly. (42 U.S.C. 6293(e)(2))

Today's rulemaking addresses amendments that, if adopted, would apply to the test procedures that manufacturers must use to demonstrate compliance with the energy conservation standards starting on September 15, 2014 (*i.e.,* 10 CFR part 430, subpart B, appendices A and B). DOE has determined that none of the amendments to the test procedures proposed in this notice would be likely to significantly change the measured energy use of refrigeration products. DOE's analyses demonstrate that the proposed amendments to Appendices A and B, along with the possible incorporation of an optional ''triangulation'' method, will not affect measured energy use to any significant extent that would necessitate a change to any of the energy conservation standards for the products that would be affected by today's proposal. (42 U.S.C. 6293(e)(2)) Further, the preliminary data indicate that if DOE were to adopt the icemaking energy measurement test procedure detailed in today's notice, an adjustment to the standards be unnecessary. To demonstrate the effects of these amendments under consideration, DOE has conducted a preliminary evaluation of the anticipated impacts presented by today's proposal. This evaluation is discussed in further detail in section D.II of this notice. DOE notes that the proposed icemaking energy measurement test procedure amendments, if adopted, would not be required for manufacturers to use unless DOE were to set new or amended standards for refrigeration products after September 2014. Until such standards are developed, manufacturers would continue following the method that is laid out in Appendices A and B.

Refrigerators and Refrigerator-Freezers

DOE's test procedures for refrigerators and refrigerator-freezers are found at 10 CFR part 430, subpart B, appendices A1 (currently in effect) and A (required for rating products starting September 15, 2014). DOE initially established its test procedures for refrigerators and refrigerator-freezers in a final rule published in the **Federal Register** on September 14, 1977. 42 FR 46140. Industry representatives viewed these test procedures as too complex and eventually developed alternative test procedures in conjunction with AHAM that were incorporated into the 1979 version of HRF–1, ''Household Refrigerators, Combination Refrigerator-Freezers, and Household Freezers'' (HRF–1–1979). Using this industry-created test procedure, DOE revised its test procedures on August 10, 1982. 47 FR 34517. On August 31, 1989, DOE published a final rule establishing test procedures for variable defrost control (a control type in which the time interval between successive defrost cycles is determined by operating conditions indicating the need for defrost rather than by compressor run time) refrigeration products, dual compressor refrigerator-freezers, and freezers equipped with ''quick-freeze'' (a manually-initiated feature that bypasses the thermostat and runs the compressor continuously until terminated). 54 FR 36238. DOE amended the test procedures again on March 7, 2003, by modifying the test period used for products equipped with long-time automatic defrost (a control type in which defrost cycles are separated by 14 hours or more of compressor run time) or variable defrost. 68 FR 10957. The test procedures include provisions for determining the annual energy use in kilowatt-hours (kWh) (54 FR 6062, Feb. 7, 1989) and the accompanying annual operating costs. 42 FR 46140 (Sept. 14, 1977).

DOE further amended the test procedures in a final rule published on December 16, 2010. 75 FR 78810. These amendments helped clarify how to test products for compliance with the applicable standards. The amendments clarified certain elements in Appendix A1 to ensure that regulated entities fully understand how to apply and implement the test procedure. These changes included clarifying how refrigeration products equipped with special compartments and/or more than one fresh food compartment or more than one freezer compartment should be tested. The amendments also accounted for the various waivers granted by DOE, specifically with regard to variable anti-sweat heater controls. The final rule also modified the regulatory definition of ''electric refrigerator-freezer'' by requiring the storage temperatures in the fresh food compartment of such a product to be at a level that would effectively exclude the coverage of combination wine storage-freezer products. *See* 10 CFR 430.2. The definition for ''electric refrigerator'' had already been amended to clarify the characteristics that distinguish it from related products, such as wine storage products, as part of a final rule published on November 19, 2001. 66 FR 57845. However, the December 2010 final rule made additional refinements to the definition. 75 FR at 78817 (Dec. 16, 2010). DOE is considering further modifying its product definitions to cover wine storage products as part of a separate rulemaking. *See* 77 FR 7547 (Feb. 13, 2012) (announcing the availability of DOE's framework document regarding wine chillers and other miscellaneous refrigeration products).

In the December 16, 2010 notice, DOE also established a new Appendix A, via an interim final rule. The new

Appendix A included a number of comprehensive changes to help improve the measurement of energy consumption of refrigerators and refrigerator-freezers. These changes included, among other things: (1) New compartment temperatures and volume adjustment factors, (2) new methods for measuring compartment volumes, (3) a modification of the long-time automatic defrost test procedure to ensure that the test procedure measures all energy use associated with the defrost function, and (4) test procedures for products with a single compressor and multiple evaporators with separate active defrost cycles. DOE noted that the compartment temperature changes introduced by Appendix A would significantly impact the measured energy use and affect the calculated adjusted volume and energy factor (*i.e.,* adjusted volume divided by energy use) values. Lastly, the interim final rule also addressed icemaking energy use by including a fixed value for manufacturers to add when calculating the energy consumption of those products equipped with an automatic icemaker. Using available data submitted by the industry, this value was set at 84 kWh per year. See 75 FR 78810, 78859 and 78871 (Dec. 16, 2010) (specifying daily value of 0.23 kWh for products equipped with an automatic icemaker).[4] In light of stakeholders' strong recommendations that the test procedure and energy conservation standards incorporate the energy use associated with icemaking, AHAM's development efforts, and additional work performed by NIST and DOE, DOE is soliciting the public for feedback on a possible replacement for the ''fixed value'' approach by detailing a test procedure based on these collective efforts that relies on laboratory measurements to determine the energy use of automatic icemakers. Based on the comments received, DOE may adopt this approach or consider other alternatives.

Freezers

DOE's test procedures for freezers are found at 10 CFR part 430, subpart B, appendices B1 (currently in effect) and B (required for the rating of products starting in 2014). DOE established its test procedures for freezers in a final rule published in the **Federal Register** on September 14, 1977. 42 FR 46140. As with DOE's test procedures for refrigerators and refrigerator-freezers, industry representatives viewed the freezer test procedures as too complex and worked with AHAM to develop alternative test procedures, which were incorporated into the 1979 version of HRF–1. DOE revised its test procedures for freezers based on this AHAM standard on August 10, 1982. 47 FR 34517. The subsequent August 31, 1989 final rule established test procedures for freezers with variable defrost control and freezers with the quick-freeze feature. 54 FR 36238. A subsequent amendment occurred to correct that rule's effective date. 54 FR 38788 (Sept. 20, 1989). The current test procedures include provisions for determining the annual energy use in kWh and annual electrical operating costs for freezers.

As with refrigerators and refrigerator-freezers, the December 16, 2010 notice also clarified compliance testing requirements for freezers under Appendix B1 and created a new Appendix B, the latter of which manufacturers are required to use starting in 2014. That new test procedure changed a number of aspects of the procedure detailed in Appendix B1, including, among other things: (1) The freezer volume adjustment factor, (2) methods for measuring compartment volumes, and (3) the long-time automatic defrost test procedure. In addition, Appendix B also addresses icemaking energy use by implementing for freezers the same procedure adopted for refrigerator-freezers in which a fixed energy use value is applied when calculating the energy consumption of freezers with automatic icemakers. 75 FR 78810.

Finalization of the Test Procedure Rulemaking for Products Manufactured Starting in 2014

The December 2010 interim final rule established comprehensive changes to the manner in which refrigeration products are tested by creating new Appendices A and B. In addition to the changes discussed above, these new appendices also incorporate the modifications to Appendices A1 and B1 that were finalized and adopted on December 16, 2010.

DOE provided an initial comment period on the interim final rule, which ended on February 14, 2011, and subsequently reopened the comment period on September 15, 2011 (76 FR 57612) to allow for further public feedback in response to the promulgation of the final energy conservation standards that were published on the same day. 76 FR 57516. This re-opening permitted interested parties to comment on the interplay between the test procedure and the energy conservation standards, and provided DOE with additional information to consider before making any final changes to the test procedures of Appendices A and B prior to their use by manufacturers starting on September 15, 2014. 76 FR at 57612–57613. That comment period ended on October 17, 2011. DOE also considered comments related to a petition for a test procedure waiver that had a direct bearing on elements of the test procedures used in Appendix A. *See* 76 FR 16760 (March 25, 2011) (petition no. RF–018, Samsung Electronics America, Inc. (Samsung)).

During the comment periods that DOE provided, interested parties raised a number of issues for DOE to consider with respect to the test procedure. The submitted comments included suggestions that DOE modify the test procedure for multiple compressor systems to reduce test burden, modify the test period for the second part of the test for products with long-time or variable defrost to assure proper accounting of all energy use associated with defrost, develop separate test procedures and standards for products combining wine storage with fresh food compartments, allow use of an alternative three-test interpolation approach as an option to potentially improve measurement accuracy at the cost of greater test burden for those manufacturers choosing to use it, adjust the test procedure's anti-circumvention provisions, and adjust the default values of CT_L and CT_M (the longest and shortest duration of compressor run time between defrosts) to be used in the energy use equations for products that do not have defined values for these parameters in their control algorithms. (Test Procedure for Refrigerators, Refrigerator-Freezers, and Freezers, Docket Number EERE–2009–BT–TP–0003; Sub-Zero, No. 42; AHAM, No. 43, Whirlpool, No. 44) Stakeholders recommended that all but the last of these changes be adopted in the current test procedures (Appendices A1 and B1) as well as the test procedures that will be required for certification of compliance with the new energy standards starting September 15, 2014 (Appendices A and B). The recommendation for changing the default values of CT_L and CT_M applied only to the latter set of test procedures.

On January 25, 2012, DOE published a final rule setting out the test procedures for refrigerators and refrigerator-freezers (Appendix A) and freezers (Appendix B) that manufacturers must use starting in 2014. 77 FR 3559. In finalizing the test procedures, DOE considered the changes recommended by stakeholders, including recommendations for certain amendments to be made to the current test procedures found in 10 CFR 430.23

[4] Multiplying 0.23 by 365 days per year yields 84 kWh.

and in Appendices A1 and B1. DOE declined to make the recommended amendments for these appendices because the supplementary comment period DOE provided had explicitly focused solely on issues related to Appendices A and B. Aspects of Appendices A1 and B1 had already been settled and finalized with the December 2010 final rule. *Id.* at 3568–3571. Additionally, DOE declined to adopt certain changes recommended for Appendices A and B. DOE declined to adopt these suggestions because the nature of those recommendations had not, in DOE's view, been presented in a manner that would have afforded the public with a sufficient opportunity to adequately comment on those issues. *Id.*

Nevertheless, after finalizing the rule setting out Appendices A and B, DOE reviewed these various suggestions and weighed their possible inclusion as part of the test procedure framework for refrigeration products. As a result of this review, DOE has decided to propose the inclusion of some of these recommended amendments in today's NOPR, including modified test procedures for products with multiple compressor systems, use of an alternative method for measuring and calculating energy use consumption at standardized temperatures for refrigerator-freezers and refrigerators with freezer compartments, and the modification of the anti-circumvention language currently found in these appendices.

Waivers

DOE has granted a limited number of petitions for waiver from the test procedures for refrigeration products since the publication of the December 2010 final rule. On January 10, 2012, DOE published a decision and order (D&O) responding to two waiver petitions from Samsung addressing products with multiple defrost cycle types. 77 FR 1474. That notice prescribed a procedure to account for the energy use associated with the multiple defrost cycles of a single-compressor-based system. The approach is identical to the procedure established for Appendix A in the January 25, 2012, final rule that manufacturers will need to follow starting in 2014. 77 FR 3559. DOE also issued a Decision and Order (D&O) that granted a waiver to GE Appliances (GE) to use the same test procedure for similar products. *See* 77 FR 75426 (Dec. 20, 2012) (GE waiver). In effect, these waivers permit these companies to address certain products that cannot be readily tested or that otherwise would produce unrepresentative energy consumption measurements under the currently required test in Appendix A1.

DOE also granted a waiver to Sub-Zero, Inc. (Sub-Zero) to address that company's multiple-compressor products. *See* 77 FR 5784 (Feb. 6, 2012) (Sub-Zero waiver). That waiver permitted Sub-Zero to use the same test procedure that AHAM had recommended that DOE adopt for both Appendix A1 and Appendix A. (Test Procedure for Refrigerators, Refrigerator-Freezers, and Freezers, Docket Number EERE–2009–BT–TP–0003; AHAM, No. 43 at pp. 2–3) Today's NOPR proposes to add a test procedure for multiple compressor products that is based on the Sub-Zero waiver procedure.

Finally, on August 16, 2012, DOE granted a waiver to Sanyo E&E Corporation (Sanyo) to address a hybrid refrigeration product, *i.e.,* a product combining wine storage compartments in a refrigerator. See 77 FR 49443 (Decision and Order granting Sanyo's petition (Sanyo waiver)). The waiver cites a guidance document that DOE published in February 2011, which indicates that products combining a wine storage compartment and a fresh food compartment are considered refrigerators and should be tested as such.[5] The waiver further explains that the Sanyo hybrid product cannot be tested with its wine storage compartment at the standardized temperature required for testing refrigerators using Appendix A1 (*i.e.,* 38 °F), and that doing so would result in a non-representative energy use measurement. Hence, DOE granted Sanyo's request that it be allowed to test the product using a standardized temperature of 55 °F for the wine storage compartment. *Id.*

After granting a waiver, DOE waiver provisions generally direct the agency to initiate a rulemaking to amend its regulations to eliminate the continued need for the waiver. 10 CFR 430.27(m). Today's notice addresses this requirement for the Sub-Zero waiver by proposing to amend Appendix A to include a test procedure for multiple compressor products that is based on the Sub-Zero waiver procedure. The Sub-Zero waiver would terminate on September 15, 2014, the same date that manufacturers must use the test procedures in Appendix A for testing. The Samsung and GE waivers have already been addressed by the January 2012 final rule for products manufactured starting September 15, 2014. DOE does not currently anticipate that additional products on the market with single-compressor-based systems using multiple defrost cycles will be introduced prior to 2014, since it is DOE's understanding that this is a system design unique to those manufacturers who are currently covered by these waivers. Hence, at this time, DOE does not believe amending Appendix A1 to include this particular alternative test procedure is necessary. As for hybrid products such as the one identified by Sanyo, DOE will consider developing appropriate test procedures for these and similar products in a separate rulemaking. *See* 77 FR 7547 (Feb. 13, 2012).

[5] This guidance is posted in DOE's online Guidance and FAQ database, and is available for viewing at *http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1*

II. Summary of the Proposal

DOE's December 2010 and January 2012 notices made a number of changes to the previous versions of the test procedures. These changes included modifying the current procedure and creating a substantially revised procedure that manufacturers must begin to use when certifying and rating refrigeration products starting in 2014. While the final rules made a number of significant improvements to the test procedures, there remained some pending issues that DOE was unable to address. Today's notice attempts to address those remaining issues.

Some of the improvements proposed in this notice could be considered for implementation in the current test procedures as well as the procedures that will be required for certification starting in 2014. However, the current test procedures will continue to be used only for a limited time. Hence, DOE is not proposing to make any substantive amendments to these test procedures, which are contained in Appendices A1 and B1. (The proposal does, however, include amendments that would correct certain cross-references in these appendices to sections of 10 CFR 429). DOE requests comments on its proposed amendments to Appendices A and B, along with its tentative decision to refrain from applying this approach to the currently required Appendices A1 and B1.

The proposed amendments and issues on which DOE seeks public comment are summarized below.

First, DOE is soliciting comment on its proposal to incorporate laboratory-based test procedures for measuring energy use associated with automatic icemaking to replace the standardized value used to represent icemaking energy use that DOE adopted as part of the December 2010 test procedure interim final rule. See 75 FR at 78859 (Appendix A, sec. 6.2.2.1.) and 78871

(Appendix B, sec. 6.2.1.1.). Responding to DOE's preliminary analysis in 2009, a broad group of stakeholders agreed that DOE should regulate icemaking energy use as part of the refrigeration product energy conservation standards. The commenters recognized, however, that suitable test procedures were not yet available to allow their introduction in time for use with the 2014 energy conservation standards. (See Energy Conservation Standards for Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2008–BT–STD–0012; ACEEE, No. 46 at p. 1; and AHAM, No. 37 at p. 2) With this understanding, many of these stakeholders collaborated to submit a joint comment recommending that DOE conduct a rulemaking in 2012 to amend its refrigeration product test procedures to incorporate icemaking energy use. (Test Procedure for Refrigerators, Refrigerator-Freezers, and Freezers, Docket Number EERE–2009–BT–TP–0003; Joint Comment, No. 20 at pp. 5–6) AHAM submitted to DOE a ''draft'' version of this test procedure in January 2012. Later, in July 2012, it submitted a revised version of this earlier draft and recommended that DOE adopt it. (AHAM Draft Test Procedure, No. 4; and AHAM Revised Draft Test Procedure, No. 5) [6]

Today's notice solicits comment on an approach that would measure the energy use of automatic icemaking. That approach is based in part on the suggested approach from AHAM. Depending on the nature of any submitted comments, DOE may modify this approach. At this time, DOE is proposing that manufacturers would not be required to use this procedure until DOE amends the energy conservation standards for refrigeration products as part of the mandatory review required under EPCA. By linking this new measurement method with a new standards rulemaking, DOE can better ensure that all of these new requirements are coordinated within the context of a standards rulemaking (which would include any potential impacts related to icemaking energy use) and avoid any potential labeling issues that may arise, particularly since the new standards that DOE promulgated in 2011 will not be required for compliance purposes until 2014. See 76 FR 57516.

Further, DOE notes that manufacturers must base their written representations of energy usage on a new test procedure within 180 days of when the final rule for that procedure is published. See 42 U.S.C. 6293(c)(2). Given the upcoming transition to the new standards for 2014, it is possible that this requirement, if adopted, could lead to confusion as consumers attempt to understand the meaning of the reported values, particularly if the reported values differ between two identical models that may have been tested under different provisions. Additionally, manufacturers would need to adjust their testing and labeling to account for the new icemaking energy measurement protocol. In light of these concerns, it is DOE's tentative view that linking the timing of when manufacturers should begin using the icemaking energy use test method with the agency's statutorily-mandated review of the 2014 standards would reduce consumer confusion and minimize the overall burdens faced by manufacturers while ensuring that a viable procedure is in place for measuring the energy use from icemaking. DOE notes that if it should adopt this measurement procedure, it would use that procedure in evaluating potential adjustments to the energy conservation standards as part of the mandatory review. This two-step approach should help ensure a smoother transition to a potential new set of standards based on any icemaking energy use test that DOE may adopt. DOE also notes that if this procedure were adopted in the manner described above, a manufacturer seeking to use the new procedure earlier than required would need to obtain a test procedure waiver from DOE in advance of doing so.

Second, today's notice proposes to add test procedures for products with multiple compressor systems. These proposed procedures are based on the waiver granted to Sub-Zero on February 6, 2012. 77 FR 5784. They are proposed for inclusion only in Appendix A (i.e. procedures for these products required starting in 2014). The approach is not applicable to freezers and, hence, is not proposed for inclusion in Appendix B.

Third, the proposal would address two issues raised by commenters during the previous refrigeration product test procedure rulemaking. The first would make modest changes to the ''anti-circumvention'' language of 10 CFR 430.23, which is found in paragraph (a)(10) for refrigerators and refrigerator-freezers, and paragraph (b)(7) for freezers. This proposed amendment would help clarify product design and control system issues to ensure that the measurements from testing are accurate and representative of expected consumer use. The second would allow the optional use of a new, alternative method for measuring and calculating the energy use of refrigerator-freezers and refrigerators with freezer compartments. This method, commonly known as ''triangulation,'' may, for some products, provide a more accurate measure of energy use—notably, for products with control systems that are not balanced to simultaneously match the standardized temperatures of both the freezer and fresh food compartments at the same positions of the temperature controls for these compartments. Triangulation involves the use of an additional test conducted using a third temperature control setting. (Under Appendix A, only two temperature control settings are used to calculate the energy usage of a given refrigeration product.) The proposal would allow manufacturers to use this test as an alternative for certification if a manufacturer believed that the more comprehensive triangulation test would provide a more accurate measurement of energy use than the simpler, ''two temperature-control-setting'' method already provided in DOE's regulations. The proposal would also require that certification reports indicate whether triangulation has been used for testing. The NOPR proposes that triangulation be adopted in Appendix A. This test method is not applicable to freezers and, hence, is not proposed for inclusion in Appendix B. Additionally, while manufacturers would have the option of using either the two-part or triangulation test, DOE is proposing that it would use the triangulation test for assessment and enforcement testing in some cases.

Today's proposal also includes amendments associated with certification of compliance. First, it includes a proposal to eliminate the current requirement to report the height of refrigeration products in certification reports starting September 15, 2014. This information will no longer be necessary to classify products after this date, because the compact product classes will no longer have a height limit. See 76 FR 57515, 57538 (Sept. 15, 2011) and DOE Guidance (Oct. 6, 2011) regarding compact products, *http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/refr-frz_faq_2011-10-06.pdf.* This change in the certification report requirements of 10 CFR 429.14(b)(2) would, in DOE's

[6] DOE's proposal is more consistent with the revised AHAM test procedure than with AHAM's initial draft. However, it is instructive to consider the contrast between the initial and revised AHAM test procedures, since justification for certain complications present in the DOE proposal for testing products that cycle compressors during icemaking are best explained through comparison with the simpler, but potentially less accurate, method of the initial AHAM draft.

view, reduce the overall reporting burden faced by manufacturers. The proposal would also move the requirement to report whether a product has variable defrost or variable anti-sweat heaters from section 429.14(b)(3) to section 429.14(b)(2) to reflect that DOE intends for this information to be publicly available.

As a measure intended to reduce testing burden and potentially improve the accuracy of reported data, today's proposal would permit the use of volume calculations derived using computer aided design (CAD) tools in lieu of physical measurements of each basic model. To enable manufacturers to use this option, DOE is proposing changes to the requirements of Appendices A and B for measuring volume, adding a new section 429.72 establishing requirements applicable to volume measurement, and adding a process in a new section 10 CFR 429.134 for verifying the rated volume of a product. Finally, the references in section 5.1 of Appendices A and B to certification test reports would be corrected, changing references from 10 CFR 429.14 to 10 CFR 429.71.

The proposal also includes several clarifying amendments. These include: (a) Clarifying the term ''incomplete cycling'' as it applies to tested products and also modifying the test period for these products to ensure more accurate energy use measurement, (b) more specific instructions for setting mechanical temperature controls at their warmest and coldest settings, (c) clarifying the requirements for measuring ambient temperature and for maintaining ambient temperature gradients during testing, (d) establishing definitions for several commonly understood (but undefined) terms used in the test procedures, (e) a correction to the definition of the term ''E'' as used in section 6.2.2.2 of Appendix A to reference the proper section of the procedure, (f) required conditions for ''connected'' products during testing, (g) more specific instructions regarding the required clearance to the rear wall during testing, and (h) more specific instructions for relocation of interior components, such as shelving, to allow placement of temperature sensors in the required locations. In DOE's view, adopting these proposed amendments would improve test accuracy and would help ensure consistency when tests are carried out by different testing laboratories. These proposals, which are not expected to lead to any changes in measured energy usage, would be adopted in Appendices A and B.

Today's proposal also includes corrections to the temperature setting tables—Tables 1 and 2 of Appendix A and Table 1 of Appendix B. These tables would be modified in the CFR to properly reflect the intended temperature-setting progression from the initial test through the final test. The proposal would eliminate some horizontal lines in these tables to clarify the temperature-setting logic.

Further, DOE is seeking comments on a specific aspect related to built-in products, namely, whether testing these products in their built-in conditions would provide more representative and accurate energy consumption measurements. Under the current procedures, manufacturers are not required to test these products in a built-in condition. However, data recently collected by DOE, described in section III.D.1, suggest that some built-in products may yield different energy use measurements depending on whether they are tested in a built-in condition.

Finally, DOE has proposed amendments to address issues that DOE has identified through product testing. The first involves products with variable defrost, which are tested using provisions in Appendices A and B that are designed to account for variation in compressor run time between defrost cycles. DOE has observed in some cases that the actual minimum time between defrosts during testing was less than the minimum value reported to DOE in the model's certification report. To ensure that measured values of energy use are representative of the actual operation of models with variable defrost, DOE proposes to require use of the minimum observed compressor run time between defrosts if it is less than the certified value. The second proposal is to include more specific instructions regarding loading of packages in freezers, as required by Appendix B, which DOE believes will result in more consistent performance of this aspect of the test procedure.

The proposed amendments discussed in this notice would, if adopted, take effect 30 days after issuance of the final rule. However, manufacturers would be required to use the modified versions of Appendices A and B for rating products starting on the compliance date for the 2014 standards, which is September 15, 2014. 76 FR 70865 (Nov. 16, 2011). With the exception of the proposed test method for icemaker energy use, which would be addressed separately from the other proposed amendments to Appendices A and B, these changes either involve clarifications or provide alternatives to those methods that manufacturers already must use—or otherwise permit manufacturers to use a procedure that the industry has already largely developed and vetted. None of these amendments would, to DOE's knowledge, alter the measured energy use to any significant extent, and DOE does not anticipate that manufacturers will need to make substantial efforts to adjust to any of these proposed changes. With respect to the adoption of the proposed icemaker-related amendments for Appendices A and B, none of these changes would be required until DOE prescribes new or amended standards for refrigeration products. Until that time, manufacturers would continue using the fixed value approach prescribed in the regulations to account for icemaking energy use. Should these proposed amendments be adopted, manufacturers seeking to use this procedure prior to DOE's promulgation of new or amended standards would need to obtain a test procedure waiver in advance of doing so.

III. Discussion

This notice contains a number of proposed modifications to the refrigerator, refrigerator-freezer, and freezer test procedures, and DOE encourages stakeholders to submit comments on any aspect of these proposals. Comments are especially encouraged if stakeholders wish to provide supporting data, propose alternate approaches, and express support for (or objections to) DOE's tentative views on the issues discussed in this notice.

The following section discusses in further detail the various issues addressed by today's notice. Table III–1 below lists the subsections of this section and indicates where the proposed amendments, along with the potential icemaking energy measurement test that DOE is considering, would appear in each appendix. Section A identifies the products covered by the proposal; section B specifies the compliance dates that would apply to the proposed amendments; section C discusses the test procedure amendments; section D discusses testing of built-in products and requests comment on the discussion without proposing a test procedure amendment; and section E discusses compliance of the proposal with other EPCA requirements.

TABLE III–1—DISCUSSION SUBSECTIONS

Section	Title	Affected appendices A	Affected appendices B
III.A	Products Covered by the Proposed Rule	No proposed changes.	
III.B	Proposed Dates for the Amended Test Procedures	X	X
1	Icemaking Test Procedure	X	X
2	Multiple Compressor Test	X	
3	Triangulation	X	
4	Anti-Circumvention Language	*	
5	Incomplete Cycling	X	X
6	Mechanical Temperature Controls	X	X
7	Ambient Temperature Gradient	X	X
8	Definitions Associated with Defrost Cycles	X	X
9	Elimination of Reporting of Product Height	**	
10	Measurement of Product Volume ***	X	X
11	Corrections to Temperature Setting Logic Tables	X	X
III.C.12	Default Minimum Compressor Run-Time Between Defrosts for Variable Defrost Models	X	X
III.C.13	Treatment of "Connected" Products	X	X
III.C.14	Changes to Confidentiality of Certification Data	***	
III.C.15	Package Loading		X
III.C.16	Rear Clearance During Testing	X	X
III.C.17	Other Minor Corrections †	X	X
III.C.18	Relocation of Shelving	X	X
III.D.1	Built-In Refrigerators	No proposed changes.	
III.D.2	Products that are Operable as a Refrigerator or a Freezer		
1	Test Burden		
2	Changes in Measured Energy Use		
3	Standby and Off Mode Energy Use		

* This amendment would appear in 10 CFR 430.23, but would affect testing using all four appendices.
** This amendment would appear in 10 CFR 429.14, but would affect certification reporting for products tested using Appendices A and B.
*** This amendment includes proposed modifications to 10 CFR 429.14.
† This section also proposes an amendment to 10 CFR 430.2.

A. Products Covered by the Proposed Rule

Today's amendments cover those products that meet the definitions for refrigerator, refrigerator-freezer, and freezer, as codified in 10 CFR 430.2. The definitions for refrigerator and refrigerator-freezer were amended in the December 16, 2010 final rule. 75 FR at 78817 and 78848.

B. Proposed Dates for the Amended Test Procedures

This notice proposes amendments that would be made in sections 429.14 and 430.23 and in Appendices A and B.

The proposed amendments to sections 429.14 and 430.23 would be effective 30 days after publication of a final rule. Manufacturers would not be required to use the amended test procedures to rate their products until 180 days after issuance of the final rule. *See* 42 U.S.C. 6293(c)(2).

Some of the proposed amendments that aim to improve measurement accuracy by clarifying certain aspects of the test procedures or to reduce test burden could potentially be considered for adoption in the current test procedures (*i.e.,* Appendices A1 and B1). However, these appendices are scheduled to be obsolete after September 2014, so DOE is not proposing to amend them. DOE requests comments on this approach.

The proposed amendments that would apply to Appendices A and B would be effective 30 days after issuance of a final rule, but manufacturers would not be required to use this procedure prior to September 15, 2014. Once that date arrives, however, Appendices A and B will be mandatory for making representations regarding the energy use or operating costs of refrigeration products. Manufacturers would be permitted to use Appendices A and B before this 2014 date if they choose to do so, provided that they indicate in their certification submissions that their ratings are based on Appendix A or B and that the products satisfy the 2014 standards.

As discussed in section I, this NOPR addresses the joint comments of a broad group of stakeholders who urged DOE to initiate a rulemaking to amend the test procedures for refrigeration products to incorporate a laboratory-based measurement of icemaking energy use. The joint comment further recommended that DOE publish a final rule by July 1, 2013, and amend the energy conservation standards scheduled to take effect in 2014 to account for the differences in measured energy use of icemakers when using the new test procedure as compared with the 84 kWh per year fixed placeholder value. (Test Procedure for Refrigerators, Refrigerator-Freezers, and Freezers, Docket Number EERE–2009–BT–TP–0003; Joint Comment, No. 20 at 5–6) However, as discussed in section 1, DOE has tentatively determined that its proposal to address icemaking energy use would not affect measured energy use to any significant extent. Hence, DOE believes at this time that adjusting the energy conservation standards as suggested would not be necessary. Section 1 discusses DOE's preliminary assessment of the likely impact of the icemaking test procedure detailed in today's notice on energy consumption measurements. Supporting data are provided to help illustrate this impact.

As pointed out earlier, the proposed icemaking test procedure would not be required until DOE prescribes new or amended standards for refrigeration products. Until that time, manufacturers would continue using the fixed value approach currently prescribed in DOE's regulations to account for icemaking energy use. Should these proposed amendments be adopted, manufacturers seeking to use this procedure prior to DOE's promulgation of new or amended standards would need to obtain a test procedure waiver in advance of doing so.

C. Proposed Test Procedure Amendments

The following discussion addresses aspects of DOE's proposal to amend 10 CFR 430.23 and Appendices A and B. DOE seeks comment on all aspects of its proposal as described below.

1. Icemaking Test Procedure

Nearly all refrigerator-freezers currently sold either have a factory-installed automatic icemaker or are ''icemaker-kitable''—*i.e.,* they are manufactured with the necessary water tubing, valve(s), and icemaker mounting hardware to allow quick installation of an automatic icemaker at any time after the product leaves the factory. Ice production increases the energy use of a refrigerator-freezer in two ways: (1) Some icemaker components (*e.g.,* the mold heater and the gear motor) consume energy, and (2) additional refrigeration is required to cool and freeze incoming water and to remove the heat generated by icemaker components (*e.g.,* the mold heater).

The current test procedure for refrigerators and refrigerator-freezers does not measure the energy use associated with ice production. Specifically, HRF–1–1979, section 7.4.2 (which is incorporated by reference into the current test procedures of Appendix A1) states, ''Automatic icemakers are to be inoperative during the test''.[7] In the May 2010 NOPR, DOE indicated that energy use associated with automatic icemaking represents 10 percent to 15 percent of the rated energy use of typical refrigeration products. *See* 75 FR at 29846–29847 (May 27, 2010). As discussed in section I of this notice, stakeholders commented in response to DOE's presentation of its preliminary analysis supporting the recently completed energy conservation standard rulemaking that the test procedures and energy conservation standards for refrigeration products should address icemaking energy use (see, for example, Energy Conservation Standards for Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2008–BT–STD–0012; ACEEE, No. 46 at p. 1).

However, stakeholders also commented that a test procedure to measure icemaking energy use had not yet been sufficiently developed. (Energy Conservation Standards for Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2008–BT–STD–0012; AHAM, No. 37 at p. 2: General Electric, No.40 at p. 1) To avoid delaying the energy conservation standard rulemaking, DOE published the new Appendix A test procedure and related energy conservation standard with a fixed placeholder energy use value of 84 kWh/year for products with automatic icemakers, to represent the average amount of energy consumed in ice production. 75 FR at 78842–78843 (Dec. 10, 2010) and 76 FR at 57538 (Sept. 15, 2011). (The 84 kWh/year value is equivalent to the 0.23 kWh/day value found in Appendices A and B, Section 6.2.2.1. That 0.23 kWh/day value is multiplied by 365 (see, for example, 10 CFR 430.23(a)(1)), which yields an annual consumption of 84 kWh/year.)

As part of the 2010 industry and efficiency advocate consensus agreement, AHAM agreed to develop an icemaking test procedure before January 1, 2012. (Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003, Joint Comment, No. 20 at p. 5).

Summary of AHAM's Initial Draft and Revised Draft Icemaking Test Procedures

A key aspect to determining annual energy use associated with icemaking is the average daily ice production. AHAM presented some information to DOE in late 2009 regarding this value in a document summarizing the status of its test procedure development work, titled ''AHAM Update to DOE on Status of Ice Maker Energy Test Procedure—November 19, 2009''.[8] (AHAM Ice Making Test Update, AHAM, No. 7 at p. 5). That document also included data suggesting that using a daily production rate of 1.8 pounds of ice per refrigeration product would be appropriate. This value was based on a total ''sample size'' of 155. However, the document did not elaborate further on the sample size other than to indicate that it had been derived using the combined data from three consumer surveys and three separate field tests.

In early January 2012, AHAM provided DOE with a draft of its icemaking test procedure, ''AHAM Refrigerator, Refrigerator-Freezer, and Freezer Ice Making Energy Test Procedure, Revision 1.0—12/14/11''. (AHAM Draft Test Procedure, No. 4) That draft indicated that it applies to refrigerators, refrigerator-freezers and freezers, as defined in 10 CFR 430.2, that were equipped with a single automatic icemaker (including non-icemaker-equipped models that could be readily retrofitted with an optional automatic icemaker).

In July 2012, AHAM provided DOE with a revision of its icemaking test procedure, ''AHAM Refrigerator, Refrigerator-Freezer, and Freezer Ice Making Energy Test Procedure, Revision 2.0—07/10/12''. (AHAM Revised Draft Test Procedure, No. 5) The AHAM Revised Draft Test Procedure applies to products that have one or more automatic icemakers. In addition, it includes several revisions to the AHAM Draft Test Procedure. The paragraphs below summarize the AHAM Revised Draft Test Procedure and highlight provisions from the AHAM Draft Test Procedure relevant to the detailed procedure on which DOE seeks comment.

The AHAM Revised Draft Test Procedure does not address the average ice production rate and does not include a value to apply when converting the measured icemaking energy use into a value of energy use per daily cycle. In contrast, the earlier AHAM Draft Test Procedure retained the current assumed 1.8-pound daily ice production rate through the use of an annual ice consumption value set at 657 pounds. Dividing this value by 365 days yields an ice production rate of 1.8 pounds per day. (AHAM Draft Test Procedure, No. 4 at pp. 7–8)

The AHAM Revised Draft Test Procedure would require an ambient test room temperature of 90 °F, which is consistent with the DOE procedures (*see, e.g.,* Appendix A, section 2.1). It

[7] DOE has published guidance documents clarifying how to render icemakers ''inoperative'' during a test. See, for example, ''Additional Guidance Regarding Application of Current Procedures for Testing Energy Consumption of Refrigerator-Freezers with Automatic Ice Makers'', *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/rf_test_procedure_addl_guidance.pdf.*

[8] Subsequently referred to as ''AHAM Ice Making Test Update''.

would also require target compartment temperatures of 39 °F for fresh food compartments and 0 °F for freezer compartments. These temperatures match the standardized temperatures prescribed by the DOE energy tests (see Appendix A, section 3.2 for refrigerator-freezers and Appendix B, section 3.2 for freezers). While the AHAM revised draft test does not mention the freezer compartment standardized temperature for refrigerators, which the DOE test sets at 15 °F (see Appendix A, section 3.2), it does indicate that its scope would extend to refrigerators. *See* AHAM Revised Draft Test Procedure, section 2.1.

In view of the above, DOE requests comment on whether any refrigerators (*i.e.,* ''electric refrigerator'' as defined in 10 CFR 430.2, and not a refrigerator-freezer) are sold with automatic icemakers (including non-icemaker-equipped models that could be readily retrofitted with an optional automatic icemaker). (DOE's review found none.) If so, DOE also seeks comment on whether test procedures for automatic icemakers should cover these ''electric refrigerators'' and to what extent, if any, the test procedure would need to be modified to accommodate the testing of these products. DOE is seeking comment on this issue in part to ascertain whether this aspect of today's proposal should apply to refrigerators as opposed to only refrigerator-freezers. DOE is currently unaware of any refrigerator that is sold equipped with an automatic icemaker.

The AHAM Revised Draft Test Procedure also does not mention whether the test procedure would apply to refrigeration products with manual defrost. Such products are tested with frozen food packages in their freezer compartments (see, for example, Appendix B, section 2.2 and HRF–1–2008, sections 5.5.3 and 5.5.5.3). Any icemaking test procedure would likely require that such products be tested with the frozen food packages removed, since some of the test operations, such as removing ice from the ice bin, may be impossible if the freezer compartment is full of packages. DOE requests comment on whether any manual defrost refrigerator-freezers or freezers are sold with automatic icemakers and whether any test procedure modifications would be required to address such products.

The AHAM Revised Draft Test Procedure specifies the use of target compartment temperatures, equal to the standardized compartment temperatures already prescribed in Appendices A and B, for a baseline test involving no icemaking. However, rather than following the DOE procedure of requiring tests to measure icemaking energy use at the median and cold (or warm) settings of the temperature controls and calculating energy use as a weighted average of the measurements at the two selected settings (see Appendix A, section 3.2.1), the AHAM Revised Draft Test Procedure, if adopted, would require that a single test be conducted with the temperature controls adjusted to achieve a compartment temperature within 2 °F of the target temperature. The temperature controls would not be adjusted further during the phases of the test in which the product is producing ice.

The AHAM Revised Draft Test Procedure would also require that the test setup be in accordance with the setup already prescribed by the DOE test procedure (or ''DOE energy test''). It also specifies that the supply water for the icemaker must have a temperature range of 90 +/− 2 °F and a pressure range of 60 ±15 pounds per square inch gauge pressure (psig).[9] No further setup requirements are provided.

In calculating the energy use per pound of ice produced, the AHAM Revised Draft Test Procedure would require subtracting the average energy use per day (in kWh/day) measured during a baseline test (during which the product is not making ice) from the average energy use per day (in kWh/day) measured during an icemaking test, and dividing the difference between the results of the two tests by the average rate of ice production (pounds per hour) during the icemaking test. This calculation would yield a final value in kilowatt-hours per pound (kWh/lb). The energy use for both the baseline and icemaking tests would be measured under the proposed procedures during steady-state operation and not during a defrost.

The test period for the baseline test could consist of at least seven hours of operation equivalent to the procedure for confirming steady-state conditions during the DOE energy test (see Appendix A, section 2.9). For products with cycling compressors, this test period would include two periods of at least two hours each, both comprising a whole number of compressor cycles, separated by one period of at least three hours. Although this test period is used only to confirm steady-state conditions in the DOE test procedure, the AHAM Revised Draft Test Procedure would also use this period as the test period for measuring energy use when the product is not making ice.

According to the AHAM Revised Draft Test procedure, the icemaking part of the test for products that do not cycle their compressors during icemaking would require a test period of at least 24 hours and consist of multiple complete icemaker cycles. If the test is interrupted by a defrost or if the ice storage bin fills before 24 hours have elapsed, the test period would be the maximum time between defrost cycles or the maximum time before the ice bin is filled with ice.

The AHAM Revised Draft Test Procedure would calculate icemaking energy use in products that cycle their compressors during icemaking differently from the initial AHAM Draft Test Procedure. Specifically, the AHAM Revised Draft Test Procedure would use a measurement of average ice production per hour that would be adjusted to account for differences in compressor run time of a first test period based on compressor cycles (which would be used to determine average energy use during icemaking) and a second test period based on icemaker cycles (which would be used as the basis for measuring the energy use per icemaking cycle and the mass of harvested ice). (AHAM Revised Draft Test Procedure, No. 5 at p. 8). The adjustment would be based on the two measurements of energy use associated with the two test periods. In contrast, the AHAM Draft Test Procedure relied on energy use and harvested ice mass measured for a single test period based on icemaker cycles, irrespective of whether the compressor cycles during icemaking (AHAM Draft Test Procedure, No. 4 at p. 7). The contrast between these two approaches is highlighted because, as discussed in more detail below, the approach DOE is considering would include the more comprehensive approach of the AHAM Revised Draft Test Procedure.

Under the AHAM Revised Draft Test Procedure, the final calculated result would be the incremental icemaking energy use per mass of ice in kilowatt hours per pound of ice. There would be no further conversion of this value into energy use per daily cycle or per year. In contrast, the AHAM Draft Test Procedure included a conversion calculation to yield an annual ice production rate. (AHAM Draft Test Procedure, No. 4 at p. 7–8)

Potential Approach Under Consideration

The approach DOE is considering for measuring icemaking energy use is based on the AHAM Revised Draft Test Procedure. It differs from that draft in

[9] Gauge pressure is absolute pressure minus barometric pressure, *i.e.,* the pressure that a pressure gauge connected to the water supply piping would indicate.

that the DOE approach would include greater detail to improve clarity and testing consistency. If adopted, DOE would likely add this icemaking energy measurement procedure as a new section 8 for both Appendices A and B. While this discussion touches on a number of key aspects related to the potential approach, DOE encourages interested parties to review it carefully and to comment on all of its aspects.

The key modifications DOE is considering compared with the AHAM test procedure would attempt to:

(1) Establish a definition for ''ice piece'' in addition to the definitions suggested by the AHAM Revised Draft Test Procedure.

(2) Clarify that the anti-sweat heater must be turned off during the icemaking test period, and that the water filter must be installed.

(3) Require that measurements be recorded during testing at time intervals not exceeding one minute.

(4) Clarify the points at which an icemaker cycle begins and ends. Many icemakers have mold heaters that are energized with 100W or more power input for more than a minute. This temporary increase in power is easily recognizable when evaluating the wattage data for a refrigerator test. Icemakers without mold heaters do not provide such an indication that one icemaking cycle has ended and the next has started. These icemakers would require the use of an alternative method to identify the beginning and end of icemaker cycles. The proposal would specify three alternative options: measuring the icemaker mold temperature, measuring the water supply temperature, or monitoring the activation of the water supply solenoid valve.

(5) Require that each compartment's average temperature during the baseline part of the test be no more than 1 °F warmer than its standardized temperature

(6) Require that each compartment's average temperature during icemaking be no more than 1°F (0.6 °C) warmer than its temperature during the baseline test, and require adjustment of temperature control settings if necessary to meet this temperature requirement. Also, the proposed test procedure would require products with a feature that automatically reduces the freezer compartment temperature setpoint or maintains compressor operation at an elevated duty cycle or speed during icemaking to be tested with this feature enabled.

(7) Prescribe the use of a baseline test period consistent with the test period specified in the DOE test procedure in Appendix A, section 4.1, rather than using the stabilization test period as the test period for baseline energy use calculation.

(8) Prescribe the use of equations that are equivalent, but not identical to, those of the AHAM Revised Draft, making more direct use of values measured during the test and involving fewer intermediate calculations.

(9) Apply a temperature stability criterion to the icemaking test period.

(10) Specify that icemaking would be initiated earlier than specified in the AHAM Revised Draft after completion of defrost.

(11) Address refrigeration products with multiple icemakers by requiring that such units be tested with only one of these icemakers operating during the test, rather than all of them simultaneously. The approach DOE is considering would also specify which icemaker to operate.

(12) Specify a daily ice production rate of 1.8 pounds per day in order to allow calculation of the contribution of icemaking to annual energy use. DOE is also considering requiring that products that cycle their compressors during icemaking would have their energy use calculated in a manner similar to the AHAM Revised Draft Test Procedure (*i.e.,* calculate energy use both for test periods comprising a complete (whole) number of compressor cycles and for test periods comprising complete icemaker cycles). The two calculations would be performed using the data from the same single icemaking test, as recommended in the AHAM Revised Draft. Using this approach would, in DOE's view, help improve measurement accuracy for the reasons described below.

Potential Icemaking Section

As noted above, DOE is considering incorporating an icemaking test based on AHAM's Revised Draft Test Procedure into Appendices A and B (*i.e.* the test procedures manufacturers must use starting in September 2014) by adding a new Section 8 to both appendices. Separating this new method from the other sections would, in DOE's view, help reduce the risk of confusion and improve the overall clarity of the procedures.

Icemaking Definitions

To help ensure clarity during testing, DOE proposes to add four definitions to provide background for the terminology that would be used in conjunction with whatever potential icemaking test procedure DOE adopts. Two of these definitions are identical to those used in the AHAM Revised Draft Test Procedure and are commonly understood in the industry but are currently undefined:

''Harvest'' means the process of freeing or removing ice pieces from an automatic icemaker.

''Ice Storage Bin'' means a container in which ice can be stored.

In addition, DOE proposes to define ''Ice Piece'' as a piece of ice made by an automatic icemaker and that has not been reduced in size by crushing or other mechanical action. Although people often refer to ice pieces as ice ''cubes'', DOE proposes to use ''pieces'' instead to (a) avoid the suggestion that ice pieces must have a specific shape, and (b) avoid confusion with DOE's energy conservation standards for automatic commercial ice makers, which include a definition for ''cube type ice''. (*See* 10 CFR 431.132) DOE also notes that the AHAM Revised Draft Test Procedure does not use the term ''cube'' and has established the precedent of using the term ''ice piece'', as seen in the definition for ''harvest'' discussed above.

Finally, since neither the test procedures in Appendices A and B nor the HRF–1–2008 test procedure specifically define the term ''through-the-door ice/water dispenser'' and because this term or similar terms are used both in the sections addressing measurement of ice making energy use and in the volume calculation method, DOE proposes to incorporate a definition for this term in both Appendices A and B to read as follows: ''Through-the-door ice/water dispenser'' means a device incorporated within the cabinet, but outside the boundary of the refrigerated space, that delivers to the user on demand ice or water from within the refrigerated space without opening an exterior door. This definition includes dispensers that are capable of dispensing ice and water, ice only, or water only.

DOE requests comment on these proposed definitions.

Anti-Sweat Heater Operation

To minimize test variation and potential error, particularly for products with variable anti-sweat heater control, the proposed procedure would require all anti-sweat heater switches to be in the ''off'' position for the test. Variable anti-sweat heater control is a feature that energizes the anti-sweat heaters only as much as needed, depending on ambient humidity and other conditions, to prevent the condensation of water vapor on the door gaskets and cool surfaces near them.

This requirement is proposed for two reasons: (1) To avoid the random activation of variable anti-sweat heaters during testing should the ambient humidity levels in the test room vary during the test and (2) to help clarify the power input measurement of the test by removing the power consumption associated directly with anti-sweat heaters. Because random activation of variable anti-sweat heaters could add extra power consumption to one part of the test and not the other, complete removal of anti-sweat heater power use from the measurement may ease the interpretation of power consumption signals measured during the test. Hence, DOE proposes that the heaters be turned off both to avoid change in anti-sweat heater energy between portions of the icemaking test and to allow for better evaluation of the power input measurements that will be used to define test periods and the number of icemaker cycles—these factors would improve the accuracy and repeatability of the test.

A potential issue with this proposal is that it may be susceptible to circumvention by products that have an anti-sweat heater switch if the icemaker's operation is modified once the switch is turned off. For example, a manufacturer may be able to reduce icemaking energy use at a lower ice production rate by reducing fan and/or compressor speed when the switch is turned off, which would violate the anti-circumvention provision. An alternative proposal to address the potentially random activation of variable anti-sweat heaters would be to require that icemaking tests be conducted with the anti-sweat heater switch turned on and the test chamber humidity level set sufficiently low to prevent heater activation—this proposed change would apply to products without anti-sweat heater switches, as described below. However, this approach would add more testing burden, since it would require that all refrigerators with variable anti-sweat heating be tested in this fashion, which requires using test facilities capable of reducing humidity levels as needed. Another approach would be to require that humidity levels in the test facility be maintained within a narrow range for which the variation in energy use of any variable anti-sweat heater would be insignificant. However, this could also add significantly to test burden, since many existing test facilities do not have the necessary equipment to control humidity levels. If it subsequently becomes clear that some manufacturers are exploiting this flexibility in a manner that would yield unrepresentative measurements of energy use, DOE may implement one of the alternative proposals in a future rulemaking.

For products with variable anti-sweat heater control but with no anti-sweat heater switch, the proposal would require that the test be performed in an ambient condition with humidity levels sufficiently low to prevent the anti-sweat heater from being energized. The proposal would not specify the humidity level required to assure that the heater is not energized, which DOE expects would maximize testing flexibility and minimize the burden associated with meeting this requirement since not all variable anti-sweat heater control systems will start to energize the heaters at the same humidity level. Data regarding the humidity levels at which variable anti-sweat heater systems energize are provided to DOE by manufacturers of products with this feature in certification reports. (*See* 10 CFR 429.14(b)(3)) These data suggest that this threshold humidity level is close to 35 percent relative humidity. DOE may consider the possibility of specifying an ambient humidity level depending on the nature of the feedback it receives in comments to this proposal.

DOE is aware of potential issues with its proposal for products with variable anti-sweat heater control but without anti-sweat heater switches and may consider alternative options to ensure that the objectives of the proposal are met. One potential issue is that some test facilities may not have the capability to sufficiently control humidity levels to assure that variable anti-sweat heaters would not be energized during testing. Based on DOE's review of available refrigeration products, every product examined that is equipped with a variable anti-sweat heater control also uses an anti-sweat heater switch. As a result, it is DOE's belief that, in spite of the potential inability of some existing test facilities to reduce humidity sufficiently to avoid variable anti-sweat heater activation, all or nearly all variable anti-sweat heater products can be readily tested using the proposed procedure by turning off their anti-sweat heater switches, which would reduce or eliminate the need for upgrades to testing facilities. Accordingly, DOE does not anticipate any new burdens associated with its proposed humidity requirements.

DOE requests comments on whether there are other alternative approaches it should consider to help ensure that random activation of variable anti-sweat heaters will not affect the accuracy of the measurements. DOE also seeks comment on the testing approaches it has proposed in today's notice to address this issue.

Setup for Icemaking

The test procedures in Appendix A and Appendix B do not require water lines or water filters to be connected or installed; they do, however, require the ice storage bin to be empty of ice. To properly execute the icemaking test that DOE is considering, DOE would revise sections 2.6(a) and 2.6(g) of Appendix A and sections 2.4(a) and 2.4(g) of Appendix B to read as follows:

(a) Connection of water lines and installation of water filters are required only when conducting the icemaking test described in section 8;

* * * * *

(g) Ice storage bins shall be emptied of ice, except as required for the icemaking test described in section 8.

These modifications would ensure that testing would be conducted consistent with current practice when measuring the energy use not associated with icemaking, but would clarify that these requirements would change when conducting the icemaking test. Also, the new section 8 would indicate that water lines and water filters must be installed for the icemaking test.

DOE seeks comments on this approach.

Ambient Temperature and Water Inlet Specifications

Currently, DOE is considering requiring that the icemaking test be conducted in a 90 °F ambient condition, identical to the condition required by the current test. While this temperature is not a typical household condition, it is intended to account for the energy use associated with door openings and other thermal loads (e.g., cooling down warm food) that would occur during usage in a typical household environment (with an ambient temperature of approximately 70 °F), and its use in the DOE tests has been reaffirmed through rulemakings several times since DOE initially adopted the Appendix A1 and Appendix B1 test procedures in a final rule published August 10, 1982. 47 FR 34517. DOE would apply this condition to the icemaking test to reduce the complexity that would be incurred by imposing a different ambient temperature requirement. Using the same temperature will allow all tests to be conducted sequentially without waiting for the test chamber to adjust and stabilize at a different temperature.

Water inlet temperature affects the thermal load (*i.e.,* heat) that refrigeration systems must remove from the cabinet to make ice, and water inlet pressure could potentially affect the water quantity that flows into the icemaker mold during each icemaker cycle. For the reasons that follow below, adopting the same inlet conditions specified in the AHAM Revised Draft Test Procedure (*i.e.,* 90±2 °F inlet water temperature and 60±15 psig inlet water pressure) is also under consideration.

DOE recognizes that the water inlet temperature noted above is not consistent with typical household water supply temperatures. However, due to the intermittent flow of water supplying an icemaker, and the relatively long periods between successive fillings of the icemaker mold with water, the temperature of water entering the refrigeration product's water supply system will always be very close to the ambient temperature since most of the supply line is located outside the refrigerated cabinet. For example, the ice production rate of automatic icemakers in refrigeration products tested by DOE ranged from 4 to 5.5 pounds per day, with icemaker cycle times of an hour or more. Unless there is significant use of water for features other than icemaking, such as the water dispenser of a product with through-the-door ice and water dispensing, the water that will be supplied to the cabinet at the start of each icemaker cycle will have been stagnant in the supply tube of the product for at least one hour. This is sufficient time for the temperature of the supply water to equilibrate (*i.e.,* achieve balance) with the ambient air temperature, and the same equilibration will occur during an icemaking test.

Supplying water to the cabinet at any temperature other than ambient would require using a water temperature conditioning system located adjacent to the cabinet, or a recirculating loop to ensure that the supply temperature at the cabinet water inlet remains at a specified temperature other than the ambient temperature. DOE believes that requiring such a system would represent an undue test burden because specifying an inlet water temperature equal to a typical household ambient condition rather than 90 °F would have a limited impact on the overall test result. The heat that must be removed from the water to make ice at 0 °F (i.e. ''Q'') is equal to the sum of three separate components: (a) The heat capacity of water (1 Btu/lb − °F) multiplied by the temperature reduction from the supply temperature down to 32 °F, (b) the heat of fusion of water (144 Btu/lb), and (c) the heat capacity of ice (0.5 Btu/lb − °F) multiplied by the temperature reduction from 32 °F to 0 °F. This value equals 218 Btu/lb for testing with a water inlet temperature of 90 °F—see below.

$$Q = [C_{water} * (90\,°F - 32\,°F)] + [\Delta H_{fus}] + [C_{ice} * (32\,°F - 0\,°F)]$$

$$= \left[\frac{1Btu}{lb°F} * (90\,°F - 32\,°F)\right] + \left[\frac{144Btu}{lb}\right] + \left[0.5\frac{Btu}{lb°F} * (32\,°F - 0\,°F)\right]$$

$$= \frac{[58 + 144 + 16]Btu}{lb} = 218\frac{Btu}{lb}$$

In contrast, requiring an inlet water temperature of 72 °F, which would occur in 72 °F ambient conditions more typical for a household, the heat removed during icemaking would be 200 Btu/lb, only 8 percent less. Because the impact of using a 90 °F water supply temperature is modest and because the test burden associated with attempting to simulate a more typical household water supply temperature would be significant, the DOE proposal retains the water inlet temperature requirement, 90±2 °F, as specified in the AHAM Revised Draft Test Procedure.

DOE also recognizes that the pressure range under consideration is broad. However, refrigeration products are designed to be used in settings that can have a wide range of water supply pressures. For example, the installation instructions for a typical refrigeration product indicate that it can be used with water supply pressures ranging from 20 to 125 psig. See Typical Water Line Installation Instructions, No. 3 at p. 1 (providing instructions for installing the water dispenser line for a typical refrigeration product, including indication of the acceptable water pressure range). The quantity of water supplied for each icemaker cycle is regulated by the product to be within a narrow range regardless of the water supply pressure. Because these products are designed to operate consistently with a relatively wide range of water supply pressures, and because allowing the proposed range will reduce the potential need for test facilities to boost or reduce the pressure of the supply water, DOE may adopt the same wide range of allowable pressures as suggested in the AHAM Revised Draft Test Procedure. Adopting this approach would minimize the testing burden faced by manufacturers when compared with an equally viable alternative that would require testing facilities to fine-tune water pressure during testing.

DOE seeks comment on the approach discussed above regarding water temperature and pressure conditions.

Frequency of Measurement

DOE is considering requiring that the temperature, input power, and energy use measurements needed to evaluate steady-state conditions and calculate energy use be recorded at intervals not exceeding one minute. DOE is aware that most test facilities record data for refrigeration product energy tests at a frequency of once per minute. The current DOE test procedures allow a recording interval of up to four minutes (see, for example, Appendix A1, section 5.1.1). Because the icemaking test involves multiple recurring events (*i.e.,* icemaker cycles and compressor cycles) that are not synchronized, a shorter recording interval would improve the accuracy of the measurements. Additionally, updating the requirements to reflect the increased accuracy of the equipment routinely employed by test facilities would ensure that the procedure adequately accounts for the improved technology already used in the field. DOE believes that the test burden associated with this requirement, if any, would be insignificant since most, if not all, test facilities already use one-minute recording intervals during testing.

DOE requests comment on the requirement for this proposed limit on the data acquisition time interval and its assumptions.

Icemaker Cycle Indication

Determining the start and end of icemaker cycles is essential for the icemaking test in order to properly correlate ice production with the energy used to produce the ice. Most automatic icemakers used in refrigeration products have a mold heater (or harvest heater) that is used to release ice from the mold. The input power measurements for the cabinet can readily be used to determine when this heater is energized, thus allowing for easy identification of the start and end of icemaker cycles.

The AHAM Revised Draft Test Procedure indicates that the icemaker harvest cycle test period starts and ends upon the initiation of harvest. (AHAM Revised Draft Test Procedure, No. 5 at p. 7) In contrast, DOE would define the icemaking cycle as starting and ending when the icemaker mold heater shuts off. DOE is considering this delineation between icemaker cycles to ensure that both the energy used to freeze the ice (which occurs prior to the harvest) and to operate the harvest heater are associated with the harvested ice for purposes of calculating overall energy use. DOE requests comment on this specification for icemaker harvest cycles.

DOE notes that icemakers in some refrigeration products use harvesting methods that do not involve mold heaters. One example is the ''twist tray'' icemaker, which has a plastic ice mold and employs a motor that rotates one end of the ice mold at slow speed, turning the mold upside-down, and then twisting the mold as the rotation is stopped by a catch at the mold's other end, thus releasing ice into the ice storage bin. To address icemakers of this type, and future designs that may be able to harvest ice without mold heaters, DOE would require one of three alternative methods to be used to determine when ice is harvested, since the examination of the power input data may not reliably reveal the time of harvest.

The three alternative methods under consideration are: (1) measuring mold temperature, (2) measuring water supply temperature, or (3) detecting actuation events of the icemaker water supply solenoid valve. Each of these methods would provide an equally reliable and readily identifiable indication of when water for the next batch of ice flows into the mold. Hence, DOE would define icemaker cycles for these methods based on when the given method indicates that water starts flowing or has entered the mold.

In addition, each of these methods has certain practical advantages that readily lend themselves to being appropriate indicators of ice harvesting. The ice mold temperature can reliably indicate the occurrence of ice harvesting because it rapidly rises when the solenoid valve dispenses warm water into the ice mold. Similarly, the water supply temperature can reliably indicate ice harvesting because the solenoid valve must dispense water into the ice mold for every round of ice production. Although water supply temperatures must remain in the 90 ± 2 °F range at all times during the test, the temperature of water in the inlet tube typically may change slightly during the filling of the icemaker mold due to temperature gradients within the test laboratory. If this change in water supply temperature is large enough, for example greater than 0.5 °F, this temperature change could be used to indicate the start of an icemaker cycle. NIST test data show a shift in water inlet temperature of roughly 0.9°F (0.5 °C) when the solenoid valve opens during testing of a refrigerator that has an icemaker without a mold heater. (NIST Technical Note 1759, No. 6 at p. 22–23) Finally, monitoring of the solenoid valve input voltage, current, or power will indicate that a new harvest cycle has started because the solenoid valve must be energized to supply water to the icemaker mold. To accommodate differences in individual product design or laboratory instrumentation capabilities which may favor one method over another, and because DOE sees no apparent difference in precision among these three methods, DOE proposes to include these three approaches and require that one of them be used if the icemaker has no mold heater. Further, the approach would require that the test report state in these cases which of these methods is used.

DOE requests comment on the proposed requirement to monitor harvest cycles if the product does not have a mold heater, the details of the three proposed alternate methods to accomplish this monitoring, and the proposed requirement that the test report indicate which one of these three methods was used. DOE further requests comment on whether other alternative methods could be used and/or should be allowed in the test procedure, including details of these alternative methods. DOE also seeks comment on whether it should specifically identify when one of these three alternative approaches must be used.

DOE's method would also clearly specify the start and end points of icemaker cycles for icemakers without mold heaters. As mentioned above, under the proposal, these time periods would occur when the mold heater is de-energized for products with mold heaters. For products without mold heaters, the proposed test procedure would indicate that the start and end points would occur when frozen ice drops into the ice storage bin and/or at the initiation of water flow into the icemaker mold. DOE requests comment on this proposed specification.

Control Settings

DOE would adopt generally the AHAM Revised Draft Test Procedure's requirement to use a single compartment temperature setting for the baseline test and the icemaking test, rather than specifying separate tests at median and warm or cold settings. Following this approach would limit the overall test burden faced by manufacturers.

However, DOE is concerned that significant differences in compartment temperatures between the baseline and icemaking tests could result in unrealistic indications of icemaking energy use. In particular, if the temperature of either compartment rises significantly during the icemaking test, the portion of the measured energy use associated with maintaining compartment temperatures would decrease significantly, which could potentially result in a value of energy use associated with icemaking that is lower than the actual amount. The AHAM Revised Draft Test Procedure approach would treat any such deviation in temperature between baseline and icemaking operation for fixed positions of the temperature control settings as typical for operation in the field, since homeowners are not expected to adjust temperature control settings when the icemaker starts making ice. (AHAM Revised Draft Test Procedure, No. 5 at p. 5)

However, DOE notes that there are some distinct differences between icemaking in the laboratory and icemaking in the field that weigh in favor of making temperature adjustments in some circumstances. First, the icemaking test would be conducted with no load in either the freezer or fresh food compartment, while a refrigerator in the field would generally be stocked with food. This load in a typical refrigerator, acting as a thermal mass, significantly dampens variations in compartment temperatures during icemaking. In an icemaking test conducted in a refrigeration product without any loaded food products, the compartment temperature could respond much more rapidly to the added load associated with icemaking.

Second, the icemaking test would be conducted with the icemaker operating at full capacity, meaning that for the entire icemaking test period, it would continually produce successive batches of ice without stopping. In contrast, in the field, continuous icemaking would typically occur only for the initial filling of the bin, and successive icemaker cycles would occur after a portion of ice has been withdrawn from the ice bin. The comparison of daily ice production with the ice production rate of tested refrigerators discussed in the following paragraph helps illustrate this point.

AHAM's ice production value of 1.8 pounds per day represents typical daily average ice production (AHAM Ice Making Test Update, No. 7 at p. 5). DOE compared this value to measured icemaking production rates when typical refrigerators operate continuously. The production rates measured by the National Institute of Standards and Technology (NIST) for four tested residential refrigerator-freezers ranged from 3.7 to 10.6 lb/day, at least double AHAM's average daily production rate. (NIST Technical Note 1697, No. 6). Hence, even the icemaker of this test with the lowest production rate would operate less than half a day to produce the amount of ice specified by the AHAM estimate (1.8 lb/day). This means that the product does not continually make ice and would have time to recover compartment temperatures between icemaker cycles. As a result, even if the compartment temperatures rise slightly during icemaking, they could recover to their ''baseline'' levels before the next icemaker cycle starts.

The tendency of the food product thermal mass to limit the compartment temperature rise that could occur during icemaking and the ability of the system to recover to steady state temperatures between icemaking cycles suggests that the average increase in cabinet temperatures during icemaking in the field may be significantly less than would occur for a laboratory test of continuous icemaking in an empty cabinet. This observation casts significant doubt on the premise of the AHAM position that the compartment temperature rise in the field would be comparable to that in the test, and likewise casts doubt on AHAM's suggestion that allowing the temperature to rise in this fashion during the test would lead to energy use measurements for icemaking that are representative of field operation. For these reasons, DOE believes that a laboratory-based icemaking energy use measurement for a product whose temperatures drift upwards during icemaking would be more representative of field energy use if an adjustment were made during the icemaking portion of the test to ensure that the compartment temperatures are no warmer than their temperatures measured during the baseline test, perhaps within a 1 °F allowance. Hence, DOE's approach would require controls to be adjusted to cooler settings during the icemaking portion of the test, if necessary, to ensure that the compartment temperatures are no warmer than 1 °F above their averages during the baseline test.

DOE selected this 1 °F maximum compartment temperature rise between the baseline and icemaking tests by considering the one percent maximum threshold for uncertainty discussed in the section above and reviewing the results of icemaking tests conducted by NIST (NIST Technical Note 1697, No. 6; NIST Technical Note 1759, No. 8). Test Samples 3 and 4 of NIST Technical Note 1697 and Test Samples 1 and 2 of NIST Technical Note 1759 were tested using an icemaking test procedure consistent with the approach under consideration but using three sets of temperature control settings for the baseline and for icemaking portions of the test rather than the single set being proposed. The results obtained using the three temperature control settings permit one to calculate the results that would be expected for any desired combination of compartment temperatures close to those measured during the tests—these results can be calculated using the triangulation approach. See section III.C.3. DOE used this approach to calculate total annual energy use, including the energy use associated with icemaking for the tested samples, for compartment temperature conditions matching the standardized temperatures (0 °F in the freezer and 39 °F in the fresh food compartment), and for conditions in which either the fresh food or freezer compartment temperature shifts 1 °F or 2 °F from its standardized temperature during the icemaking test. (Assessment of Icemaking Test Temperature Control Setting Tolerance, No. 9). The results of the calculations are summarized in Table III–2 below.

TABLE III–2—IMPACT ON ENERGY USE OF SHIFT IN COMPARTMENT TEMPERATURE DURING ICEMAKING

Product class	Change in annual energy use			
	2011 Sample 3	2011 Sample 4	2012 Sample 1	2012 Sample 2
	5A (percent)	5A (percent)	5 (percent)	5 (percent)
Fresh Food Compartment Temperature Change				
−2 °F	+0.4	+0.3	+0.1	+13.5
−1 °F	+0.2	+0.1	+0.1	+6.6
+1 °F	−0.2	−0.1	−0.1	−6.3
+2 °F	−0.4	−0.3	−0.1	−12.3
Freezer Compartment Temperature Change				
2 °F	+1.2	+3.5	+1.8	-1.5
−1 °F	+0.6	+1.7	+1.0	−0.8
+1 °F	−0.6	−1.5	−1.0	+0.9
+2 °F	−1.3	−2.9	−2.1	+1.8

''2011'' samples are those discussed in NIST Technical Note 1697, while ''2012'' samples are those discussed in NIST Technical Note 1759.

The calculations reflected in the above table show that the 1 °F shift in compartment temperature during icemaking can change the annual energy use measurement by as much as 6.6 percent. However, this extreme case occurred for the one test sample among the group of four that is not typical of most products in the U.S. market. (NIST Technical Note 1759, No. 8 at p. 20) The calculated annual energy use results for the other three products showed little sensitivity to temperature shifts in the fresh food compartment during the icemaking test. One of the test samples showed a calculated change in annual energy use as high as 1.7 percent when the freezer compartment temperature shifted 1 °F. This change would yield a variation of 11 kWh over an entire year—the annual energy use of this product was calculated to be 671 kWh assuming all compartment temperatures match their standardized temperatures during all tests. This analysis shows that even the 1 °F compartment temperature tolerance that DOE has considered for the icemaking test leads to overall measurement uncertainty larger than the desired one percent threshold discussed in the section above.

On the other hand, limiting compartment temperature variation to less than 1 °F between the baseline and icemaking tests could pose considerable test burdens because of the potential difficulty of achieving such tight control for both compartments of a refrigeration product. To mitigate these burdens, DOE would allow an increase in compartment temperatures of no more than 1 °F between the two tests, and would not impose a lower limit on the compartment temperatures for the icemaking test. In cases where the compartment temperature increases for the icemaking test, DOE would require adjustment of the temperature control to the warmest settings for which the compartment temperature is no more than 1 °F warmer than measured during the baseline test.

DOE's method would not allow disabling of ''quick freeze'' operation during icemaking for products that use this feature to accelerate icemaking. Quick freeze is an operating mode that, when selected by the user, runs the compressor without stopping for a specified interval in order to rapidly reduce the compartment temperature (see Appendix B1, section 1.9). DOE tested a product with a control system that automatically activated a ''quick freeze'' operation whenever the product was making ice. Such a product clearly would be incurring additional energy use associated with continuous compressor operation during icemaking in the field. Hence, DOE would require that such control features remain active (not disabled) during the icemaking test.

Additionally, the AHAM Revised Draft Test Procedure contained a requirement that compartment temperatures be within 2 °F of their standardized temperatures for the baseline test, and that if both the freezer and fresh food compartments cannot be maintained in this range, then the freezer compartment must be maintained in this range and the fresh food compartment must be maintained as close to this range as possible (AHAM Revised Draft Test Procedure, No. 5 at p. 5). DOE conducted an analysis using the NIST icemaking test data discussed above to determine the impact of deviation in compartment temperatures from their standardized temperatures for the baseline test. The analysis, summarized in Table III–3, shows that the 2 °F allowance can result in an increase in the total annual energy use measurement of 2 percent or more. (Assessment of Icemaking Test Temperature Control Setting Tolerance, No. 9) Hence, DOE considered proposing a tighter tolerance of 1 °F, which, for most products, would limit the variation on the total annual energy use measurement to roughly one percent. However, DOE recognizes that the precision with which compartment temperatures can be set during testing may be insufficient to use a 1 °F tolerance. In recognition of this limitation, DOE would require temperature controls to be set during baseline testing in the warmest settings for which the compartment temperatures are no more than 1 °F warmer than their standardized compartment temperatures. Using this approach would mean that the fresh food and freezer compartment temperatures would be no warmer than 40 °F and 1 °F, respectively, during the baseline test.

TABLE III–3—IMPACT ON ENERGY USE OF DEVIATION IN COMPARTMENT TEMPERATURE FROM STANDARDIZED TEMPERATURES

Product class	Change in annual energy use			
	2011 Sample 3	2011 Sample 4	2012 Sample 1	2012 Sample 2
	5A (percent)	5A (percent)	5 (percent)	5 (percent)
Fresh Food Compartment Temperature Deviation from 39 °F				
−2 °F	−0.1	−0.1	−0.4	+1.5
−1 °F	−0.1	0.0	−0.2	+0.7
+1 °F	+0.1	0.0	+0.2	−0.7
+2 °F	+0.1	+0.1	+0.4	−1.4
Freezer Compartment Temperature Deviation from 0 °F				
2 °F	+0.7	+2.3	+0.4	−0.6
−1 °F	+0.4	+1.1	+0.2	−0.3
+1 °F	−0.4	−1.0	−0.2	+0.4
+2 °F	−0.7	−1.9	−0.5	+0.8

''2011'' samples are those discussed in NIST Technical Note 1697, while ''2012'' samples are those discussed in NIST Technical Note 1759.

As discussed above, DOE is considering using the warmest temperature control settings that satisfy the compartment temperature requirements for the baseline and icemaking tests. By preventing the use of excessively cold settings, this approach would help to ensure consistency between tests conducted by different laboratories. For products with mechanical temperature controls, DOE proposes requiring that the temperature settings be those for which the temperature setting indicator aligns with a control symbol. This provision will prevent setting the indicator at undefined positions between the symbols and thus will also help to ensure consistency between tests conducted by different laboratories.

DOE requests comment on all aspects of its approach regarding temperature settings.

Test Periods

DOE is considering using an approach that would modify the test periods suggested in AHAM's Draft Test Procedure in two key ways. The proposal would include: (a) A test period for the baseline test that is more consistent with the existing DOE test procedure and (b) an energy use calculation based upon two test periods for products that undergo compressor cycles during icemaking. The first of these proposed changes diverges also from the AHAM Revised Draft Test Procedure, while the latter one is consistent with the more recent AHAM approach.

Baseline Test Period

The AHAM Revised Draft Test Procedure would allow use of the stabilization test period for measuring baseline energy use. In contrast, DOE is proposing that the stabilization and energy measurement test periods be defined as they are in the DOE test procedure (see, for example, Appendix A, sections 2.9 and 4.1). However, in order to minimize testing burden, DOE is proposing to permit the overlap of these test periods in order to avoid the three or more hours of additional test time that would be required if no overlap were allowed. The proposal would permit this overlap only if the baseline test period ends no later than the stabilization test period ends.

Icemaking Test Period

For products that do not cycle their compressors during icemaking, there is no potential distinction between compressor cycles and icemaker cycles. For such products, DOE is considering adopting the same icemaking test period suggested in both the initial and revised AHAM Draft Test Procedures. This test period would incorporate a complete (whole) number of icemaker cycles, beginning when the first of these cycles starts and ending with the completion of the last cycle.

On the other hand, for products that cycle their compressors during icemaking, DOE considered whether energy use measurements should be based on compressor cycles or icemaker cycles. The initial AHAM Draft Test Procedure suggested a test period based on icemaker cycles for the icemaking portion of the test, but AHAM later altered this approach in its revised draft, suggesting instead that both compressor and icemaker cycles be part of the test period. NIST reviewed several icemaking test procedure approaches and concluded that average power input is a much stronger function of compressor cycles than icemaker cycles. (NIST Technical Note 1759, No. 8 at p. 48) Hence, when subtracting the average power of the baseline test from the average power of the icemaking test, as is done to determine the energy use associated with icemaking (AHAM Draft Test Procedure, No. 4 at p. 7), a much more stable and repeatable result is attained if the average power is calculated for a test period based on compressor cycles.

In contrast to the average power input during icemaking, the ice mass must be correlated with the icemaker cycles rather than with compressor cycles because ice production occurs in batches that are harvested at the end of icemaker cycles. Furthermore, the NIST work shows that, assuming the product is in stable operation during icemaking, the energy use per icemaker cycle stays relatively constant, even though the time between harvests may vary. NIST recommended an approach that calculates average power based on compressor cycles and average energy use per pound of ice produced using the same test data. Without increasing test time, the approach improves accuracy and repeatability in determining the energy use associated with ice production, as compared to the use of the same calculation based only on icemaker cycles. NIST's suggested calculation of energy use expended per pound of ice produced, abbreviated as EIM, in kilowatt-hours per pound, can be expressed as follows:

$$EIM = \frac{(PI3 - PI1) \times (EPI2)}{PI3 \times M_{ICE_{CYC}} \times N_{CYC}}$$

Where:

PI3 is the icemaking test average power input in Watts, measured based on compressor cycles;

PI1 is the baseline test average power input in Watts;

EPI2 is the energy use in kilowatt-hours, measured based on icemaker cycles;

M_{ICE_CYC} is the mass of ice in pounds produced per icemaker cycle; and

N_{CYC} is the number of icemaker cycles in the test period associated with the energy measurement EPI2.

This equation uses the icemaking test average power based on compressor cycles (the more stable test period for measuring average power) when subtracting the average power of the baseline test. This approach of using the more stable power measurement based on compressor cycles in the calculation helps to minimize the potential error associated with the measurement, since any variation in the measurement of PI3 is amplified by subtracting the baseline test average power PI1. However, to maximize accuracy, the calculation must also use the measurement based on the icemaker cycles, since the energy use measurement based on compressor cycles is not correlated to the ice production. The improvement in accuracy afforded by this approach is illustrated in Table III–4 below, which shows test data for an icemaking test for a 22 cu. ft. refrigerator-freezer with a bottom-mounted freezer and no through-the-door ice service. The table compares successive icemaker cycles from results based on the AHAM Draft Test Procedure against those results obtained using the NIST-recommended approach of the AHAM Revised Draft Test Procedure. The data show that it takes more than roughly 15 icemaker cycles for the results of the two tests to be consistently close to each other.

The data also indicate that test results using the AHAM Draft Test Procedure fluctuate between icemaker cycles during testing, indicating that this test method's accuracy depends on whether the test period ends on a cycle that happens to experience no fluctuations—an extremely unlikely event based on the inherent variability built into the AHAM Draft Test Procedure. In cases where the test must terminate early due to the filling of the ice storage bin or initiation of a defrost, the test would end and the error would not be corrected by the additional icemaker cycles exhibited for this test. Because of its significantly improved accuracy over the AHAM Draft Test Procedure, and the absence of any increase in testing time, DOE is considering the approach recommended by NIST that the AHAM Revised Draft Test Procedure ultimately adopted for products with cycling compressors during icemaking.

TABLE III–4—COMPARISON OF DRAFT AHAM AND NIST ICEMAKING TEST RESULTS

Icemaker cycle No.	Cumulative energy use per ice produced (kWh/lb)	
	AHAM Draft Test	NIST recommended test (AHAM revised draft)
1	0.010	0.165
2	0.151	0.186
3	0.192	0.189
4	0.148	0.191
5	0.177	0.191
6	0.194	0.192
7	0.169	0.192
8	0.186	0.193
9	0.196	0.193
10	0.178	0.193
11	0.189	0.193
12	0.194	0.193
13	0.180	0.192
14	0.188	0.192
15	0.194	0.192
16	0.182	0.192
17	0.189	0.192
18	0.194	0.192
19	0.184	0.192
20	0.191	0.193
21	0.193	0.193

In light of these recorded data, DOE seeks comment on whether the NIST approach it is considering would be reasonably sufficient for purposes of assessing icemaking energy use.

Icemaking Test Stability

The AHAM Revised Draft Test Procedure does not require temperature stability during the icemaking portion of the test. DOE has tested a product that significantly reduces its freezer temperature during icemaking, from 0 °F to roughly −12 °F. This reduction in temperature requires three to four icemaker cycles to occur. During the initial reduction in freezer compartment temperature, the energy use per icemaker cycle was much higher than after the compartment temperature stabilized, starting at 0.28 kWh/lb and dropping to 0.20 kWh/lb. A test that included the initial icemaker cycles, during which the compartment temperature was dropping significantly, would have resulted in a significantly higher measurement of icemaking energy use. The data also showed that selecting a temperature stability threshold of 3 °F (i.e. the maximum allowable variation for the freezer compartment temperature from its average during the selected test period) is sufficient to reduce the potential error to less than one percent of the product's overall energy use. (Examination of Icemaking Test Period Stability, No. 10) These test data show that a stability requirement for the icemaking test is important in order to obtain repeatable results. Hence, DOE is weighing whether to include a requirement that the temperature for the freezer compartment remain within 3 °F of the compartment's temperature average for the full test period for the icemaking part of the test. For products with non-cycling compressors, the proposal would apply this requirement by comparing the freezer compartment temperatures for complete icemaker cycles. For products with cycling compressors, the requirement would be applied by comparing average temperatures for complete compressor cycles and would also be applied to the freezer compartment.

DOE seeks comment on this potential approach.

Duration of the Icemaking Test Period and Initiation of Icemaking

The AHAM Revised Draft Test Procedure would require test periods lasting 24 hours, if this is possible during steady icemaking operation between defrost cycles, and that the ice storage bin be able to hold 24 hours of ice production. The AHAM Revised Draft Test Procedure also specifies that if 24 hours of icemaking operation are not possible between two defrost cycles, the icemaker would be enabled after the product has recovered from a defrost. DOE would adopt nearly identical requirements for the test duration and initiation of test, except that the DOE approach would specify that icemaking should be initiated shortly after the start of compressor operation following a defrost cycle. The DOE approach would reduce the overall testing time compared to the AHAM Revised Draft Test Procedure approach because the AHAM approach may lead to the start of a second ''recovery'' period after the initiation of icemaking, since the cabinet temperatures may shift after icemaking starts. The shifting of these temperatures would require additional time for the unit under test to reach the new steady operating condition.

DOE seeks comment on these potential durations and initiation periods.

Ice Mass

Measuring the ice mass produced by a test sample is a necessary prerequisite to determine the energy use required per pound of ice produced. The AHAM Revised Draft Test Procedure requires that the amount of ice produced during the test be determined by weighing the ice storage bin with the ice in it and subtracting the weight of the empty ice storage bin. It would also provide that the weight measurement must not include the ice harvested prior to the test period or after the initiation of the last harvest cycle. (AHAM Revised Draft Test Procedure, No. 5 at p. 8)

To properly correlate total ice production with the test period used for the energy use measurement, DOE's approach would require calculating the mass of ice produced per icemaker cycle in pounds. This value would be multiplied by the number of icemaker cycles within the test period in the equation used to calculate energy use per pound of ice produced (see the equation for EIM above). This approach would enhance test accuracy by explicitly assuring proper correlation of ice production with the test period used for measuring energy use.

DOE seeks comment on its potential approach.

Products with Multiple Icemakers

DOE is aware of very few refrigerator models with multiple icemakers. The only such products of which DOE is aware are French Door refrigerator-freezers with one icemaker serving a through-the-door ice dispenser and a second icemaker located in the bottom-mounted freezer compartment. The AHAM Draft Test Procedure did not address multiple icemaker products. (AHAM Draft Test Procedure, No. 4 at p. 4) However, the AHAM Revised Draft Test Procedure included methods for testing products with multiple icemakers. Specifically, the test would require that all icemakers make ice during the icemaking part of the test. (AHAM Revised Draft Test Procedure, No. 5 at p. 10) The icemaking test would continue for 24 hours, until interrupted by a defrost, or until all ice bins are full.

For products with one icemaker serving a through-the-door dispenser and another that does not, DOE is considering requiring that manufacturers account for icemaking energy use by measuring the energy consumption only for the icemaker serving the through-the-door dispenser. This approach would minimize the testing burden while providing a measurement of energy use that should be reasonably representative of actual usage since the icemaker serving the through-the-door dispenser would likely be more frequently used. This expectation of more frequent use of the through-the-door icemaker is based on the fact that this ice is much more convenient for consumers to access. Taking this approach would also make the test simpler to perform. As discussed above, one of the complications of measuring the energy use associated with icemaking is the lack of coordination between icemaker and compressor cycles. The test approach described above is a compromise that balances the need for accuracy and the need to limit test burden by using two test periods based on the same icemaking test. If two icemakers were operating, the test procedure would have to address the non-synchronized cycles of two icemakers and the compressor. The AHAM Revised Draft Test Procedure does not fully address how this issue should be handled other than indicating that icemaking for both icemakers would be initiated after recovery from defrost and that the test may continue until *both* ice bins are full. Because of these unresolved complications and DOE's expectation that most of the ice would be produced by the icemaker serving the through-the-door feature, DOE's approach would involve testing only this icemaker. DOE seeks comment on its tentative approach and expectations.

Additionally, DOE's approach would not address other configurations of products with multiple icemakers. As a result, DOE seeks comment on (a) whether any such products exist or are likely to exist, (b) what their configuration details might be, and (c) what test procedure modifications should be developed to address these products.

Ice Production Rate

DOE initially obtained ice production rate information from AHAM, based on available survey data it reviewed. That data indicated that 1.8 pounds per day would be a representative ice production rate. (AHAM Ice Making Test Update, No. 7 at p. 5). DOE used this production rate as the basis for the fixed icemaking energy use placeholder it adopted in the Appendix A and B test procedures. 75 FR at 78842–3 (Dec. 16, 2010).

Subsequently, NEEA sponsored a field study that monitored daily refrigerator energy use, kitchen ambient temperature, and the number of icemaking harvest cycles for refrigerators at 80 sites. (NEEA Icemaking Field Study Data Summary Spreadsheet, No. 11). The study showed that the average number of icemaking cycles per day for the field test sites was 3.3 cycles/day. The spreadsheet did not include data indicating the mass of ice produced per icemaking cycle for any of the test sites. Hence, calculating the average ice production per refrigerator per day requires applying a representative value of ice production per icemaking cycle to the NEEA data. Values of this parameter measured during tests conducted by DOE and NIST are summarized in Table III–5 below. The average of these measurements is 0.21 lb/cycle. Multiplying the 3.3 cycles/day of the NEEA study by this average gives an average daily ice production rate of 0.7 lb/day.

TABLE III–5—ICE PRODUCTION PER ICEMAKING CYCLE

Data Source	Product class	Ice production (lb) per cycle
NIST 2011 Sample 1	3	0.31
NIST 2011 Sample 2	7	0.21
NIST 2011 Sample 3	5A	0.15
NIST 2011 Sample 4	5A	0.12
NIST 2012 Sample 1	5	0.2
NIST 2012 Sample 2	5	0.15
DOE Sample 1	7	0.19
DOE Sample 2	3	0.26
DOE Sample 3	5A	0.26
	Average	0.21

"NIST 2011" samples are those discussed in NIST Technical Note 1697, "NIST 2012" samples are those discussed in NIST Technical Note 1759, and "DOE" samples are those tested by DOE.

The NEEA data suggest that daily ice consumption rate may be half of the 1.8 lb/day initially selected for the test procedure. However, the field study was limited to sites in the northwest region of the United States and its representativeness as a national average ice production rate is not certain. The 1.8 lb/day value was initially proposed by AHAM as a representative value based on its own testing, and DOE has insufficient information about the details of its development to question its validity. Hence, DOE is considering retaining the 1.8 lb/day production rate for use in the test procedure.

Impact of the Icemaking Test Procedure on Energy Consumption Measurement

DOE conducted testing to validate the feasibility of its potential icemaking test procedure. The test results can be examined to determine if they suggest that icemaking energy measurements using the proposed test procedure would differ significantly from the 84 kWh/year fixed value currently used in Appendices A and B. As noted above, this annual energy use is based on a daily production rate estimate of 1.8 lb/day (1.8 lb/day multiplied by 0.128 kWh per pound of ice multiplied by 365 days per year). The section above discusses the daily ice production rate. This section examines data currently available to DOE regarding icemaking energy use per pound of ice and calculations of annual energy use based on these data.

Table III–6 summarizes the icemaking energy test results conducted by DOE and NIST. Measured icemaking energy consumption per pound values range from 0.092 kWh/lb to 0.192 kWh/lb, with an average of 0.139 kWh/lb. Note that this average includes the measurement for DOE test 3B but not 3A (see Table III–6, below), since these measurements were made for separate icemakers of a single product. In DOE's view, the product used in tests 3A and 3B is not sufficiently representative of icemaking in refrigeration products, in large part because it has two automatic icemakers, an uncommon feature currently. As a result, DOE sought to prevent double-counting (*i.e.,* results from both icemakers of this one unit which may not be representative of the market) when calculating the average energy usage measurements and, therefore, DOE included only one of its measurements in the average. Consistent with the approach contained in today's notice, DOE included only the measurement for the ice maker serving the through-the-door dispenser of this product to determine the average for the tested samples. DOE requests additional data indicating the energy use associated with icemaking, using test methods as nearly identical as possible to the test method detailed in today's notice.

TABLE III–6—ICEMAKING TEST RESULTS

ID No.	Product class	Through-the-door (TTD) ice delivery?	Ice mold heater?	Icemaking energy use (kWh/lb)	Icemaking energy use (kWh/year)
NIST					
2011–1	3	No	Yes	0.143	94
2011–2	7	No	Yes	0.150	99
2011–3	5A	TTD	Yes	0.170	112
2011–4	5A	TTD	Yes	0.113	74
2012–1	5	No	Yes	0.125	82
2012–2	5	No	No	0.092	60
DOE					
1	7	TTD	Yes	0.134	88
2	3	No	Yes	0.134	88
3A	5A	No	No	0.169	111
3B	5A	TTD	Yes	0.192	126
Averages				0.139	92

Note: The averages include data for DOE icemaker 3B but not icemaker 3A (both are part of the same test sample refrigerator-freezer).

The test data show that the initial icemaking energy use estimate of 0.128 kWh per pound of ice is a very good approximation, as is the 84 kWh annual energy use. The samples tested by NIST and by DOE were selected to provide a range of icemaker styles with which to evaluate the icemaking test procedure, rather than to provide the actual average of the icemaking performance of refrigeration products currently on the market. Hence, DOE does not consider the 8 kWh difference in annual energy use measurement (84 kWh as compared with 92 kWh) to be significant. Given the closeness of these values, DOE may also consider, as an alternative to the test procedure detailed in today's notice, retaining the 84 kWh/year value to denote the energy usage stemming from icemaking.

DOE requests comments and alternative data addressing the energy use expended for production of a pound of ice, and DOE's tentative conclusion that the impact of the proposed test procedure changes on energy use measurements is not significant.

2. Multiple Compressor Test

Refrigerator-freezers combine a fresh food compartment and a freezer compartment in a single cabinet. Most refrigerator-freezers use a single-compressor refrigeration system that directly cools the freezer compartment; cooling for the fresh food compartment is achieved by circulating air between the two compartments. This approach cools the fresh food compartment with cold freezer air and allows the freezer-located refrigeration system to remove heat gained by the fresh food compartment. However, some refrigerator-freezers have a separate refrigeration system serving each individual compartment. This approach has been adopted by some manufacturers to improve food preservation in the fresh food compartment. By preventing the introduction of dry freezer air into the fresh food compartment, its humidity can be maintained at higher levels, which can improve food preservation. (See, e.g., Sub-Zero Dual Refrigeration User Manual Excerpt, No. 2 at p. 1)

DOE first recognized that testing products with more than one compressor requires different test procedures from those that apply to single compressor system-based products as early as 1989. *See* 54 FR 36238 (introducing a dual compressor system test procedure). The 1989 proposal introduced a two-part procedure that separately measures each compressor system's energy use. The first part measures the energy use during stable operation between defrosts, while the second, conducted separately for each defrost, measures the energy use contribution of the defrost cycle for each compressor system. This second part of the test, like the second part of the test for products with long-time or variable defrost, measures total energy use during the defrost cycle. *See* 10 CFR part 430, subpart B, appendix A1, section 4.2.3.

In order to determine the amount of energy use associated with defrost using the measurements for the second part of the test, the test procedure requires that the average energy use for stable operation for a period of time exactly equal to the elapsed time of the second part of the test be subtracted from the total energy use measured for the second part of the test. This difference is then adjusted by the defrost frequency in order to calculate its contribution for each 24-hour daily cycle (see, e.g., Appendix A1, section 5.2.1.2).

However, when measuring the defrost energy use for one of the compressors of a dual-compressor system, the second compressor continues to operate. If its average energy use per unit of time during the second part of the test exactly matches its average energy use per unit of time expended during the first part of the test, this compressor's energy use cancels out in the equation, and the calculation provides an accurate indication of the first compressor's defrost energy use. The timing of cycles of the two compressors generally is not synchronized. If the average duty cycle (i.e. the fraction of time the compressor runs) of the second compressor is different during the second part of the test than it was during the first part of the test, the equation does not properly cancel out its energy use, which would create an error in the calculated defrost energy use. As an example, the second compressor may have completed a whole number of compressor cycles during the first part of the test, but may have completed 4.5 compressor cycles during the second part of the test. The additional half compressor cycle may represent the time period when the second compressor is not running. Hence, the average duty cycle for the second part of the test would be less than for the first part of the test, and the defrost energy use for the first compressor would not be correctly calculated.

The same issue applies during the first part of the test. Each of the two compressors has an average duty cycle and a cycle time, which are not likely identical. In order to ensure that the single time period selected to measure the energy use of both compressors reflects the average duty cycle for both, this time period must be equal to a whole number of compressor cycles for both. However, this is not generally possible unless the cycle times of the two compressors are identical or are perfect multiples of each other. If they are not, a portion of one of the compressor's last cycles is cut from the test period, resulting in a ''truncated'' test period. If the average energy use of this compressor for this truncated time is different from its average duty cycle, the result is a truncation error. This error can either increase or decrease the energy use measurements of either part of the test.

By requiring the energy use of the two compressor systems to be separately measured, the current procedure eliminated the truncation error, since the measurements focus on each individual system rather than the combined unit. Because the energy use of each compressor is evaluated and calculated separately, different test periods equal to whole compressor cycles can be selected for each compressor system, thus avoiding truncation error.

As part of the most recent rulemaking to address the test procedures for refrigeration products, DOE amended the dual compressor system equation definitions. *See* 75 FR at 78830. These amendments clarified two areas of the procedure. First, DOE modified the text in section 4.1.2.4 of Appendix A1 to explicitly include the compressor and defrost heater in the list of components associated with each system that must have their energy use separately measured. Second, DOE corrected errors in the energy use equation that addresses this class of products (section 5.2.1.4 of Appendices A1 and A). *Id.*

AHAM had expressed concerns during that prior rulemaking about the continued test burden associated with separately measuring the energy used by the two systems, as well as the problem that some of the components of existing dual compressor products are shared by the two compressor systems. As a result of the shared nature of these components, their energy use cannot be readily assigned to one system or the other as required by the test. (See Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003; AHAM; No. 16 at p. 7; No. 43 at pp. 2–3) Sub-Zero, a manufacturer of dual-compressor products also expressed similar concerns and supported AHAM's views (Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003; Sub-Zero; No. 23 at p. 1; No. 42 at pp. 1–2).

On September 6, 2011, Sub-Zero filed a petition for waiver from the test procedures for its products that use more than one compressor. DOE published a decision and order granting this waiver request (the ''Sub-Zero waiver'') on February 6, 2012. 77 FR 5784. The Sub-Zero waiver prescribed an alternative test procedure that does not require separate measurement of each system's components but includes specific provisions to minimize the measurement error associated with truncation. The test does this by requiring a duration of 24 hours for key parts of the test, including the stabilization period, along with the first and second parts of the test. *Id.* By increasing the test period to 24 hours, the total energy use measured during the test is much greater than the possible truncation error, thus reducing the error to an insignificant magnitude. This result is illustrated with test data in the discussion below.

The last set of comments AHAM submitted in response to the December 2010 interim final rule recommended that DOE replace the dual compressor system test procedure with one that is essentially identical to the Sub-Zero waiver test procedure. (Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003, AHAM, No. 43 at pp. 2–3)

DOE declined to adopt AHAM's proposed test procedure during the last round of rulemaking because stakeholders did not have an opportunity to comment on the AHAM procedure. Given the complexity of the proposed dual compressor test, and the extent to which it differed from the existing DOE test, DOE believed that, prior to modifying the test procedure in the manner suggested by AHAM, all interested parties should have an opportunity to fully vet and comment on that approach. DOE also noted the limitations of the existing dual compressor test procedure and indicated it would consider revising the procedure in a future rulemaking. 77 FR at 3570–1 (Jan. 25, 2012). Today's notice is addressing these issues.

Summary of AHAM's Proposed Multiple Compressor Test Procedure

The multiple compressor test procedure being proposed by DOE today is based in part on the multiple compressor test procedure previously suggested by AHAM—and that DOE ultimately permitted Sub-Zero to use in response to that company's waiver request. The proposed procedure would determine energy use based on a measurement of power input at the product's power cord rather than requiring a separate measurement of the power input of the two compressor systems. The energy use calculated for a multiple compressor product would include: (a) energy use measured during the first part of the test, which involves stable operation (excluding events associated with defrost), and (b) a defrost energy use contribution for each compressor that undergoes defrost cycles, based on measurements made during a second part of the test, which would be conducted for each of the defrosting compressor systems.

To ensure that the product has stabilized after adjusting the temperature controls, the AHAM procedure would require waiting 24 hours rather than evaluating steady-state conditions as currently prescribed in Appendix A1, section 2.9.

The revised draft AHAM procedure would require the first part of the test to be at least 24 hours long in order to minimize the truncation error (see the discussion above explaining truncation error). The test period would consist of a whole number of freezer compressor cycles. The procedure would allow this test period to be a summation of several running periods that do not include any of the events associated with defrost cycles. To ensure stability during the first part of the test, the procedure would require that the compartment temperatures measured for the compressor cycle at the start and end of the test period (or of each individual running period comprising the test period, if there is more than one) be within 1.0 °F of the test period's temperature average, and that these measurements for fresh food temperature be based on the complete fresh food compressor cycles that are closest to the start and end of the test period.

The revised draft AHAM procedure would require the second part of the test for each measured defrost cycle to be at least 24 hours in duration, running from a time of stable compressor operation (normal compressor cycling) through all events associated with the measured defrost to a later time of stable compressor operation. The test procedure would allow additional non-continuous running periods of stable operation to be added to the test period if needed to achieve a total test duration of 24 hours. To ensure stability during the second part of the test, AHAM's revised procedure would require the compartment temperature averages for the first and last compressor cycle of this test period to be within 1.0 °F of their averages for the first part of the test. DOE notes that this approach is less stringent than the current Appendix A requirement for long-time or variable defrost systems. That provision requires that compartment temperature averages for compressor cycles just prior to and after the second part of the test be within 0.5 °F of their averages for the first part of the test (see Appendix A, section 4.2.1.1).

Proposed Amendment

DOE proposes to replace its dual compressor test procedure with a modified version of the test procedure recommended by AHAM. The key differences between the DOE proposal and the Sub-Zero/AHAM test procedure are:

(1) The proposal would define the term ''multiple compressor'' to help enhance the clarity of this term and to ensure that a uniform definition applies to this term. Adopting such a definition would lessen the risk of confusion.

(2) The proposal would allow an examination of temperature cycles as an alternative to an examination of compressor cycles as the basis for test period duration and for compartment temperature calculation. Also, a definition is proposed for the term ''complete temperature cycle'' to support this change.

(3) The proposal would use a stabilization period consistent with the existing test procedure rather than requiring 24 hours for stabilization.

(4) The proposal would allow a single-part test if only one compressor system has defrost and it is a timed defrost with less than 14 hours of compressor run time between defrosts.

(5) In cases where only one compressor in a multiple-compressor-based product cycles, the proposal would specify a test period consisting of a complete number of compressor or temperature cycles lasting at least three hours for the first part of the test, similar to single-compressor products. Similarly, if none of the compressors cycle, the procedure would allow a 3-hour test period for the first part of the test.

(6) Under the proposal, if at least one compressor cycles, the test periods would be based on temperature cycles or compressor cycles of a ''primary'' compressor system. This would be the freezer compressor system, if its compressor cycles.

(7) For the first part of the test, the proposal would require 24 hours of continuous stable operation if there is no defrost interruption. It would also require at least 18 hours of continuous stable operation if there is a defrost interruption, rather than allowing use of non-continuous running periods, as suggested by AHAM.

(8) For the second part of the test, the proposal would not require 24 hours of operation.

(9) The proposed test would require that, for both the first and the second parts of the test, the temperature averages for the first and last cycle of the test period (either compressor or temperature cycles) for each system must be within 0.5 °F of the temperature average for the first part of the test.

These modifications and other details of the implementation of the proposed procedure are discussed in more detail below. DOE seeks comment on this approach, including on the details that follow below.

Multiple Compressor Definition

The term ''multiple compressor'' is currently undefined. In light of this gap, and the accompanying need to ensure clarity for manufacturers, DOE is proposing to define this term. This term would be used in lieu of the term ''dual-compressor'' in order to provide general applicability to all refrigeration products that have more than one compressor. Although DOE is not aware of any current refrigeration products with more than two sealed compressor systems, taking this broader approach in defining this particular term would ensure that products using more than two sealed refrigeration systems that might be manufactured and sold in the future are addressed by DOE's regulations. The new definition in Appendix A, for example, would read as follows: ''Multiple Compressor'' refrigerator or refrigerator-freezer means a refrigerator or refrigerator-freezer with more than one compressor.

DOE requests comment on this proposed definition.

Temperature Cycles

DOE is proposing that test periods for multiple compressor refrigeration products be determined by either compressor operation or compartment temperatures. Reliably identifying individual compressor cycles from power data based on a single power measurement of all the energy use for multiple compressor refrigeration products may be difficult because identifying compressor cycle starts and stops may be challenging and it might not be obvious which events are associated with each compressor unless some means of differentiating these events applies. As an alternative, the proposed test procedure would allow the selection of test periods based on the cycles of the compartment temperatures associated with the multiple compressor systems. Complete temperature cycles are equivalent to complete compressor cycles because the starts and stops of each temperature cycle coincide nearly exactly with the starts and stops of the compressor cycles for the compressor associated with the considered compartment temperature. Since it is the operation of the compressor that causes the refrigeration system to reduce compartment temperatures, compressor and temperature cycles are inherently equivalent. This approach may be easier to apply to some multiple compressor products because the compartment temperature measurements of separate compressor systems are not combined like total product power inputs are. In general, these temperature cycles would coincide with their corresponding compressor cycles (i.e. the compartment temperature falls as the compressor operates and it rises when the compressor is not operating), but the use of temperature cycles may make identification of test periods easier.

DOE proposes to use a definition for ''complete temperature cycle'' that would refer to a cycle based on compartment temperature variations. To maintain flexibility, the proposal would allow the selection of both temperature cycles that start when the temperature is at a maximum and those that start when the temperature is at a minimum—such temperature cycles would correspond to compressor cycles that start when the compressor starts or when it stops, respectively. Under the ''maximum temperature'' approach, the time period would be based on a starting point that coincides with the compartment temperature reaching its maximum temperature and would end once the compartment temperature returns to an equivalent maximum (within 0.5 °F of the starting temperature). During the course of the temperature cycle, the compartment temperature must have fallen to a minimum temperature for the period before rising again to reach the maximum temperature. Likewise, under the ''minimum temperature'' approach, the time period's starting point would occur once the compartment temperature reaches a minimum and ends when the compartment temperature returns to an equivalent minimum (within 0.5 °F of the starting temperature), having, in the interim, risen to a maximum and subsequently fallen again to reach the second minimum.

By defining the complete temperature cycle in this way, this proposed definition should resolve the potential difficulties in identifying test periods based on compressor cycles, because, as mentioned above, the compartment temperature measurements would be made separately for the different compressor systems, whereas the power input measurement combines all of the product's power input. DOE requests comment on this proposed definition that would define a ''complete temperature cycle'' in a manner that would permit the use of temperature cycles to identify test periods.

Measurement Frequency

The current test procedure allows temperature measurements to be taken at up to four-minute intervals (see Appendix A sections 2.9 and 5.1.1). This approach, however, carries with it an inability to further reduce the risk of truncation error beyond a certain degree. The Sub-Zero and revised draft AHAM procedures would further reduce this risk by requiring the measurement of multiple-compressor systems to be recorded at regular intervals not to exceed one minute (Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003, AHAM, No. 43 at p. 3).

In DOE's view, increasing the frequency of measurement periods would provide a more accurate picture regarding the energy usage of refrigeration products. DOE is aware that most test facilities record data for refrigeration product energy tests at a frequency of once per minute. DOE believes that there would be, at most, an insignificant test burden associated with this requirement since most test facilities already use one-minute recording intervals. Accordingly, DOE proposes to adopt a data collection interval that would not exceed one minute in length. DOE requests comment on the requirement for this proposed limit on the data acquisition time interval for test of multiple compressor products.

Stabilization Period

Instead of requiring a stabilization period of 24 hours as AHAM suggests, DOE is proposing to apply the existing stabilization requirements (see Appendix A, section 2.9). The DOE proposal would also permit the use of temperature cycles rather than compressor cycles to determine steady-state conditions. For example, while the current section 2.9 requires the comparison of temperature averages for two periods lasting at least two hours comprising complete compressor cycles, the proposal would allow this comparison to consider periods comprising complete temperature cycles or complete compressor cycles. As described above, it may be easier in certain cases to identify individual temperature cycles than individual compressor cycles for a multiple compressor system. DOE proposes to offer this alternative to reduce test burden for the majority of products, which achieve stabilization in less than 24 hours, and to ensure that the existing stabilization requirement is met for any product that requires more than 24 hours to achieve stabilization. DOE requests comments on this proposal.

One-Part Test Simplification

DOE proposes using a one-part test for multiple compressor products where (a) only one compressor system has automatic defrost and (b) the defrost is a ''short-time'' defrost (*i.e.,* not a ''long-time defrost'' with more than 14 hours of compressor operation between defrosts (see Appendix A, Section 1.12) or variable defrost). The proposed test period would start at a point during a defrost period and end at the same point during the subsequent defrost period, as does the existing test procedure for single-compressor products with automatic defrost that is neither long-time nor variable (see Appendix A, section 4.2). DOE proposes to allow use of the single test period to minimize the test burden for products with short-time automatic defrost for only one of the compressor systems.

Such a one-part test introduces the possibility of truncation error associated with the second compressor system. However, the clock time (as opposed to the compressor run time upon which CT values are based—see Appendix A section 5.2.1.2) between defrosts for short-time defrost systems is generally about 24 hours. (For example, one of the refrigerators tested and reverse-engineered as part of the September 2011 refrigeration product energy conservation standard rulemaking had a defrost timer with a 10.5-hour timer interval, and clock time between defrosts of 22 hours for a test with temperature controls in the median setting). (Refrigerator with Defrost Timer Example, No. 12) As described below in the discussion addressing truncation error associated with the first part of a two-part test, a test duration of 24 hours is sufficiently long to minimize the overall impact of this type of error.

DOE requests comments on its proposal to allow a one-part test for multiple compressor products in which only one compressor system has a defrost cycle that is neither long-time nor variable.

Test Simplifications for Tests With One or No Cycling Compressors

AHAM's Revised Draft Test Procedure does not consider potential test simplifications that could be implemented for multiple compressor refrigeration products for which one or more of the compressors does not cycle. The DOE proposal would address this possibility by providing details on how to determine test periods and the intervals over which compartment temperatures should be measured if the tested unit has one or no cycling compressors. Specifically, if only one of the compressors cycles, the test period for the first part of the test would be at least three hours long and comprise two or more complete cycles of the cycling compressor. Further, if none of the compressors cycle, the test period for the first part of the test would be three hours long. These test periods are nearly identical to the test periods for products with single compressors. (e.g. Appendix A, section 4.1) This approach, which would reduce manufacturer testing burdens, is justified because truncation error is essentially eliminated when only one compressor cycles or when no compressors cycle.

The proposed test procedure would use a similar simplification for the second part of the test for such products. For example, for a product with one cycling compressor, it would require that the second part of the test start and stop when the single cycling compressor starts or stops. In addition, the criteria for compartment temperatures at the test period start and stop times would be based on temperature measurements made for full cycles of the single cycling compressor. Again, using this approach for the second part of the test is, in DOE's view, merited since truncation error is eliminated with one or no compressors cycling.

DOE requests comment on this proposed approach to help simplify the test periods for both the first and second parts of the test when less than two of the compressors of a multiple compressor product cycle during a test.

First Part of a Two-Part Test for a System With at Least Two Cycling Compressors

DOE's proposal would require that the first part of the test for multiple compressor products have a test duration of at least 24 hours if the test period is not interrupted by a defrost cycle. The proposal would require test periods to be selected based on the compressor or temperature cycles of a ''primary'' compressor. A primary compressor would normally be the freezer compressor, if it cycles. If the freezer compressor does not cycle, a fresh food compressor would be the primary compressor, and the test periods would be based upon the compressor or temperature cycles of this fresh food compressor. DOE proposes to require that the first part of the test would include a whole number of primary compressor cycles or temperature cycles. If a defrost cycle occurs prior to the completion of the 24-hour test period, the DOE proposal would allow a shorter test duration of 18 hours. This proposal contrasts with the AHAM test procedure proposal, which would permit multiple segments of running time that add up to at least 24 hours. DOE's reasoning for its approach is described below.

DOE is adopting this modified approach of AHAM's revised draft procedure because the accuracy of the test is not necessarily improved by allowing the use of multiple segments of running time to increase the total test period time to 24 hours. This is because each segment that is used to comprise the test period would introduce its own contribution to truncation error. Hence, the benefit to accuracy associated with adding additional time to the test period would be reduced or eliminated by the additional truncation error introduced by each additional segment of test period time. DOE recognizes that there may be situations in which it is difficult to obtain 24 hours of uninterrupted stable operation. Based on a review of the test data for tests of multiple compressor products described below, DOE has tentatively concluded that shortening the test period time to 18 hours is a reasonable compromise in such cases, but that further reductions may not be acceptable because of the potential for the truncation error to become unreasonably large.

At the same time, an 18-hour test period would be possible without combining non-continuous running periods, assuming that most multiple compressor products have variable defrost. Multiple compressor products are generally premium products with electronic control and variable defrost as standard convenience features. DOE is aware of products sold by Sub-Zero, Liebherr, Bosch, LG, and GE (under that company's Monogram line of appliances) that use multiple compressor systems. To the extent DOE could determine based upon the certification information in its product listing database, models of this type all have variable defrost systems. Occasionally, defrost cycles may occur with less than 18 hours of stable operation between them, but variable defrost products would increase the defrost time interval during testing. DOE expects that in all cases, the period of stable operation after the second defrost would extend to at least 18 hours. The DOE test would continue to be conducted with the product doors closed, creating little opportunity for moisture to enter the cabinet. Under these conditions, the need for frequent defrost is eliminated, and a variable defrost product would increase the time duration between defrosts to significantly longer intervals. Hence, DOE believes that an 18-hour minimum continuous test period is reasonable for multiple compressor products.

DOE selected the 18-hour minimum test period duration after considering truncation error—both the actual truncation error associated with a given refrigerator test and the maximum possible truncation error that could occur for the product, given the compressor cycle times and compressor duty cycles exhibited in the examined tests. In order to conduct this evaluation, DOE examined the test data of two multiple compressor refrigerator-freezer products. Table III–7 below summarizes the test data showing the relationship between truncation error and test period duration. DOE was able to distinguish between the operation of the separate compressors of the two products based on an examination of power input and temperature data. This allowed DOE to determine the truncation error (including the maximum possible truncation error) by calculating the difference in measured energy use between a test period with whole fresh food cycles and a test period based on freezer cycles with a truncated fresh food cycle. This method was used because the test period for the first part of the tests includes a whole number of freezer compressor cycles. In general, it includes a whole number of fresh food compressor cycles plus a fraction of a fresh food compressor cycle. The actual truncation error is the difference in energy use for the fresh food compressor between its actual energy use for this fraction of a fresh food compressor cycle and the energy use it would have incurred had it operated at its average wattage for the same amount of time. The maximum possible truncation error is calculated assuming that for the remaining fraction of a fresh food compressor cycle the compressor either runs continuously or is not energized.

TABLE III–7—TRUNCATION ERROR DATA FOR FIRST PART OF TEST *

Product Number	1		2	
Product Class	4		5	
Temperature Setting	Mid	Warm	Mid	Cold
Hours	32.9	31.0	21.9	21.1
Actual Error	0.2%	0.6%	0.0%	0.1%
Maximum Error	1.0%	1.1%	0.6%	0.6%
Hours	12.3	13.4	12.6	15.1
Actual Error	1.1%	1.0%	0.2%	0.1%
Maximum Error	2.6%	2.5%	1.1%	0.9%

TABLE III—7 TRUNCATION ERROR DATA FOR FIRST PART OF TEST *—Continued

Hours	6.8	8.0	5.6	10.7
Actual Error	2. 6%	1.1%	0.4%	0.4%
Maximum Error	4.7%	4.2%	2.4%	1.2%
Hours	4.1	4.1	2.1	5.3
Actual Error	2.6%	4.5%	0.2%	0.4%
Maximum Error	7.8%	8.1%	6.3%	2.4%

* Error is presented as a percent of total energy use including defrost energy use.

The data show that the truncation error could be substantially less than one percent for a test period of 24 hours, although in a worst case (the maximum truncation error) scenario, it could be approximately one percent. Hence, if more than 24 hours of run time is present between defrost cycles, using a 24-hour test period would provide acceptably accurate measurements. DOE test data also show that the potential error could be significantly greater than one percent for a test period of 12 hours. Hence, the test period should exceed 12 hours in length in order to reduce this error.

As mentioned above, in cases where a first stable period between defrosts is not long enough, it would be expected that the next stable period would be long enough, since most multiple compressor products have variable defrost. However, DOE believes that an 18-hour test period would be acceptable in order to balance the needs of accuracy and the limitation of test burden. As a result, DOE is proposing to require that the first part of the test include at least 18 hours of stable compressor operation if the 24-hour requirement cannot be met due to an interruption by a defrost cycle. DOE seeks comment on this proposed minimum test period duration.

To ensure stability during the 24-hour first part of the test, the revised draft AHAM procedure would require that compartment temperatures measured for the compressor cycles at the start and end of the test period (or of each individual running period comprising the test period if there is more than one) be within 1.0 °F of this test period's temperature average. Measurements for fresh food compartment temperatures would be based on the complete fresh food compressor cycles that are closest to the start and end of the test period. Because of the duration of the required test period, this temperature requirement would help ensure temperature and average energy use stability throughout the test. However, as described in section III.C.8, DOE is proposing to establish a definition for the term ''stable operation.'' This definition would provide a temperature tolerance based on a temperature change rate of 0.042 °F per hour, which is consistent with the existing test procedure requirements for determining steady-state operation (see, for example, Appendix A, section 2.9). In essence, DOE proposes to require that the first part of the test for products with multiple compressors be a period of stable operation consistent with this definition, thus obviating the need for additional requirements specific for multiple compressor products. DOE requests comments on this proposal.

Second Part of the Two-Part Test

The draft AHAM test procedure would require the second part of the test to have a 24-hour duration that would start before a defrost cycle during stable operation and continue through the defrost cycle (including any precooling and post-defrost temperature recovery) to the next period of stable operation. If additional defrosts limit the test period to less than 24 hours, the revised draft AHAM procedure would require that additional periods of stable operation be appended to the test period to ensure a total duration of at least 24 hours, even if the test period is not continuous.

The DOE proposal would not require a 24-hour test period for the second part of the test, and would not permit non-continuous running periods to comprise the full test period. The DOE proposal would clarify that the test period may be defined by compressor cycles or temperature cycles, and would require that it start and end when the product is at equivalent states. For example, it can both start and stop at the start of a compressor on-cycle. Similarly, it can both start and stop at the end of a compressor on-cycle.

As described above for the first part of the test, combining multiple running periods to create a test period does not reduce the impact of truncation error. This observation also applies to the second part of the test. Hence, the DOE proposal would not allow combined multiple running periods to comprise the second part of the test.

DOE's analysis and testing show that increasing the duration of this part of the test would not reduce the risk of truncation error. The energy use associated with defrost would be calculated as the energy use measured during the second part of the test minus the energy use that would have been measured during the same time period if the product had been in stable operation for this time with no influence of events associated with defrost (as done with single-compressor products—see, for example, Appendix A, section 5.2.1.2). A longer test period duration would not minimize the truncation error in this calculation because the calculation would not involve dividing by the test period duration in hours, as would be done for the contribution to daily energy use of the first part of the test. Hence, the duration of the second part of the test would have no direct influence on the magnitude of truncation error associated with the non-synchronous operation of the compressors during this part of the test. The truncation error would instead be minimized by the ratio 12/CT, which adjusts the entire energy use contribution of defrost according to the defrost frequency. Consequently, DOE does not believe that there is a benefit to requiring a 24-hour duration for the second part of the test because increasing test period duration would not reduce the magnitude of the truncation error that might occur.

DOE investigated truncation error associated with the second part of the test in multiple compressor refrigeration products. Table III–8 below contains data from testing that DOE conducted. The data show that the duration of the second part of the test makes little difference to either the actual truncation error measured for the test or the maximum possible truncation error. These errors are calculated in the same manner described in the discussion above involving the first part of the test. DOE found that the maximum possible truncation error associated with the second part of the test did not exceed 0.5% of the total daily energy use measurement, and there is no significant difference in this maximum truncation error associated with the length of the test period. Hence, DOE concludes that requiring a 24-hour test period for the second part of the test is unnecessary, and is proposing that the test period start and end during stable operation.

TABLE III–8—TRUNCATION ERROR DATA FOR SECOND PART OF TEST *

Product Number	1		2	
Product Class	4		5	
Temperature Setting	Mid	Warm	Mid	Cold
Hours	25.9	27.8	25.1	27.2
Actual Error	0.2%	0.1%	0.2%	0.2%
Maximum Error	0.4%	0.5%	0.3%	0.3%
Hours	2.5	3.6	7.4	10.7
Actual Error	0.1%	0.1%	0.0%	0.3%
Maximum Error	0.4%	0.5%	0.3%	0.3%

* Error is presented as a percent of total energy use including defrost energy use.

The revised draft AHAM procedure for the second part of the test specified its start and end points as follows: ''The test period shall start at the beginning of [a] normal compressor cycle after the previous defrost occurrence (refrigerator or freezer). The test period includes the target defrost and following normal compressor cycles until the next defrost occurrence (refrigerator or freezer).'' (Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003, AHAM, No. 43 at p. 3) DOE believes that this approach is not sufficiently precise since (a) the term ''beginning of [a] normal compressor cycle'' does not clarify whether the start can occur at the start of an on-cycle, start of an off-cycle, or at either point in the test, and (b) there is no clear end point for the test period. The AHAM approach would, however, specify that the temperature average for each compartment for the first and last compressor cycle of the test period must be within 1.0 °F of the temperature average for the first part of the test, which would ensure that the test period does not omit any portion of the defrost cycle, such as precooling or temperature recovery. (*Id.*) The 1.0 °F temperature requirement is essentially designed to ensure that the second part of the test both starts and ends during steady state operation. By having the start and end points occur during steady state operation, the procedure would ensure that all of the events associated with defrost occur after the start and before the end of the second part of the test. By having all of the events occur in this manner during testing, all additional energy use associated with defrost would be captured by the procedure.

The alternate test procedure DOE permitted in the Sub-Zero waiver specifies the start and end of the test period for the second part of the test slightly differently: ''The test period shall start at the end of a regular freezer compressor on-cycle after the previous defrost occurrence (refrigerator or freezer). The test period also includes the target defrost and subsequent regular freezer compressor cycles, ending at the end of a regular freezer compressor on cycle before the next defrost occurrence (refrigerator or freezer).'' 77 FR at 5785–5786 (Feb. 6, 2012). The Sub-Zero waiver procedure also shares the same requirement as the AHAM test procedure proposal regarding the temperature average for each compartment for the first and last compressor cycle of the test period—these must be within 1.0 °F of the temperature average for the first part of the test. *Id.*

The specified start and end times for the Sub-Zero waiver test procedure are consistent with the start and end times specified by DOE for long-time and variable defrost in Appendix A in the January 2010 test procedure final rule. 77 FR at 3564–3565 (Jan. 25, 2012). The test procedure final rule required that the test period both start and end at the end of a compressor on-cycle, because this method provides a more accurate measurement of defrost energy use. *Id.* DOE believes that measurement accuracy will improve for all refrigeration products with long-time or variable defrost, including those with multiple compressors because starting and ending the test period at the same part of a compressor cycle ensures that the product is in the same state (i.e. having the same compartment temperatures) at the end of the test period that it was in at the start of the test period.

The DOE proposal would adopt a similar approach to the Sub-Zero procedure described above for the second part of the test for multiple compressor systems. However, DOE's proposal would permit a test to start and end at the start of the on-cycle of the primary compressor, or to start and end at the start of the off-cycle. In this way, the DOE proposal would allow greater flexibility in conducting the test, while ensuring the improved accuracy associated with starting and ending the test period when the refrigeration product is in the same state. The DOE proposal would also specify that if the test periods are defined based on temperature cycles rather than compressor cycles, the test period for the second part of the test would both start and end when the temperature associated with the primary compressor system is at a minimum, or it would both start and end when it is at a maximum. This strategy is equivalent to requiring that the test period both start and end either when the compressor starts or when it stops, ensuring that the product is in the same state at the end of the test period as it was at the start. Hence, this approach would ensure accuracy in measuring the energy use associated with defrost for products tested using test periods based on temperature cycles.

In addition, the DOE proposal for multiple compressor systems would remain consistent with Appendix A's requirement that the test period for the second part of the test for products with long-time or variable defrost must start and end during stable operation. Appendix A requires that the compartment temperatures for the compressor cycles prior to and after the second part of the test be within 0.5 °F of their temperature averages for the first part of the test (see Appendix A, section 4.2.1.1), as opposed to the 1.0 °F requirement of the Sub-Zero waiver and the AHAM proposal. DOE believes that this same tolerance for ensuring that the test period does not include any events associated with the defrost cycle (such as precooling or recovery) should apply to multiple compressor systems as it does for single-compressor systems because the events before, during, and after the defrost cycles of both types of products have the same basic functions (removing frost from the evaporator) and same basic control sequence (optional precooling, heating, temperature recovery).

However, the DOE proposal for multiple compressor systems would also require that the compressor cycles examined to confirm stable operation at the start and end of the second part of the test be the first and last compressor cycles (or temperature cycles) within the test period, consistent with the AHAM proposal and Sub-Zero waiver. DOE believes that this approach would better ensure that the test period starts and ends during stable operation since it examines compressor or temperature cycles within the test period, not the cycles that may fall outside of it.

In the special case in which there are no cycling compressors, the DOE proposal would require that the test period start and end when the compartment temperatures are within 0.5 °F of their averages for the first part of the test—this is also consistent with the Appendix A test procedure (see Appendix A, section 4.2.1.2).

DOE seeks comments on its proposals for the second part of the test.

Energy Use Equations

The energy use equations proposed by AHAM for the multiple compressor system test procedure and contained in the Sub-Zero waiver are similar to those already found in Appendix A for products with single compressors and multiple defrost cycle types tested using the two-part test. The similarity stems from the fact that the energy use for each compressor system's defrost is added separately using its appropriate CT (i.e. hours of compressor operation between defrosts) value to adjust the measurement so that it represents a tested unit's average energy use over 24 hours (see Appendix A, section 5.2.1.5). The DOE proposal for this energy use equation is essentially identical to the AHAM proposal and Sub-Zero waiver. However, the DOE proposal would also include a test for products where only one of the compressor systems has automatic defrost—and that defrost is neither long-time nor variable. The proposal for this test, which is described above, would reduce the test burden for these types of products. Hence, DOE is also proposing to apply the energy use equation for products tested using a single test period (see Appendix A, section 5.2.1.1) to those multiple compressor products that can use the single-part test.

Scope of Amendments

DOE proposes to replace the existing test procedure in Appendix A for products with dual compressor systems with the new test procedure described in this section for products using multiple compressor systems. When modifying test procedures, DOE considers the extent to which the energy use or energy efficiency measurement may be altered under a proposed procedure. (42 U.S.C. 6293(e)(1)) The test procedures of Appendix A will not be required for certifying compliance until the new refrigeration product energy conservation standards take effect on September 15, 2014. 77 FR 3559 (Jan. 25, 2012). DOE is aware of very few products that have multiple compressor systems and has received a petition for waiver from the existing test procedure only from Sub-Zero—DOE has granted this petition. 77 FR 5784 (Feb. 6, 2012). In DOE's tentative view, today's proposal would not affect the manner in which those Sub-Zero products covered under the waiver are measured for energy usage. DOE seeks information on whether any other products are currently tested using the dual compressor test procedure, whether their measured energy use would change as a result of the proposed test procedure amendment, and by how much the measurement would change. DOE notes that, consistent with its regulations, if it adopts the proposed amendments in Appendix A to address multiple compressor products such as those covered by the Sub-Zero waiver, that waiver would terminate once the amendments to the procedure are required to be used to demonstrate compliance with DOE regulations—*i.e.,* on September 15, 2014.

DOE notes that the discussion in this section focused only on multiple compressor system products with automatic defrost. DOE recognizes that the issues associated with truncation error would also affect multiple compressor products with manual defrost. However, DOE is not aware of any such products and has for this reason not proposed to address them in its test procedures. DOE requests comment on whether any such products exist and whether provisions for assuring the accuracy of testing them should be incorporated into the test procedure as part of this rulemaking.

DOE is also interested in receiving general comments regarding the proposed multiple compressor test procedure.

3. Triangulation

The energy use of refrigeration products is sensitive to the temperature(s) maintained within the cabinet.[10] For this reason, the DOE test procedures for refrigeration products specify standardized compartment temperatures that form the basis of the energy use measurements (see, for example, Appendix A1, section 3.2). However, conducting a test in which the product's compartment(s) temperatures exactly match the standardized temperatures is generally impossible. Particularly, today's electronic controls often provide only integer options for temperature control set points. The lack of smaller increments would make tuning to the standardized temperature within a tight tolerance impossible if the control did not exactly match the standardized temperature for one of the available settings. Even if smaller control increments are available, such as with mechanical controls, to try to approach the standardized temperatures within tight tolerances would require several iterations of adjusting the temperature controls, followed by re-stabilization and evaluation of the new steady state. This approach is particularly difficult for refrigerator-freezers and refrigerators with freezer compartments because the temperatures of two compartments must be adjusted, rather than just one, and because the compartment temperatures can affect each other.

To avoid these difficulties, the current test procedures require two tests in which the controls are adjusted so that the measured compartment temperatures bound the standardized temperatures (*i.e.,* the compartment temperature is warmer than the standardized temperature for one test and cooler for the second). The energy consumption is calculated as a weighted average of the measurements of the two tests, with averaging weights based on the measured compartment temperatures for the two tests in order to account for their respective variation from the standardized temperatures. In other words, the two measurements establish the relationship of energy use as a function of the compartment temperature(s). DOE's existing test procedure under Appendix A assumes this relationship is linear, which means that the energy use is calculated using linear interpolation (*i.e.,* a method to fit a straight line between a set of points). For example, the energy use equation of section 6.2.1.2 of Appendix A, which applies to all-refrigerators (*i.e.,* refrigerators without freezer compartments or with freezer compartments of 0.5 cubic feet capacity or less, *see* Appendix A, section 1.2), simply determines the value of this

[10] See DOE's discussion regarding the impact of the new Appendix A standardized compartment temperatures on energy use measurement in the refrigeration product energy conservation standard technical support document at *http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/refrig_finalrule_tsd.pdf* (Chapter 5, section 5.4.2.1).

function at the standardized temperature.

For refrigerator-freezers and refrigerators with freezer compartments, the two-test approach is complicated by two independent variables—the temperatures of the fresh food and freezer compartments. The energy use depends on both of these temperatures. However, based on information provided by two tests, it is mathematically impossible to determine how the product's energy use varies as both of the temperatures vary independently. As a result, when using two tests, it is generally not possible to determine what the product's energy use would be when both compartments are at their standardized temperatures.

However, there is one exception to this rule: it is possible to determine the energy use in the special case where the temperature controls are perfectly tuned to the standardized temperatures. In this special case, on a chart showing freezer temperature as a function of fresh food temperature, the line passing through the points defined by the compartment temperature pairs measured for the two tests would also pass through a point defined by the standardized temperatures. For this exception, if the energy use is calculated separately for the fresh food and freezer compartments' standardized temperatures (assuming energy use is a linear function of fresh food temperature for one of these calculations and assuming it is a linear function of freezer temperature for the other), the two energy use calculations would give the same result. For the general case in which such energy use calculations are not equal, the test procedure indicates that the larger of these measurements is used as the basis for the product's rating (see Appendix A, section 6.2.2.2). For this general case, this higher energy use calculation applies to an operating state in which one of the compartments is at its standardized temperature and the other is cooler than its standardized temperature. Consequently, this calculation overestimates the energy use that would occur if both compartments were at their standardized temperatures. It is this overestimation that the so-called triangulation approach eliminates for products that have both fresh food and freezer compartments.

DOE believes the triangulation approach could provide a more accurate estimate of energy use at the standardized temperatures by requiring a third test. If conducted with appropriate control settings, this third test would provide additional information regarding the dependence of energy use on the compartment temperatures, specifically providing the information needed to determine the energy use for any chosen pair of compartment temperatures. Hence, the approach allows a more accurate calculation of energy use when both compartments are at their standardized temperatures.

In most cases, the error in the calculated energy use when using the two-test method is small because temperature controls are reasonably well-tuned for the standardized temperatures. The modest overestimation of energy use associated with the two-test approach is acceptable in these cases because it avoids the additional test burden of conducting a third test. However, there may be circumstances in which conducting the third test would avoid excessive measurement error. These cases can be identified by observing when the two energy use calculations required in Appendix A, section 6.2.2.2 yield significantly different results. Table III–9 below quantifies the difference in fresh food and freezer interpolations to calculate energy use for six refrigerator-freezer samples tested by DOE using Appendix A. The difference between the two compartment interpolations ranges from a potential overestimation of energy usage of 15 to 51 kWh/year.

TABLE III–9—FRESH FOOD AND FREEZER INTERPOLATION COMPARISON

Sample No.	Product class	Fresh food interpolation (kWh/yr)	Freezer interpolation (kWh/yr)	Difference between interpolations (kWh/yr)	Percent difference %
1	7	599	548	51	8.5
2	3	580	617	37	6.0
3	5A	631	595	37	5.9
4	5	646	683	37	5.4
5	4	595	562	33	5.5
6	3	471	485	15	3.1

The Australian/New Zealand Standard 4474.1–2007 [11] (AS/NZ 4474.1–2007) includes a triangulation method that involves three tests conducted using three temperature control setting combinations to allow calculation of energy use for the product that would occur when both compartment temperatures exactly equal their standardized temperatures.

Stakeholders suggested in oral and written comments to the 2010 NOPR that DOE should adopt the triangulation method outlined in AS/NZS 4474.1–2007 to improve the flexibility and repeatability of the test procedure. 75 FR at 78822 (Dec. 16, 2010). In the interim final rule, DOE declined to adopt this method because it had not been subject to stakeholder evaluation and comment. *Id.* AHAM commented again in response to the interim final rule that DOE should adopt the triangulation method in the test procedures, indicating that it should be introduced as an optional approach for setting temperature controls for testing. AHAM also indicated that DOE could have put this topic up for stakeholder comment in the interim final rule, and added that if the DOE permits triangulation, it must also use triangulation for enforcement purposes. (Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003, AHAM, No. 39 at pp. 3–4) In the January 2012 final rule, which finalized Appendices A and B, DOE noted that the triangulation approach departs sufficiently from current procedures for setting temperature controls such that it would have been inappropriate for DOE to incorporate it based solely on the strength of the very limited number of NOPR comments, which contained little to no supporting data. 77 FR at 3571 (Jan. 25, 2012).

[11] ''Australian/New Zealand Standard, Performance of Household Electrical Appliances—Refrigerating Appliances, Part 1: Energy Consumption and Performance'', AS/NZS 4474. 1:2007, Appendix M, available for purchase at *http://infostore.saiglobal.com/store/results2.aspx?searchType=simple&publisher=all&keyword=AS/NZS%204474.*

Further, interested parties did not have an adequate opportunity to fully evaluate and comment on this issue. Hence, DOE did not incorporate the triangulation approach into DOE's test procedure in the January 2012 final rule.

However, the rulemaking initiated with today's notice provides an opportunity to present the triangulation approach and subject it to full stakeholder consideration and comment. DOE has evaluated the triangulation approach, determined that it has merit, and is proposing to adopt it as an alternative approach, as described below.

DOE conducted testing to evaluate the triangulation approach and to quantify the difference in measurement when using it as compared to the two-test method currently required. Table III–10 below summarizes test results for two of the tested refrigerator-freezers. The first product has a side-mounted freezer and electronic temperature controls, and the second product has a top-mounted freezer and mechanical temperature controls. These are the two products of Table III–9 that have the greatest discrepancy between the two energy use calculations based on the fresh food and freezer compartment standardized temperatures.

TABLE III–10—TRIANGULATION TEST RESULTS

	Sample 1 (Side-Mount)			Sample 2 (Top-Mount)		
Test Number	1	2	3	1	2	3
Setting (Freezer/Fresh Food)	(Mid/Mid)	(Cold/Cold)	(Mid/Warm)	(Mid/Mid)	(Warm/Warm)	(Mid/Cold)
Fresh Food Temperature (°F)	39.9	32.6	40.4	36.4	44.9	37.4
Freezer Temperature (°F)	−1.4	−5.6	4.9	−0.3	7.8	−3.4
Energy Consumption (kWh/day)	1.60	1.92	1.52	1.70	1.34	1.81
Test Results:						
Fresh Food at Std. Temp.:						
Energy Use (kWh/day)	1.64			1.59		
Freezer Temperature (°F)	−1.9			2.2		
Freezer at Std. Temp.:						
Energy Use (kWh/day)	1.50			1.69		
Fresh Food Temperature (°F)	42.3			36.7		
Energy Use Difference (%)	8.5%			6.0%		
Triangulation Result (kWh/day)	1.62			1.67		
Triangulation and Two-Test Percent Difference (%).	−1.2%			−1.2%		

As mentioned above, the existing DOE test procedure requires a rating based on the higher of the two test results (Appendix A, section 6.2.2.2). Hence, for Sample 1, the daily energy use measured using the current test procedure is 1.64 kWh, based on a weighted average of results using the fresh food compartment temperatures to determine averaging weights. At this level of energy use, the fresh food compartment temperature would be equal to the standardized temperature of 39 °F—and the freezer compartment temperature would be −1.9 °F. The equivalent freezer compartment temperature for this test is calculated by applying the same averaging weights used for the energy use calculation to determine a freezer compartment average temperature. The triangulation energy use result, which was determined by matching the standardized temperatures for both compartment temperatures, is 1.62 kWh—lower than the two-test result by approximately 1.2 percent. This difference in measured energy use reflects the difference between the freezer compartment temperatures of the two test methods. The table shows similar results for a second tested sample. These results illustrate the limitations of the current test procedure's two-test approach to exactly determine the energy use of a product when both compartments are at the standardized temperatures and provide an indication of the magnitude of the potential difference in results obtained when using the triangulation method. DOE concludes that the triangulation method can make, at most, a modest difference in the measured energy use for a subset of products. Since DOE expects this difference to be small in the vast majority of cases, and since use of the two-setting test will always result in a more conservative measurement of energy use, DOE believes that this generally does not merit a mandatory third test when considering the additional test burden that such a requirement would cause.

Because DOE recognizes that there may be circumstances in which the additional test may be more representative of a given product's energy use, particularly in cases where a product's temperature controls are not tuned well to the standardized temperatures, which may result in more significant measurement differences. In such cases, DOE believes that it is appropriate to allow ratings based on use of the triangulation approach to obtain more precise energy use measurements. Hence, DOE proposes in this notice to adopt in Appendix A a modified version of the AS/NZS triangulation approach as a voluntary testing option that manufacturers may choose to use. DOE requests comments on its proposal to allow triangulation as an optional approach.

Implementation of Triangulation in DOE's Test Procedures

DOE proposes to permit triangulation as an optional method to certify refrigeration products where, due to the basic model's operational characteristics, use of the triangulation method could result in a more representative measurement of energy use than the two-setting test. DOE's approach would be to permit this option in Appendix A. These procedures would incorporate by reference parts of Appendix M of AS/NZS 4474.1–2007 as an optional linear interpolation method. A new section 3.3 of the test procedure would reference subsections M3.a through M3.c and Figure M1 of appendix M of AS/NZS 4474.1–2007 to outline the requirements for the three-setting test procedure as an alternative to using the requirements of section 3.2 of Appendix A. The procedure would clarify that the target temperatures t_{xA} and t_{xB} discussed in the Australia/New Zealand procedure would be the standardized temperatures as defined in section 3.2 of the DOE test procedure. However, the DOE proposal would require that the first two of the three tests comply with the requirements for the DOE two-test method as described in Appendix A, section 3.2.1.

A new section 6.2.2.3 would set the required energy calculation for the triangulation option. The section would reference section M4.a of AS/NZS 4474.1–2007 to determine the energy consumption of the unit and add to it the icemaking energy use, which would be defined in section 6.2.2.1 and which would, if adopted, be measured as described in the new section 8 that DOE is considering adding to its test procedure.

DOE requests comments on this approach for implementing triangulation into the DOE test procedure.

Certification

DOE is also proposing that manufacturers identify which method they have used to rate and certify a particular basic model. This proposed amendment would require a manufacturer to indicate whether triangulation serves as the basis for the certified rating. This change would be made in section 429.14(b). DOE recognizes that more than one test is conducted for each rating (see, for example, 10 CFR 429.11(b), which indicates a sample size minimum of two units). DOE proposes to require that all units of a given model that are tested for certification purposes be tested using the same test method and proposes to require that the certification report indicate whether the triangulation method was used. This requirement would be added to the sampling plan for residential refrigerators, refrigerator-freezers, and freezers in 10 CFR 429.14.

Since the two-test method generally yields results that are more conservative than the triangulation test (i.e., higher energy use), DOE would permit manufacturers to continue using the two-part test at their discretion. By permitting manufacturers to continue using the simpler two-part test, DOE's intention is to limit the overall burdens that are placed on the industry. In those instances where individual manufacturers believe that use of the triangulation method will give a more representative value of the energy use of a given basic model, those manufacturers can elect to follow the more comprehensive steps of the triangulation method.

However, given that tests conducted using the triangulation approach may potentially, for certain basic models, yield more representative results, DOE is proposing to use this particular method when conducting assessment testing, pursuant to 10 CFR 429.104, and enforcement testing, pursuant to 10 CFR 429.110, if certain conditions are observed during the first two tests of a given unit of a basic model that suggest that a third test would clearly yield a more representative measurement than the two-test method. Specifically, if the difference in the energy use calculated using the two compartment temperatures measured for the two sets of tests for any one unit of a basic model is greater than five percent, DOE would use the triangulation method for any assessment or enforcement testing of units in that basic model. This approach may, in certain circumstances, require conducting a third test of particular units of a basic model on which DOE has recently conducted assessment or enforcement testing. DOE requests comment on this five percent threshold. As noted, whether used optionally for manufacturer certification testing or for assessment or enforcement testing, DOE would require that all units of a basic model be tested using the same method.

DOE welcomes comment on its proposal to require manufacturers to state in their certification reports whether the triangulation approach was used to determine energy use of a product, and on the proposals to use triangulation for assessment and enforcement if (a) the product was certified using this method, or (b) the measurement results calculated based on the first two tests differ by more than five percent using the two different compartment temperatures for the interpolations.

4. Anti-Circumvention Language

Revisions Addressing Past Stakeholder Comments

The current test procedure requires very specific conditions during testing that would normally not exist during consumer use in the field. For example, products are tested in 90 °F ambient temperature conditions (see, for example, Appendix A1, section 2.1), which is much warmer than typical room temperature. Recognizing that manufacturers could design product control systems to detect energy test conditions and modify their operation during testing to obtain a more favorable rating, AHAM introduced ''anti-circumvention'' language into the 2007 version of HRF–1. (HRF–1–2007, section 1.2) AHAM revised this language slightly in HRF–1–2008.

In the December 2010 final rule, DOE added similar language to 10 CFR 430.23(a)–(b), which contain general provisions applicable to Appendices A and A1 and Appendices B and B1, respectively. Specifically, the final rule added a new section 430.23(a)(10) and a new section 430.23(b)(7), which require that all refrigeration products tested under the DOE test procedures operate during the prescribed testing in a manner equivalent to their operation during representative average consumer use. Both of these provisions included four examples of situations in which a manufacturer must obtain a waiver under 10 CFR 430.27. However, the anti-circumvention language adopted by DOE was not identical to the language contained in either HRF–1–2007 or HRF–1–2008. 77 FR at 3568 (Jan. 25, 2012).

DOE issued an interim final rule covering amendments to Appendices A and B in conjunction with the final rule that added the anti-circumvention language to 10 CFR 430.23. During the comment period for the interim final rule, AHAM and Whirlpool urged DOE to adopt anti-circumvention language identical to HRF–1–2008's. (Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003, No. 16 at p. 4, No. 12 at p. 2)

In the January 2012 final rule for Appendices A and B, DOE noted that amendments made to 10 CFR 430.23 as part of the December 2010 final rule were already final and not subject to further amendment. However, DOE noted that it would consider making such revisions in a future rulemaking. 77 FR at 3568 (Jan. 25, 2012).

In this notice, DOE proposes to adopt AHAM's suggested revisions to sections 430.23(10)(a)(ii) and 430.23(7)(a)(ii), and to adjust the order of the parts of these sections. The modified anti-circumvention language would duplicate the HRF–1–2008 text, as recommended by AHAM in its comments on the interim final rule, which address the four examples providing test procedure instructions for specific control features. (Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003, No. 16 at p. 4, No. 12 at p. 2)

In addition, DOE proposes to move the discussion of the circumstances that would lead to the requirement for a waiver to the end of the anti-circumvention section. Currently, the four examples mentioned above appear directly after the waiver requirements discussion. However, their format providing test procedure instructions (e.g., ''Energy used during adaptive defrost shall continue to be tested and adjusted per the calculation provided for in this test procedure.'') is inconsistent with their appearance directly after the waiver discussion. Hence, DOE proposes to reorder the sections, so that the four examples instead follow the sentence, ''Energy consuming components that operate in typical room conditions (including as a result of door openings, or a function of humidity), and that are not exempted by this test procedure, shall operate in an equivalent manner during energy testing under this test procedure, or be accounted for by all calculations as provided for in the test procedure''. The discussion of circumstances leading to the requirement to obtain waivers would appear at the end of the section.

DOE welcomes stakeholder comment on DOE's proposed revisions to the anti-circumvention language and on the reordering of the language.

Components That Operate Differently During Testing

The DOE test procedure simulates typical room conditions (approximately 70 °F) with door openings by testing at 90 °F without door openings. See 10 CFR 430.23(a)(10). DOE's adoption of a modified version of AHAM's anti-circumvention language for refrigerators and refrigerator-freezers was intended to prevent manufacturers from designing products that actively reduce the energy use of key components when they sense that the product is undergoing energy testing. DOE's test procedure is designed to permit passive changes in operation because a product under test is expected to operate differently in certain respects than it would under typical room conditions to remove the higher thermal load imposed by the test conditions while continuing to maintain the same thermostatically-controlled internal temperature (*e.g.,* compressor percent run time would be expected to increase during operation at a room temperature of 90 °F as compared with typical room conditions). In this case, the added thermal load to simulate door-openings and the insertion of warm food products is the reason for conducting the test in the 90 °F ambient rather than at approximately 70 °F.

On August 27, 2012, Whirlpool Corporation submitted a petition for waiver from the DOE test procedure for basic models of refrigeration products that use a dual-speed condenser fan motor. (Whirlpool subsequently altered its waiver request into a request for guidance.) These basic models run their condenser fans at low speed in typical room conditions, increasing condenser fan speed when sensors detect ambient temperatures greater than 80 °F. Increasing condenser fan speed increases the heat rejection from the condenser to a consumer's home, which reduces the condensing temperature and potentially increases the measured efficiency of the refrigeration system during testing if the reduction in compressor energy use exceeds the increase in fan energy use. Whirlpool indicated that fan noise necessitated the use of a lower fan speed below 80 °F in order to maintain consumer acceptance.

Based on Whirlpool's description, this feature represents an active operation change that would require the filing of a waiver request from a manufacturer under 10 CFR 430.23(a)(10)(i), since this feature appears to cause the product to operate differently during energy testing than it would during representative average consumer use. See also 10 CFR 430.27 (regarding general test procedure waiver requirements). In its petition, Whirlpool acknowledged that such a feature may conflict with section 430.23(a)(10), but argued that disabling this feature in order to force the test unit to operate in a manner equivalent to typical room conditions would be intrusive to the product's operation and could introduce concerns about test accuracy. In effect, Whirlpool requested that DOE waive the conditions of section 430.23(a)(10) with respect to this particular feature and permit testing and rating of models with this feature without the use of an alternative test procedure. Whirlpool also indicated that it had determined through testing that Samsung has already introduced models using such a control feature.

As a related matter, on March 7, 2013 Samsung Electronics America Inc. (Samsung) submitted to DOE a petition for waiver for several models that use a multi-speed condenser fan motor, with a description similar in nature to the petition submitted by Whirlpool. The petition did not indicate the specific impact on the measured energy use resulting from the use of this feature or propose an alternative test method, but requested that DOE confirm whether, in fact, the use of this feature represents a violation of the language in 10 CFR 430.23(a)(10) requiring that energy consuming components that operate in typical room conditions (including as a result of door openings, or a function of humidity), and that are not exempted by the DOE test procedure, shall operate in an equivalent manner during energy testing under the DOE test procedure, or be accounted for by all calculations as provided for in the DOE test procedure. Samsung stated that the general purpose of this feature is to induce a condensing rate that is appropriate for the given ambient room conditions, thus minimizing stress on the refrigerant system and improving system performance and durability.

To address these types of issues generally, DOE initially proposed modified language in its May 27, 2010 NOPR (*see* 75 FR at 29856), but did not adopt this language due to valid concerns expressed in stakeholder comments. In response to the issues raised by Whirlpool and Samsung, DOE issued guidance on this matter on May 28, 2013, that provides a framework for assessing the potential need for a waiver within the context of the existing anti-circumvention provisions.[12] In the absence of more specific details about the expected energy impact of this feature, DOE is unable to propose a specific amendment to the provisions of 430.23(a)(10) (and 430.23(b)(7) for freezers) that would address these concerns. However, DOE requests comments as to whether modifications to the anti-circumvention language are needed in order to address control algorithms similar to the control described above as well as any available data regarding the net impacts on the measured energy consumption for such a feature and the impacts on the representativeness of related ratings. DOE may consider revising the test procedure accordingly in this or a future test procedure rulemaking.

5. Incomplete Cycling

The refrigeration circuit compressor, which is a key component of refrigeration products, generally is the component that consumes the most energy. Most products use single-speed compressors with sufficient capacity for peak demand conditions, such as when doors are frequently opened. Hence, when testing a product with the doors closed, compressors cycle on and off as the thermostat in the cabinet intermittently energizes the compressor to provide more cooling. Energy use is high when the compressor is operating and low or even zero when it is not. In order to provide a meaningful measurement of average product energy use to maintain specified compartment temperatures, the measurements must be made for a whole number of compressor cycles. A full compressor cycle includes both the time when the compressor is operating and the time

[12] This guidance is posted in DOE's online Guidance and FAQ database, and is available for viewing at: *http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1.*

when it is not. At the end of a full compressor cycle, the cabinet is in the same state as at the start of the cycle, where the start of the cycle is marked by the time at which the compartment thermostat (or electronic control system) switches the compressor on (or, alternatively, both the start and end of the cycle occur when the compressor is turned off). For this reason, the DOE test procedure requires that when measuring energy use, test periods must include at least two whole compressor cycles (see, for example, Appendix A, section 4.1).

However, some refrigeration products may, for some test conditions, have compressor cycles lasting many hours. In such cases, the specified test period (two whole compressor cycles) could last significantly longer than a day. To limit the testing burden, the test procedure currently limits the test period to a maximum of 24 hours. The test procedures use the term ''incomplete cycling'' to denote this condition in which two compressor cycles last more than 24 hours.

In DOE testing, several freezers had compressor cycles lasting longer than 12 hours each, thus invoking the requirements associated with incomplete cycling. (Test Data for Incomplete Cycling Freezers, No. 13) Table III–11 shows the potential measurement error associated with the 24-hour test period as compared with a test period comprising a whole number of compressor cycles. DOE determined that this measurement error varied from 3 to 14 percent for these products. While products that operated with incomplete cycling did so only for one of the two temperature control settings used for the test, the errors shown are based on the energy use associated with the standardized compartment temperature, based upon the weighted average of energy use measurements made for the two settings. The magnitude of the error and its direction (*i.e.,* whether it results in overestimating or underestimating energy use) depend on whether the 24-hour test period begins when the compressor starts or when it stops. The current DOE test procedure does not specify when such a 24-hour period should start. For these tests, the error is reported based on 24-hour test periods that begin when the compressor starts. In each case, the 24-hour test overestimates the energy use that would have been calculated using test periods consisting of whole numbers of compressor cycles.

TABLE III–11—MEASUREMENTS ERROR ASSOCIATED WITH 24-HOUR TEST PERIOD FOR INCOMPLETE CYCLING

Product Class	10	10	10	10
Total Volume (cuft)	12.9	14.3	12.9	14.7
Settings used in Test	Mid, Warm	Mid, Warm	Mid, Warm	Mid, Warm
Setting with Incomplete Cycling	Mid	Mid	Mid	Mid
Energy use 24-hour limit (start w/compressor start)	347	367	404	391
Energy use whole number of cycles	336	356	349	377
Percent Impact	−3.2%	−3.0%	−13.6%	−3.6%
Test start	5/7/10	7/28/10	11/4/10	8/7/10
End	5/18/10	8/18/10	11/15/10	8/17/10
Duration in hours	264	504	264	240
Assessment of Added Test Time				
Two full cycles:				
Test period (hr)	47.1	42.1	27.9	50.8
Additional time (hr)	23.1	18.1	3.9	26.8
(percent test time)	9%	4%	2%	11%
Single cycle:				
Test period (hr)	23.5	21.0	14.0	25.4
Test time change (hr)	−0.5	−3.0	−10.0	+1.4
(percent test time)	−2%	−13%	−42%	+6%

The table also summarizes the increase in test time for these products if a two-cycle or one-cycle test period were specified rather than the current 24-hour test period. For two-cycle test periods, the total test time would increase from 2 to 11 percent. For a single-cycle test period, the total test time could increase up to 6 percent but would on average decrease.

DOE also conducted a theoretical analysis calculating the magnitude of the error associated with the current 24-hour test period. For this analysis, DOE considered variation in (a) The ratio of compressor ''on'' time relative to ''off'' time, (b) the duration of full compressor cycles, and (c) whether the 24-hour test period starts when the compressor starts or when it stops. This analysis shows that the error associated with the 24-hour test period can be as large as 40 percent for a temperature setting for a product operating with incomplete cycling and demonstrates that the current 24-hour test period limit for incomplete cycling products can, in certain circumstances, result in significant errors in measurement as compared with the products' actual average energy use. (Theoretical Analysis of Potential Measurement Error for Incomplete Cycling Products, No. 1)

Based on the test data and its analysis, DOE tentatively concludes that the current test procedure's approach for incomplete cycling products requiring a 24-hour test period has the potential for a large measurement error. Further, DOE's test data show that requiring, instead, the use of a full compressor cycle would not add significant test burden and would in most cases reduce test time. For this reason, DOE proposes to eliminate the current 24-hour test period for products exhibiting incomplete cycling. In order to mitigate the test burden of this change, DOE proposes to allow the test period to consist of a single compressor cycle. DOE requests comments on this proposal.

Temperature Measurement for Incomplete Cycling or Non-Cycling Products

As discussed in section III.C.3, the energy use of refrigeration products is sensitive to the temperatures maintained in the compartments. However, the compartment temperatures for most products are not constant. The temperatures of refrigeration product compartments vary as the compressor cycles, dropping when the compressor is operating and rising when it is not operating. In order to provide a meaningful measurement of compartment temperature, the measurement must be an average for one or more whole compressor cycles, which includes both the off-time and on-time of the compressor.

The December 2010 interim final rule modified the test period for measuring temperature for products tested starting in 2014. This change, implemented in Appendices A and B (see, e.g., Appendix A, section 5.1.2), requires that the test period for temperature measurement coincide with the test period for energy measurement, regardless of whether the product's compressor cycles regularly, does not cycle, or exhibits incomplete cycling. These changes were incorporated into Appendices A and B as part of amendments made to the second part of the test for products with long-time or variable defrost. 75 FR at 78836 (Dec. 16, 2010).

However, DOE has become aware that requiring the same test periods for temperature measurement and energy use, as done for Appendices A and B as described above, may not be appropriate for products with an automatic defrost cycle that is neither long-time nor variable in nature (i.e., ''short-time defrost'' products). In Appendices A1 and B1, the temperature measurement is made during one or more complete compressor cycles, one of which shall be the last complete compressor cycle in the test period (i.e., the test period specified for energy measurement) (see, e.g., Appendix A1, sections 5.1.2 and 5.1.2.1). For products with short-time defrost, the test period is from one point during a defrost cycle to the same point during the next defrost cycle (see, e.g., Appendix A1, section 4.2). The last complete compressor cycle in such a test period occurs during stable cycling of the compressor just before the defrost timer initiates the defrost cycle. Hence, modifying the test period for temperature measurement to be the same as the test period used for measuring energy usage would be inconsistent with DOE's current test procedures for such products.

To ensure the accuracy and consistency of the soon-to-be required test procedures for short-time defrost products, DOE is proposing to address the inconsistency associated with temperature measurements for short-time defrost products. Specifically, DOE proposes to require that the compartment temperatures for such products shall be the average of the measured temperatures taken in a compartment during a stable period of compressor operation containing no defrost cycle or events associated with a defrost cycle, such as precooling or recovery, that includes at least two complete compressor or temperature cycles (if the compressor(s) or temperatures cycle) and is at least three hours in duration—essentially the same test period specified in section 4.1 of the test procedure for products with manual defrost. This provision would apply to Appendices A and B. This proposed approach for defining temperature measurement invokes several definitions described elsewhere in this notice: The term ''complete temperature cycles'' is described in section III.C.2, while ''precooling'', ''recovery'', and ''stable operation'' are discussed in section III.C.8. As described in these sections, DOE proposes to add these definitions to Appendices A and B to support already-established test procedures for products with long-time or variable defrost (see, for example, Appendix A, section 4.2.1), and to support the multiple compressor test procedures proposed for Appendix A.

DOE welcomes comment on its proposed revision to section 4.1 to reduce the potential error while limiting test burden for incomplete cycling products, as well as the proposed revisions to section 5.1 to ensure consistency regarding measurement of compartment temperature.

6. Mechanical Temperature Controls

As discussed in section III.C.3 of this notice, DOE's procedure requires testing at two temperature settings. Appendix A, section 3.2.1 requires that temperature controls be set to the median setting for the first test. The test procedure then calls for a second test to be performed with all controls set at their warmest setting or all controls set to their coldest setting.

Achieving either the warmest or coldest setting for electronic control products is straightforward because controls are set to either the highest or lowest temperature setting that the electronic control allows. However, DOE has received questions about how to properly position a mechanical control to obtain the highest or lowest temperature setting. More specifically, DOE has become aware that there may be confusion as to the meaning of the term ''setting'' for the purposes of this aspect of the test, particularly for products with mechanical controls that have a range of motion extending beyond the printed indications on the knob or label. In such cases, DOE proposes to clarify whether the control should be set either with a pointer aligned to the highest or lowest number or letter on the dial or to the warmest or coldest end of the range by turning the dial completely until it is physically unable to be turned further. In doing so, DOE is seeking to ensure test consistency to avoid different lab interpretations of the temperature control setting requirements, which could generate inconsistent results.

To improve test result consistency, DOE is considering modifying section 3.2.1 of Appendices A and B to indicate that the warmest and coldest setting should be achieved by aligning mechanical temperature control dials to the highest or lowest numeral or symbol that indicates a temperature setting. The new approach, which is intended to standardize testing practices while accounting for variability in design of mechanical temperature controls, would be inserted in section of 3.2.1 of Appendices A and B. It would read, ''. . . the warmest and coldest settings shall correspond to the positions in which the indicator is aligned with control symbols indicating the warmest and coldest settings.'' The remainder of section 3.2.1 would not be changed.

DOE welcomes stakeholder comment on its proposal to modify section 3.2.1 of the current test procedure to clarify mechanical control settings during testing.

7. Ambient Temperature Gradient

DOE has observed that the key sections of the two industry-based protocols (i.e., HRF–1–1979 and HRF–1–2008) on which the DOE procedures rely contain inconsistencies regarding specified ambient temperature and vertical ambient temperature gradient requirements. Vertical ambient temperature gradient is the rate of temperature variation with height. For example, the temperature gradient measured by two temperature sensors separated vertically but otherwise at the same location in a room is equal to the difference in measured temperature divided by their vertical separation.

The key requirements for ambient temperature sensors, ambient temperature, ambient temperature gradients, and temperature sensor shielding are summarized in Table III–12 below. All of these factors are significant for purposes of specifying the ambient temperature conditions surrounding a test sample because each one can affect the measured energy use. For example, the ambient temperature sensor location affects the measured value of ambient temperature since temperatures generally are not completely uniform throughout the test chamber. Also, the ambient temperature level directly affects the cabinet thermal load that must be removed by the refrigeration system.

TABLE III–12—KEY AMBIENT TEMPERATURE REQUIREMENTS

Requirement	Appendix A1	Appendix A
Ambient Temperature Sensor Location.	The ambient temperature is to be recorded at points located 3 feet (91.5 cm) above the floor line and 10 inches (25.4 cm) from the center of the two sides of the cabinet. (HRF–1–1979, section 7.4.3.1).	Not specified (missing from HRF–1–2008).
Ambient Temperature	The ambient temperature shall be 90.0± 1 °F (32.2±0.6 °C) during the stabilization period and the test period. (Appendix A1, section 2.1).	The ambient temperature shall be 90.0±1 °F (32.2±0.6 °C) during the stabilization period and the test period (Appendix A, section 2.1).
Ambient Temperature Gradient Sensor Locations.	The vertical ambient temperature gradient in any foot of vertical distance from 2 inches (5.1 cm) above the floor or supporting platform to a height of 7 feet (2.17 m) or to a height 1 foot (30.5 cm) above the top of the cabinet, whichever is greater, is not to exceed 0.5 °F per foot (0.9 °C per meter). (HRF–1–1979, section 7.2.1) Also see text below under "Maintaining Ambient Temperature Gradient During the Test".	The vertical ambient temperature gradient at locations 10 inches (25.4 cm) out from the centers of the two sides of the unit being tested shall be maintained during the test. Unless the area is obstructed by shields or baffles, the gradient shall be maintained from 2 inches (5.1 cm) above the floor or supporting platform to a height 1 feet (30.5 cm) above the unit under test. The vertical ambient temperature gradient in any foot of vertical distance is not to exceed 0.5 °F per foot (0.9 °C per meter) (HRF–1–2008, section 5.3.1).
Ambient Temperature Gradient.	*See* above (HRF–1–1979, section 7.2.1)	*See* above (HRF–1–2008, section 5.3.1).
Maintaining Ambient Temperature Gradient During the Test.	* * * the vertical ambient temperature gradient at locations 10 inches (25.4 cm) out from the centers of the two sides of the unit being tested is to be maintained during the test. Unless the area is obstructed by shields or baffles, the gradient is to be maintained from 2 inches (5.1 cm) above the floor or supporting platform to a height 1 foot (30.5 cm) above the unit under test. (Appendix A1, section 2.2).	*See* above (HRF–1–2008, section 5.3.1).
Shielding of Temperature Sensors.	Temperature measuring devices are to be located or shielded so that indicated temperatures will not be affected by the operation of the condensing unit. (HRF–1–1979, section 7.4.3.1).	Temperature measuring devices shall be located or shielded so that indicated temperatures are not affected by the operation of the condensing unit or adjacent units (HRF–1–2008, section 5.3.1).

Test temperature requirements for freezers, described in Appendices B1 and B, are the same as those summarized in the table above—the Appendix B1 requirements are identical to those of Appendix A1, and the Appendix B requirements identical to those of Appendix A.

Location of Ambient Temperature Sensors

DOE notes that Appendices A and B do not specify the locations of the ambient temperature measurement sensors, since these locations are not specified in HRF–1–2008. To remedy this gap, DOE proposes to add requirements for these sensor locations in a new section 2.1.1 to be added for these two appendices. The addition of these requirements would help ensure testing consistency. DOE requests comment on this proposed amendment.

Shielding

DOE notes one issue with the shielding requirements (as specified in section 5.3.1 of HRF–1–2008, which is incorporated by reference in Appendices A and B): the requirements suggest that relocating the sensors is appropriate in order to avoid the impact of the warming effect of the condensing unit.

DOE does not believe that relocating temperature sensors is an appropriate means to remedy the effects of the condensing unit or adjacent products under test. As Table III–12 clearly lays out, the requirements for temperature sensor placement are precise, providing manufacturers with the necessary specificity in setting up sensors for the test. *See* HRF–1–2008, sec. 5.3.1. An attempt to relocate these sensors in a manner that conflicts with these requirements would, in DOE's view, undermine the procedure's purpose to ensure that an accurate measurement of energy usage is obtained. Hence, to remove any potential ambiguity or potential loophole, DOE is proposing to eliminate the current sensor relocation option. DOE proposes to implement this change in Appendices A and B by moving the shielding requirement, without the option for sensor relocation, to a new section 2.1. Making a change in this manner would, as described below, permit the removal of related references to section 5.3.1 of HRF–1–2008 currently contained in Appendices A and B.

DOE requests comment on its proposals to disallow relocation of ambient temperature sensors in order to prevent them from being affected by the test sample's condensing unit or adjacent test samples.

Maintaining the Ambient Temperature Gradient During Testing

The requirement for maintaining the temperature gradient during the test was added to the test procedure during the rulemaking that adopted sections of HRF–1–1979 by reference. 47 FR 34517 (Aug. 10, 1982). DOE proposed amendments to its then-existing test procedure based on the test methods of HRF–1–1979. See 45 FR 47396 (July 14, 1980). These amendments incorporated HRF–1–1979, section 7.2.1 to require that the vertical temperature gradient in the test room in every foot of vertical distance must be no more than 0.5 °F per foot. On August 10, 1982, DOE revised its test procedures by adding a requirement that the ambient temperature gradient be maintained during testing to address comments pointing out that the proposal lacked such a requirement. 47 FR at 34522–34523. This new language was incorporated into Appendix A1, section 2.2. DOE tentatively believes that amending this requirement may be necessary because (a) it is not clear that the temperature gradient requirement applies when temperature sensors are shielded, and (b) there are no specific details provided in the referenced HRF–1 procedure regarding the measurements that would demonstrate successful compliance with this requirement.

The current temperature gradient maintenance language indicates that the temperature gradients should be maintained during testing. However, the next part of the requirement states, ''Unless the area is obstructed by shields or baffles, the gradient is to be maintained from 2 inches (5.1 cm) above the floor or supporting platform to a height 1 foot (30.5 cm) above the unit under test.'' (See Appendix A, section 2.2) This language is unclear as to whether the ambient temperature gradients must be maintained as described if there are shields or baffles. DOE is unaware of any refrigeration product equipped with shields or baffles in the specified locations. Hence, DOE concludes that such shields or baffles would be those placed in the vicinity of the temperature sensors during testing to comply with the requirements to shield the sensors from the effects of the condensing unit or adjacent products under test. (*See, e.g.,* HRF–1–1979, section 7.4.3.1) DOE proposes to eliminate the ambiguity regarding whether the temperature gradients are to be maintained when the temperature sensors are shielded by removing the qualifying text, ''unless the area is obstructed by shields or baffles''.

DOE has observed during testing that the gradients are often difficult to maintain during testing. It is DOE's understanding that test laboratories generally shield the temperature sensors as required and strive to arrange the shields to ensure that the temperature gradients are maintained during the test at the specified location 10 inches from the sides of the units. For example, DOE is aware that test laboratories have generally placed temperature sensors 10 inches from the sides of the unit at heights 2 inches above the floor, 36 inches above the floor, and 12 inches above the top of the unit. The 36-inch high sensors are monitored to ensure they remain within the 90 +/− 1 °F specified ambient temperature range required under the procedure. The laboratories also strive to maintain temperature gradients between the lower and higher pairs of temperature sensors on each side of the unit (*i.e.,* between the 2-inch and 36-inch sensors and also between the 36-inch and highest sensors). Often, one of these gradients exceeds 0.5 °F per foot for a few minutes after the start of a compressor ''on''-cycle, when condenser heat release is highest.

In order to rectify this situation, the laboratories shield the sensors (or adjust the shielding as needed) and recheck whether the gradients are maintained. The condensing unit as well as the operation of adjacent test units can impact the temperature measurements by raising the temperature in some locations in the test chamber. The condensing unit rejects heat from the product's refrigeration system by transferring it to the air surrounding the cabinet, either by drawing air through the condensing unit, or by direct transfer to the air from a condenser mounted on the outside of the cabinet. If this warm air passes near a temperature sensor after leaving the warm condenser, the temperature measured by the sensor will rise.

Further, if this temperature rise is sufficiently greater at one temperature sensor than at the temperature sensor below it, the measured vertical ambient temperature gradient will increase, potentially above the maximum 0.5 °F per foot. Such a condition indicates a failure to ''maintain the vertical ambient temperature gradient during the test'', as required by the test procedure. DOE recognizes that it may be difficult to maintain the temperature gradient during testing if some of the temperature sensors are exposed to the warm air of the condensing unit or adjacent test units and requests comment on whether maintaining the gradient at a location 10 inches from the side of the unit as specified is essential to assure repeatable results. Intrinsic to this issue is whether maintaining the temperature gradient can be demonstrated using a different location. However, DOE also recognizes that the test procedure does not specify how to demonstrate that the temperature gradient is maintained during the test. DOE proposes to require the use of sensors on both sides of the test sample at three heights, as described above—at 2 inches above the floor, 36 inches above the floor, and one foot above the top of the cabinet—and that the gradient must be maintained during the test between the two pairs of vertically-adjacent sensors on each side (i.e. between the 2-inch and 36-inch temperature sensors and also between the 36-inch and highest sensors). In addition, DOE would require that the temperatures measured by these sensors be recorded in the test data underlying certifications in accordance with 10 CFR 429.71. DOE proposes these changes for Appendices A and B.

DOE requests comments on its proposal to modify the requirements for maintaining the ambient temperature gradient during testing. In addition, because DOE is aware that it may be difficult to maintain the gradients when temperature sensors are affected by the heat of the condensing unit or adjacent units, DOE also requests comments on whether verification of temperature gradient maintenance should be performed in a different location.

Revising Ambient Temperature Requirements for Appendices A and B

Several of the ambient temperature requirements of Appendices A and B appear in section 5.3.1 of HRF–1–2008, which is incorporated by reference. DOE is proposing to modify some of these requirements, particularly those related to maintaining the temperature gradient during testing, as described above. In order to make the necessary changes related to temperature gradient and ambient temperature sensor location requirements while retaining certain other requirements, DOE proposes to move these requirements directly into Appendices A and B, in new sections 2.1.1 through 2.1.3, and to remove the incorporation by reference for HRF–1–2008 section 5.3.1.

DOE requests comments on the proposed changes to ambient temperature and ambient temperature gradient requirements, and on the proposed approach to implement these changes.

8. Definitions Associated With Defrost Cycles

DOE's amendments in the January 2012 final rule included modifications to test periods for products with long-time and variable defrost (see, for example, Appendix A, section 4.2.1). 77 FR at 3563–3568 (Jan. 25, 2012). That rule provided that the first part of the test would be a stable period of compressor operation that includes no portions of the defrost cycle, such as precooling or recovery. See 77 FR at 3563 (Jan. 25, 2012) for a detailed explanation of the concepts of ''precooling'' and ''temperature recovery.'' However, DOE did not define the terms ''precooling'' and ''temperature recovery'', nor did it define what comprises a ''stable period of compressor operation.'' To address any potential issues that may arise from this gap, today's notice proposes definitions for each of these terms.

These definitions would also clarify two other proposed sections of the test procedures, should they be adopted. Today's notice proposes adopting test procedures for multiple compressor refrigeration products that use the same concepts of stable operation, precooling, and recovery that are important in describing the test procedure for products with long-time or variable defrost (see section III.C.2). That procedure would be added as part of Appendix A. In addition, this notice proposes to alter the manner in which to determine compartment temperatures in Appendices A and B for products with short-time defrost (automatic defrost that is neither long-time nor variable defrost). Determining compartment temperatures under today's proposal would invoke the concepts of precooling, recovery, and stable operation.

The proposed definitions are as follows:

''Precooling'' means operating a refrigeration system before initiation of a defrost cycle to reduce one or more compartment temperatures significantly (more than 0.5 °F) below its minimum during stable operation between defrosts.

''Recovery'' means operating a refrigeration system after the conclusion of a defrost cycle to reduce the temperature of one or more compartments to the temperature range that the compartment(s) exhibited during stable operation between defrosts.

''Stable operation'' means operation after steady-state conditions have been achieved but excluding any events associated with defrost cycles. During stable operation the rate of change of all compartment temperatures must not exceed 0.042 °F (0.023 °C) per hour. Such a calculation performed for compartment temperatures at any two times, or for any two complete cycles, during stable operation must meet this requirement.

(A) If compartment temperatures do not cycle, the relevant calculation shall be the difference between the temperatures at two points in time divided by the difference, in hours, between those points in time.

(B) If compartment temperatures cycle as a result of compressor cycling or other cycling operation of any system component (e.g., a damper, fan, or heater), the relevant calculation shall be the difference between compartment temperature averages evaluated for whole compressor cycles or complete temperature cycles divided by the difference, in hours, between either the starts, ends, or mid-times of the two cycles.

''Stable period of compressor operation'' is a period of stable operation of a refrigeration system that has a compressor.

The proposed definition for stable operation uses the same rate of temperature change specified in the current test procedures as the indication of steady-state conditions (see, for example, Appendix A, section 2.9).

DOE seeks comment on its proposal to add these definitions to Appendices A and B.

9. Elimination of Reporting of Product Height

Before 1997, DOE made no class distinctions by product size, and compact refrigerators were governed by the same standards as full-size refrigerators. In 1997, DOE issued a final rule that added new product classes for compact refrigerators, refrigerator-freezers, and freezers, which included products with a total volume of less than 7.75 cubic feet that are also 36 inches or less in height. 62 FR 23102, 23111 (Apr. 28, 1997). DOE explained in its July 1995 proposal that it was considering treating compact products separately from standard-sized products because compact products had fewer design options to help reduce their energy consumption. 60 FR 37388, 37396 (July 20, 1995). The July 1995 NOPR proposed a 36-inch height limit for compact class products and explained that this limit was established in recognition of the design constraints faced by manufacturers, particularly with respect to top and bottom panel insulation thicknesses. See 60 FR at 37397 (July 20, 1995).

However, the majority of compact products are not undercounter products that fall within these specified dimensions. To account for this situation, the September 2011 Energy Conservation Standard final rule (September 2011 Final Rule) eliminated the 36-inch height restriction in the definition for compact products, effectively expanding the ''compact'' definition to include products with a total volume less than 7.75 cubic feet and height exceeding 36 inches. 76 FR at 57538 (Sept. 15, 2014). As described in DOE guidance, the 36-inch height requirement still forms part of the classification of a product as ''compact'' until the new standards final rule is required for compliance in September 2014.[13] To confirm the proper classification of products as compact or standard size before the change in the definition takes effect, DOE has required reporting of product height in certification reports (see 10 CFR 429.14(b)(2)). However, such reporting will no longer be necessary after the new definition applies. Consequently, DOE proposes removing this remaining reporting requirement from 10 CFR 429.14(b)(2). DOE requests comments on this proposal.

[13] *http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/refr-frz_faq_2011-10-06.pdf.*

10. Measurement of Product Volume

The current DOE test procedures for refrigerators, refrigerator-freezers, and freezers in Appendices A1 and B1 require that the total refrigerated volume of these products be measured according to HRF–1–1979. In contrast, Appendices A and B require that volume be measured according to HRF–1–2008. In general, these referenced procedures describe the dimensions that must be measured, list volumes to include or deduct in the final calculation, and specify the appropriate rounding of the final calculated values. However, the procedures do not specify whether measurements may be based on design specifications or if physical measurement of the actual test unit is required. With respect to the latter approach, the procedures do not specify the types of instruments that would be appropriate or should be used for performing these measurements, leaving it to the test laboratory to determine the best means by which to conduct this portion of the test.

Since the January 2012 final rule was published, DOE has become aware that some manufacturers use computer programs to calculate these volumes based on computer-aided design (CAD) models of the product in lieu of physical measurements. While DOE understands that this practice may allow for more precise measurement of these products, especially where the measured volumes include irregular shapes and textured surfaces, and recognizes that neither the referenced AHAM test procedures nor the DOE test procedures specifically prohibit it, DOE has identified two potential issues involved with measuring volumes in this manner. First, the use of measurements based upon design models for the purposes of certification represents an assumption that the actual production units will be exactly consistent with the designs, which may not actually occur. Second, independent verification of the manufacturer's rated volume by a test laboratory that does not possess these models can be difficult, particularly when a product's interior volume includes irregularly shaped surfaces or volumes that cannot easily be measured by hand. Because permitted maximum annual energy use is a function of volume within a given product class, discrepancies between the volumes measured directly during lab testing and the volumes manufacturers calculate using CAD models could potentially, under the current regulations, affect whether a tested unit of a given basic model meets the applicable energy conservation standard.

In recognition of the practical difficulties associated with measuring the volumes of many products currently on the market, DOE is proposing to explicitly permit the use of CAD models for measuring and computing the volume of refrigerators, refrigerator-freezers, and freezers for the purposes of certifying compliance with the DOE energy conservation standards for these products. This proposal is intended to ensure that manufacturers are able to accurately measure the volumes of their products and that test laboratories are able to verify these.

In addition to a general provision that permits the use of CAD models for determining the volume for the purposes of certification, DOE would also require that manufacturers retain measurements derived using CAD as part of the test records that underlie certifications pursuant to 10 CFR 429.71. These provisions would include a requirement that the manufacturer make these records available to DOE upon request in the form of printed diagrams and/or spreadsheets that demonstrate the calculations of volume performed using the CAD model (rather than computer files that would require use of CAD software to read, such as .dwg files). For the purposes of volume verification, DOE would ensure that the volume measured by the test laboratory is within a prescribed tolerance of the total refrigerated volume certified by the manufacturer. DOE could also request documentation of the manufacturer's volume measurements as needed.

DOE would modify section 5.3 of Appendices A and B to incorporate the requirements allowing use of CAD for volume calculation.

In determining the appropriate tolerance for assessing the validity of volume ratings, DOE considered information from two primary sources. First, DOE considered the AHAM Refrigerator, Refrigerator-Freezer, and Freezer Verification Program Procedural Guide, which uses a 2 percent tolerance for verification of manufacturer volume ratings. To ensure that this threshold would be appropriate, DOE evaluated its own test data and compared volume measurements taken over the past three years for nearly 300 individual test units representing over 100 models. DOE found that, on average, manufacturers' reported adjusted volumes are slightly less than 0.5 percent larger than the adjusted volumes measured by the test laboratory and that less than 20 percent of units had an adjusted volume more than two percent larger than their certified adjusted volume. Among the tested units that exceeded the 2 percent threshold, more than 70 percent were beyond 3 percent and nearly one third were beyond 4 percent. There was also greater variation in the frequency of results above the 2 percent threshold compared with the units below the threshold, with the frequency of observations below 2 percent following a roughly normal distribution and the frequency of results above 2 percent appearing more erratic. Finally, DOE observed that the impact of a difference in reported adjusted volume of 2 percent resulted in an impact on the calculated energy conservation standard of only 0.5%, probably less than the impacts of other potential errors in measurement and data reporting. This all suggests that the 2 percent threshold is appropriate and that the vast majority of measurements should fall well within this margin.

Based upon this analysis, DOE is proposing to adopt requirements that are essentially the same as those used by AHAM for its verification program. Specifically, the test laboratory's measurement of volume must be no more than 2 percent smaller than the manufacturer's rated volume. If 2 percent of the rated volume is smaller than 0.5 cubic feet for standard-size products or 0.2 cubic feet for compact products, then a 0.5 (or 0.2) cubic feet tolerance would be used. For example, if a product's rated volume is 29.2 cubic feet, the 2 percent margin would be 0.6 cubic feet. Since this is larger than 0.5 cubic feet, the 2 percent margin would be used; therefore, under the proposed approach, the laboratory measurement would have to be at least 28.6 cubic feet for the rating to be considered valid. If DOE determines that the rated volume is not valid, the energy conservation standard applicable to the tested model would be calculated based upon the volume measured by the laboratory. DOE proposes to add a new section 429.134 of 10 CFR part 429 to address the volume verification protocol. DOE also proposes to amend the certification requirements in section 429.14 to require reporting of the total refrigerated volume of each compartment instead of the adjusted volume. This will enable direct comparisons between the certified volume of a basic model and independently measured volumes for the same model and will also harmonize the DOE reporting requirements for refrigerators, refrigerator-freezers, and freezers with those of the Federal Trade Commission.

As a related matter, DOE noted during its review of test data and manufacturer ratings of adjusted volume that some volumes may have been improperly reported or calculated. Specifically, in some cases it appeared that the adjusted volume may have been calculated based on a total refrigerated volume that was rounded to the nearest whole cubic foot rather than the nearest 0.1 cubic foot as required by section 4.2.3 of AHAM HRF–1–1979, which is referenced by the DOE test procedure. In the most extreme theoretical case, this error could result in the reporting of a total refrigerated volume that is larger by up to 0.5 cubic feet. For a product such as an upright freezer with automatic defrost (product class 9 in the DOE energy conservation standards), this would result in a difference in adjusted volume of 0.865 cubic feet, and a resultant increase in calculated energy conservation standard for that basic model of nearly 11 kWh/year. Such a margin could make the difference between a model meeting the standard or failing to do so. In any evaluation of a product's certified total refrigerated volume, DOE will consider all aspects of the volume calculation, including the rounding of the measured total volume that was used in the calculation to help determine whether a manufacturer derived its certified value of total refrigerated volume in conformity with the DOE test procedure.

DOE seeks comment on its proposal to add a provision permitting use of CAD for measurement of product volume to section 429.72 and procedures for verifying rated volumes to section 429.134, including the proposed tolerance range. DOE also requests information on the documentation kept by manufacturers of CAD modeling used for calculations of volume and whether this documentation is in or could be converted to a format that would allow review by DOE without use of CAD software.

11. Corrections to Temperature Setting Logic Tables

The December 16, 2010 Interim Final Rule established tables in Appendices A and B to illustrate the requirements for setting temperature controls during testing. 75 FR at 78840–78842. However, the tables were presented in the notice without the necessary horizontal lines to properly divide the different test result possibilities and next steps. The tables were then entered into the CFR with horizontal lines in locations that effectively confused the information that the tables were intended to present. DOE proposes to correct these errors and ensure that the tables in the CFR are corrected to properly show the sequence of temperature control settings required for testing.

12. Minimum Compressor Run-Time Between Defrosts for Variable Defrost Models

The DOE test procedures in Appendices A and B provide specific provisions for calculating the energy use of models with variable defrost, which DOE defines generally as an automatic defrost system in which successive defrost cycles are determined by an operating condition variable or variables other than solely compressor operating time. For such models, the periodicity of defrost cycles may vary based on factors other than the time since the last compressor cycle, such as ambient temperature and humidity, length and frequency of door openings, and other factors that may affect the formation of frost on the evaporator or provide an indication of how much frost may have accumulated. As noted in the definition, this differs from models with non-variable automatic defrost, which generally perform defrosts of the evaporator based solely on compressor operating time. The energy use of variable defrost products is measured using a two-part test which separately measures the energy use associated with defrost in the second part of the test.

To properly account for energy use associated with defrost, Appendices A and B both provide calculations specifically for models that have variable defrost. These calculations estimate the contribution to energy use based upon the values for the minimum compressor run-time between defrosts (CT_L) and the maximum compressor run time between defrosts (CT_M). Some models have control algorithms with specific values for CT_L and CT_M, which DOE requires manufacturers to report as part of their certifications of compliance. These values must be known in order to calculate the representative average value CT for compressor run time between defrosts, which is used to calculate defrost frequency and therefore also defrost contribution to energy use. In any subsequent verification or enforcement testing, DOE uses the values of CT_L and CT_M reported by the manufacturer. For models that are not programmed with fixed CT_L and CT_M values, tests must be conducted using default values of 6 and 96, respectively. For descriptions of these calculations, see sections 5.2.1.3 and 5.2.1.5 of Appendix A, and section 5.2.1.3 of Appendix B.

In general, use of the CT_L and CT_M values reported by the manufacturer rather than the default values should result in measurements of energy use that are more representative of the product's actual operation because they represent the actual minimum and maximum amounts of compressor run time between defrosts that the model's control system is designed to use. Thus, the compressor run time between defrosts should never be less than CT_L and never greater than CT_M. However, in certain DOE testing of models for which the manufacturer reported values of CT_L and CT_M in the certification report, DOE has found that the number of hours of compressor operation between defrost cycles observed in the test data was less than the CT_L value reported by the manufacturer in its certification report. This difference suggests either that the certified value was erroneous or that the model did not operate as designed. In either case, the energy use calculated using the values reported by the manufacturer would not be representative of how the model actually performed during the test and how it would be expected to perform in the field. To ensure that the energy use calculations will reflect the actual operation of the unit as tested, DOE is proposing to require the use of a value for CT_L for the energy use calculation that is equal to the shortest compressor run time between defrosts observed during the test, if this observed time is less than the value of CT_L reported in the certification report. If the model did not have values of CT_L and CT_M reported in the certification report, the observed value of CT_L would only be used if it is less than the default value of 6 hours. This change is proposed for sections 5.2.1.3 and 5.2.1.5 of Appendix A and section 5.2.1.3 of Appendix B.

13. Treatment of ''Connected'' Products

As part of the Version 5.0 ENERGY STAR Specification for Residential Refrigerators and Freezers, DOE is developing, in cooperation with the EPA, specifications and test methods for refrigerators and refrigerator-freezers that have the capability to enable consumer-authorized energy related commands, such as demand-response signals from a utility.[14] Products with this capability are referred to generally as ''connected'' products in the final draft ENERGY STAR specification and in the associated test method (ENERGY STAR Connected Refrigerators and Freezers Final Draft Test Method, No. 14). The draft test method addresses aspects of testing specific to the demand response functionality, but refers to the DOE test procedure in Appendix A to Subpart B of 10 CFR Part 430 for test setup and test conditions. However, the current Appendix A test procedure does not address the condition of the communication module of a connected product during the standard DOE energy test, which is used in section 6 of the demand response test to establish the baseline energy consumption and can be placed by the user in either an active communication mode or a non-communicating mode (ENERGY STAR Connected Refrigerators and Freezers Final Draft Test Method, No. 14, p. 3). DOE views this feature as subject to section 5.5.2.e of AHAM HRF–1–2008, incorporated by reference in Appendix A, which states that customer accessible features, not required for normal operation, which are electrically powered, manually initiated, and manually terminated, shall be set at their lowest energy usage positions when adjustment is provided. In keeping with this requirement, and to ensure that Appendix A provides sufficient clarity on the condition of the communication module of connected products during the DOE energy test, DOE is proposing to amend section 2 of the Appendix A test procedure to specify that the communication module, if integrated into the cabinet, must be energized but placed in the lowest energy use position, and there shall be no active communication during testing. DOE understands that some products will be manufactured without an integrated communication module, and instead will have the capability to allow connection of a module supplied by another manufacturer. In these cases, DOE cannot specify a test condition for the communication module since the module used for the test will not be standardized. Thus, the proposed requirement in section 2 of the test procedure does not require connection of communication modules for products designed for use of an externally-connected module. Finally, while the ENERGY STAR specification for connected products addresses only refrigerators and refrigerator-freezers, DOE is also proposing to add the same provisions to Appendix B to accommodate any future provisions made for connected freezers.

[14] For additional background on the ENERGY STAR Version 5.0 Specification for Residential Refrigerators and Freezers, go to *https://energystar.gov/products/specs/node/125.*

14. Changes to Confidentiality of Certification Data

Section 429.14(b) specifies the data that manufacturers of residential refrigerators, refrigerator-freezers, and freezers must provide to DOE in certifications of compliance for each basic model. Data submitted for the items in paragraph (b)(2) are treated by DOE as public data whereas the data for items in paragraph (b)(3) are evaluated on a case-by-case basis. The items listed in paragraph (b)(3) include specific information related to variable defrost control, variable anti-sweat heater control, and the use of alternate temperature sensor locations. For models with variable defrost and variable anti-sweat heaters, this includes not only the specific operational details of those features, but whether the model has those features at all. Since the publishing of the current version of section 429.14, DOE has determined that there is no clear reason that the indications as to whether a model has variable defrost or variable anti-sweat heater control or the use of alternate temperature sensor locations should be treated as non-public and proposes to move them to paragraph (b)(2), which would make them public data. The other details of variable defrost operation and variable anti-sweat heater control would remain in paragraph (b)(3). These changes would take effect 30 days after publication of the final rule.

15. Package Loading

Section 2.2 of the DOE test procedure for residential freezers, which is located in appendix B1 to subpart B of 10 CFR part 430 (Appendix B1), references the AHAM HRF–1–1979 test procedure for provisions related to certain operational conditions. Among these is a specific provision described in section 7.4.3.3 of AHAM HRF–1–1979, which requires that the freezer compartment be loaded to 75% of the maximum number of filled packages that can be fitted into the compartment, and that the 75% load is to be fitted into the compartment as to permit air circulation around and above the load. The requirements applicable to these products in appendix B to subpart B of 10 CFR part 430 (Appendix B) and the section it references in AHAM HRF–1–2008 procedure (section 5.5.5.3), are essentially identical except that package loading is required only for manual defrost freezers whereas it is required by HRF–1–1979 for all freezer types.

DOE has learned that there may be ambiguity about how to consistently determine the actual number of packages that fulfills the 75% loading requirement for a given basic model. To clarify, DOE views the appropriate method of accomplishing this requirement as consisting of two steps. The first step is to determine the number of packages that represents 75% of the maximum capacity of the freezer compartment, and the second step is to arrange the 75% load such that the air gap of 0.5 to 1.5 inches between the load and the compartment wall and the pyramid or tiered form needed for placement of the thermocouples are both established, as required by section 7.4.3.3 of the AHAM HRF–1–1979 procedure (or section 5.5.5.3 of AHAM HRF–1–2008).

For determining the number of packages that represents 75% of the load, the compartment should be filled completely with the packages that are to be used for the test, such that the packages fill as much of the usable refrigerated space within the compartment as is physically possible. Once this has been accomplished, a number of packages is removed from the compartment so that the compartment contains 75% of the packages that were placed in the compartment to completely fill it. The remaining packages would then be arranged as necessary in order to achieve the necessary air gap and the tiered or pyramid form needed for thermocouple placement.

To ensure that this practice is used consistently, DOE proposes to place a description of this practice in section 2.9 of Appendix B. The proposed text also specifies that the number of packages representing the completely filled condition and the number left in the compartment for the test should both be recorded in the test data, and maintained as part of the test record in accordance with 10 CFR 429.71. Because section 5.5.5.3 of HRF–1–2008 also applies these requirements to each shelf of a multi-shelf freezer, the requirement to count and record the number of packages would apply on a per-shelf basis for such products.

DOE requests comment on these clarifications and proposed amendments to Appendix B.

16. Product Clearance to the Wall During Testing

In the December 16, 2010 interim final rule, which established Appendices A and B, DOE included provisions to address product clearances to the wall during testing. 75 FR 78810. Specifically, section 2.8 of Appendix A and section 2.6 of Appendix B both require that the space between the plane of the cabinet's back panel and the vertical surface behind the cabinet (i.e., the test chamber wall or simulated wall) be the minimum distance in accordance with the manufacturer's instructions or 2 inches, whichever is less. If the product has permanent rear spacers that extend beyond this distance, the product is to be located with the spacers in contact with the vertical surface. However, DOE received a request for guidance from AHAM dated May 22, 2013 (AHAM Guidance Request) indicating that these provisions may not be sufficiently clear for cases in which the back of the test unit is not all on one plane due to protrusions or surface irregularities rather than a uniformly flat panel. (AHAM Guidance Request, No. 15, p. 2). AHAM requested that DOE clarify these sections by referencing the Committee Draft for Vote (CDV) version of Part 1 of IEC 62552.2 *Household refrigerating appliances—Characteristics and test methods.* As explained by AHAM, this reference provides guidance on product spacing that is consistent with section 2.8, but is more specific regarding the treatment of irregular surfaces.

Because the IEC reference that AHAM suggested has not been finalized as of the date of this notice, and because DOE generally seeks to limit the number of external references incorporated in the DOE test procedure, DOE declines to incorporate by reference the IEC procedure suggested by AHAM. However, since clarification of this item may result in more consistent application of the DOE test procedure, DOE proposes to adopt revised language for section 2.8 that is intended to accomplish the same objective. Specifically, DOE proposes to specify that, for the purposes of determining the appropriate clearance to the wall for the test, the rear plane of the cabinet is the largest flat surface at the rear of the cabinet. The test procedure would also indicate where individual features, such as brackets, the compressor, or the condenser protrude from the rear plane, that these could not to be used as the basis for determining the rear clearance. To account for products that are required by the manufacturer's instructions to be set up with the front of the unit slightly higher off the floor than the rear, such that the top of the cabinet is closer to the wall behind the cabinet than the bottom, the proposed language specifies that the reference point for the maximum 2 inch clearance is lowest part of the rear plane of the cabinet. The proposed language also permits the top of the cabinet to touch the vertical surface if necessary to meet the clearance requirement at the bottom, and for the clearance requirement to be exceeded if the bottom edge is still more than 2 inches from the vertical surface when the top edge is in contact with the vertical surface. Similarly, the proposed language is consistent with the existing Appendix A test procedure, which allows for the 2-inch clearance requirement to be exceeded if individual features extend more than 2 inches beyond the rear plane, provided these features are in contact with the vertical surface during the test. DOE proposes to incorporate this language in section 2.8 of Appendix A and section 2.6 of Appendix B, and requests comment on these proposed additions.

17. Other Minor Corrections

In reviewing the text of Appendix A, DOE observed that the version adopted in the January 25, 2012 final rule contained a minor error in section 6. Calculation of Derived Results From Test Measurements. Section 6.2.2.2, which provides the method for calculating average per-cycle energy use (''E'') for refrigerators and refrigerator-freezers through interpolation based on compartment temperatures, states that ''E'' is defined in section 6.2.1.1.'' Section 6.2.1.1, however, does not define the term ''E'' and contains only a formula for E = ET1 + IET, which does not clarify the meaning in section 6.2.2.2. Since the term ''E'' itself has the same basic meaning for all portions of section 6.2, DOE proposes to place the definition of this term in the introductory text of section 6.2 and modify the text in the follow-on sections so that it is referred to consistently. For consistency, DOE has proposed nearly identical changes for Appendix B.

DOE has also noted that a certain aspect of the definition of ''compact refrigerator/refrigerator-freezer/freezer'' in 10 CFR 430.2, which distinguishes the product classes in section 430.32(a) for compact products from the classes for standard-size products, could potentially cause confusion. Specifically, the definition limits the applicability of the compact product classes to products smaller than 7.75 cubic feet in volume. The volume referred to in the definition is the total refrigerated volume measured as specified in section 5.3 of Appendices A, A1, B, and B1. However, the definition uses the term ''rated volume,'' which is not defined or listed elsewhere in DOE's test procedures or reporting requirements for these products, and could potentially be confused with the ''adjusted volume,'' which is a different measurement. To prevent confusion regarding the applicability of this definition, and to ensure standard terminology is used throughout DOE's regulations, DOE proposes to amend the definition of ''compact refrigerator/refrigerator-freezer/freezer'' in 10 CFR 430.2 to specifically indicate that the definition applies based upon the product's total refrigerated volume.

Also, in its guidance request to DOE dated May 22, 2013, referred to previously in section III.C.15, AHAM raised additional issues. One of these was about a portion of the existing definition of ''Defrost cycle type'' found in section 1.9 of Appendix A. Specifically, AHAM referred to the last sentence of the definition, which states that ''. . . defrost achieved regularly during the compressor off-cycles by warming the evaporator without active heat addition is not a defrost cycle type,'' and indicated that this sentence may be causing confusion by implying that this type of defrost, which is commonly referred to as ''off-cycle defrost'' does not constitute automatic defrost. (AHAM Guidance Request, No. 15, p. 2) DOE inserted the clause regarding off-cycle defrost as part of the December 2010 Interim Final Rule in response to AHAM's concern that off-cycle defrost should not be considered a defrost cycle type. 75 FR at 78838 (Dec. 16, 2010). However, as pointed out by AHAM in its recent comments, this does not imply that off-cycle defrost is not a form of automatic defrost. DOE agrees and made its position on this topic public as part of the preliminary analysis for the energy conservation standard rulemaking that ended September 15, 2011. (Energy Conservation Standards for Residential Refrigerators, Refrigerator-Freezers, and Freezers, 2009–12–10 Public Meeting Presentation Slides, Docket No. EERE–2008–BT–STD–0012, No. 28 at p. 21) However, DOE understands AHAM's concerns that the definition of defrost cycle types may be misinterpreted. The clause in question was intended to distinguish off-cycle defrosts from the unique types of defrost cycles that involve a defrost heater, which must be identified individually to establish test periods as required by section 4.2 of the test procedure. To clarify this intent, DOE has proposed a revision to the definition of ''defrost cycle type'' in section 1.9 of Appendix A.

Finally, another issue raised in AHAM's May 22, 2013 guidance request addressed test periods for products with automatic defrost that is neither long-time nor variable. (AHAM Guidance Request, No. 15, p. 3) Section III.C.5 addresses this issue.

18. Relocation of Shelving for Temperature Sensors

HRF–1–2008, section 5.5.4, which is incorporated into the DOE test procedures by reference, requires at least one inch of air space separating the thermal mass of a temperature sensor from contact with any surface. In the case of interference with hardware at the specified sensor locations, section 5.5.4 requires that the temperature sensors be placed at the nearest locations such that there will be a one inch air space separating the sensor mass from the hardware. In the case of proximity of the sensor to shelving or other components whose position is adjustable by the consumer, DOE believes that it is more appropriate to relocate the shelf or component than to relocate the sensor. However, HRF–1–2008 section 5.5.2(a) requires that shelves and bins be evenly spaced throughout the compartment. DOE proposes to revise the test procedures to indicate that temperature sensor location would take precedence over the position of shelving and components whose position is adjustable by consumers, even if this means that the shelving closest to the temperature sensors would not be in their evenly spaced locations. Specifically, DOE proposes to add language to Appendices A and B, section 5.1 indicating that consumer-movable shelves and other components should be moved to maintain temperature sensor clearance requirements. While DOE intends that this action would take precedence over the even-spacing requirement, to minimize variation in such repositioning DOE also proposes to specify that any placement adhere as closely as practicable to the setup instructions of section 5.5.2 of HRF–1–2008 (including the requirement that shelves and door bins be evenly spaced). For example, if shelves are repositioned from the exactly evenly spaced positions to accommodate temperature sensors, they should still be spaced as nearly evenly as possible while meeting the required minimum 1-inch separation between the temperature sensor thermal mass and the shelf. DOE requests comments on this proposal.

D. Other Matters Related to the Test Procedure

1. Built-In Refrigerators

In the course of evaluating the proposed amendments to the DOE test procedures for residential refrigerators, refrigerator-freezers, and freezers, DOE tested several current models of these products. Included were three ''built-in refrigerator/refrigerator-freezer/freezer'' models, as defined in 10 CFR 430.2. That provision generally applies to products that (1) Have unfinished sides that are not intended to be viewable after installation, (2) are designed exclusively to be installed totally encased by cabinetry, fastened to the adjoining cabinetry, walls, or floor, and (3) are either equipped with a factory-finished face or accept a custom front panel.

While the tests that DOE conducted on these models were generally associated with evaluating the proposed amendments discussed in this notice, DOE also conducted testing to evaluate any additional impact on measured energy use that may result from being tested in a built-in condition in the test laboratory. DOE performed these tests by enclosing the models in simulated cabinetry and conducting a round of tests using Appendix A, and then compared the results from this round of tests to the results of tests conducted using Appendix A with the products in a freestanding condition. DOE conducted these tests to address questions that DOE received from testing organizations regarding the proper test conditions for products of this type under the DOE test procedure and to ensure that the DOE test procedures prescribed as a result of this rulemaking will result in measures of energy consumption that are representative of average use, as required under 42 U.S.C. 6293(b)(3). Because these products are, by definition, designed to operate when enclosed by cabinetry, DOE tentatively views the built-in condition during testing as more accurately representing the average use condition of these products than testing these products in a free-standing condition.

DOE expects that many manufacturers and testing organizations are unlikely to test these products in a built-in condition in the laboratory, however, and that in some cases it may not be necessary. DOE believes this to be the case generally because some models of this type use a refrigeration system that, because of the way they reject heat from the refrigeration system, are designed to consume little or no additional energy as a result of being installed in cabinetry, meaning that the difference in measured energy use would essentially be zero. The heat rejection from the condenser of the refrigeration system of these units is achieved by drawing air in from the front of the product and blowing the air back out the front, after the air is warmed by the condenser and the compressor. Enclosing such a product in cabinetry adds no restriction to the air flow path—hence, there should be no significant impact on energy use (see, for example, the test results for Samples No. 1 and 3 shown in Table III–13).

However, there are competing designs in which the flow of air used to remove refrigeration system heat can be restricted when the refrigeration product is built into cabinetry. As a result, these products could, in DOE's tentative view, consume more energy when tested in a built-in condition than in a free-standing one.

DOE conducted tests on a model of each type of design, and the results were consistent with the expectations noted above. More specifically, two models demonstrated essentially no change in measured energy use, and the other model demonstrated an increase in measured energy use of approximately 5 percent when tested in a built-in condition. Table III–13 summarizes available DOE data for refrigerator-freezer samples tested in a freestanding configuration and a built-in configuration according to UL 250 sections 8.65 and 11.2. Samples 1 and 3 reject heat through the front and the test results show change in energy use of 0.5% or less, for the built-in test, which very likely represents test variation rather than the impact of testing in the built-in configuration. Sample 2 rejects heat through the back of the unit and has a significant increase in energy consumption for the built-in test.

TABLE III–13—FREESTANDING AND BUILT-IN AEU COMPARISON

Sample No.	Heat rejection location	Freestanding annual energy consumption (kWh/year)	Built-in annual energy consumption (kWh/year)	Percent difference between freestanding and built-in tests (%)
1	Front	679	675	−0.5
2	Rear	576	607	5.1
3	Front	485	487	0.4

While testing products in a built-in condition would theoretically yield the most accurate results, there may be added costs. Assuming that built-in manufacturers do not already have the facilities and testing set-up to test their products in a built-in condition, the primary added cost in this instance stems from the added time and material required for technicians to set up a built-in unit to be tested in a configuration comparable to the manner in which it would be installed in the field. That additional requirement could be significant but it may also represent a first-time-only cost if manufacturers were able to continue using the same built-in configuration set-up for all subsequent built-in products that would need to be tested.

In order to ensure that DOE has considered all relevant aspects of this matter prior to proposing a specific requirement in the test procedure for these products to be tested in a built-in condition, DOE is requesting more information from manufacturers, testing organizations, and any other interested parties on several aspects of this element of the test. Specifically, DOE is interested in receiving information about whether testing in a built-in condition would generally be more representative of energy consumption in average use and, if so, the extent to which testing in this condition would be expected to affect the measured energy use of these products. DOE is also interested in receiving information about the amount of additional test burden, if any, that would be imposed as result of a specific requirement for all manufacturers of these products to test them in a built-in condition in order to determine their rated value of energy consumption for the purpose of assessing compliance with the energy conservation standards in 10 CFR 430.32.

2. Specific Volume Measurement Issues

As part of the same May 22, 2013 guidance request referred to previously in this notice, AHAM requested clarification of certain provisions of DOE's prescribed method for measuring product interior volume in section 5.3 of Appendices A and B, which both reference AHAM/ANSI HRF–1–2008. Section 4.2.2 of the HRF–1–2008 procedure lists several components that are required to be deducted from the measured interior volume, among which is ''the volume of air ducts required for proper cooling and operation of the unit.'' AHAM requested guidance on DOE's interpretation as to whether this particular provision includes only air ducts that supply cold air to the fresh food and freezer compartments, or to all air ducts within the unit (AHAM Guidance Request, No. 15, p. 2). The guidance request did not include specific examples of ducts other than those which supply air to the fresh food and freezer compartments, which are both clearly required for proper cooling and operation of the unit. DOE is aware also of air ducts used to cool icemaking compartments—such ducts would also be required for proper operation of any refrigeration product that is equipped with an automatic icemaker, or any kitable product with an icemaking compartment that could have an automatic icemaker installed after shipment. DOE is not aware of any other specific examples. However, since the volume measurement method generally excludes volumes occupied by components that are not intended to be removed by the user and that occupy space that cannot be used for storage, which are both likely to apply to an air duct, DOE takes the view that any air duct in the interior of the cabinet should be deducted from the measured product volume.

In a separate communication from a manufacturer, DOE received a question as to whether a water tank within the fresh food space should be included in the measured volume as measured using HRF–1–2008. The tank in question is used for chilling water prior to use in the product's water dispenser and is located downstream of the valve that admits water into the cabinet from the household water supply. DOE notes that such features were addressed in sections 4.2.1.1(a) and 6.2.1 of HRF–1–1979, which treated ''water coolers'' as special features and required that they be included in the measured volume. The text of section 4.2.2 of HRF–1–2008, which addresses the determination of volume, is more general than the provisions in HRF–1–1979 and does not specifically address features such as water coolers. Section 4.2.2 of HRF–1–2008 did add a clarification that through-the-door ice and water dispensers and the insulating hump are not included in the volume and that generally no part of the dispenser unit shall be included as volume. DOE understands this to mean that if the water cooler unit is integral to the dispenser, and thus a part of the dispenser unit, it would be deducted from the volume. However, if the water cooler is separate from the dispenser unit and located within the refrigerated space, it would be included in the volume measurement.

To limit the potential for future confusion regarding components such as those discussed in the preceding paragraphs, DOE proposes to amend section 5.3 of Appendices A and B to clarify the general intent of the volume measurement procedure and the treatment of general categories of components. Specifically, the proposed amendment to section 5.3 would state that the measured volume is to include all spaces within the refrigerated volume of each compartment, with the exception of the volumes that are required to be deducted in accordance with section 4.2.2 of HRF–1–2008. As discussed in section III.C.1 of this notice, DOE has also proposed a definition for ''through-the-door ice and water dispenser'' for inclusion in Appendices A and B. With this definition, and the proposed clarification in section 5.3 regarding the general volume to be measured, DOE intends to remove any ambiguity regarding the components to be deducted from the volume and the boundaries between these components and the measured refrigerated volume.

DOE requests comment on these interpretations and the proposed modifications to section 5.3 of the test procedures in Appendices A and B addressing volume measurement.

3. Treatment of Products That Are Operable as a Refrigerator or Freezer

Since completion of the last test procedure rulemaking, DOE has received questions regarding the appropriate test setting for products with a single compartment that can be operated in either the temperature range for an electric refrigerator or the temperature range for a freezer, as defined in 10 CFR 430.2. DOE notes that section 2.7 of Appendix A1 and Section 2.7 of Appendix A both require compartments that are convertible (e.g., from fresh food to freezer) to be operated in the highest energy use position. In the case of a product for which the convertible compartment is the only compartment (i.e., the entire product is convertible), the product effectively meets the definitions of two different covered products. If the product is marketed as both an electric refrigerator and as a freezer, the product must be tested as both covered products, must meet both applicable standards, and must be certified as meeting both standards.

If, however, the product is marketed only as a refrigerator or only as a freezer, the product must be tested in accordance with the applicable test procedure, must meet the appropriate standard for that product, and must be certified accordingly.

4. Stabilization Period

AHAM's May 22, 2013 guidance request asked whether the stabilization period (see section 2.9 of Appendix A1 for an example) has a maximum time constraint. (AHAM Guidance Request, No. 15, p. 4) The stabilization period for products with cycling compressors consists of two time periods of at least two hours duration comprising a whole number of compressor cycles, and the time interval between these two periods, where there is an elapsed time of at least three hours between the two time periods. Specifically, AHAM asked whether the two time periods in question have a maximum duration or if they must be selected to be as short as possible while still satisfying the requirements. (Id.) Neither of these requirements is explicitly stated in the test procedure, and neither is implied. The two time periods in question may be extended, for example, if there is irregular cycling of the compressor that makes the first possible selection of such a time period non-representative of the average compartment temperatures for the captured time period. However, it would not be consistent with the test procedure to select two sets of time periods that would allow stability to appear to have been achieved when it has not. Alternative selections of time periods that satisfy the test procedure requirements should also demonstrate that stability has been achieved. DOE does not believe that changes to the test procedure regulatory language are required as clarification for this issue.

E. Compliance With Other EPCA Requirements

In addition to the issues discussed above, DOE examined its other obligations under EPCA in developing the amendments in today's notice. These requirements are addressed in greater detail below.

1. Test Burden

EPCA requires that the test procedures DOE prescribes or amends be reasonably designed to produce test results which measure the energy efficiency, energy use, or estimated annual operating cost of a covered product during a representative average use cycle or period of use. These procedures must also not be unduly burdensome to conduct. *See* 42 U.S.C. 6293(b)(3). DOE has concluded that the amendments proposed in today's notice satisfy this requirement.

Some of the proposed test procedure amendments would clarify how the test should be conducted, or otherwise represent minor changes to the test that do not affect the equipment required for testing, nor the time required to conduct it. These proposed amendments include changes to the anti-circumvention language and ambient temperature gradient requirements, and clarifications to help with setting mechanical temperature controls.

The proposal would also make other changes, none of which would have a significant impact on burden. First, the proposed change in the test procedure for incomplete cycling products could increase or decrease test time, as illustrated in section III.C.5. However, based on tests conducted by DOE, the impact on test time for the proposed amendment does not appear significant. Second, the proposed change to the test procedure to allow use of the triangulation approach for products with two temperature controls would create an optional test and not affect test burden.

Additionally, the proposed modification of test procedures for products with multiple compressors is expected to reduce overall test burdens for manufacturers. This expectation is consistent with information DOE received in written comments such as those from Sub-Zero, which cited the test burden of the current test procedure as an issue in its comments as part of the recent refrigerator test procedure rulemaking. (Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket No. EERE–2009–BT–TP–0003, Sub-Zero, No. 42 at p. 1)

Regarding the proposed changes to the requirements for ambient temperature measurement and ambient temperature gradients, these changes would also not increase the burden faced by manufacturers since they would not impose an additional recurring test requirement. The proposed amendments to the anti-circumvention language, the specifications for setting mechanical temperature controls, and the adoption of new definitions associated with defrost cycles would clarify the test procedures but not add any new requirements that would increase test burden. To the extent that there is any burden, the proposed elimination of the current product height reporting requirement would, in DOE's view, reduce overall burdens on manufacturers.

After reviewing each of the changes under consideration, DOE believes that the icemaking test procedure under consideration would be the only change detailed in this notice that would be likely to increase test burden. That procedure would involve additional measurements and set up requirements not included in the current test procedure. Specifically, it would require the installation of a water supply; the measurement of several additional parameters, including ice weight and water pressure; additional test time; and (for products with icemakers that have no harvest heaters) the monitoring of icemaker mold temperature, water supply temperature, or solenoid valve activity in addition to the measurements already required for the DOE refrigeration product test procedures.

Providing the required water supply to a test facility will likely require some investment. Assuming that the building housing the test facility has water available, the cost of extending this supply to the test facility will require some length of ½-inch outer-diameter copper tubing, possibly with insulation to prevent water vapor condensation, and a pressure gauge to confirm that the supply pressure is within the required range specified by the procedure under consideration. Such a water supply system may also require a pressure regulating valve to reduce the supply pressure to the required range if the water supply pressure in the test facility exceeds the pressure required by the test procedure. Assuming $100 for materials and one day for installation at a $75 per hour loaded labor rate, the water supply system cost would be roughly $700 per test chamber. The cost of a scale to weigh ice and the other additional items (temperature sensors, etc.) required for conducting the icemaking test are not expected to exceed $100. The resulting overall test facility cost increase of $800 is insignificant compared to the overall anticipated cost of a test facility suitable for testing refrigeration products.

The additional set-up time for connecting the water supply to the product and, if necessary, a temperature sensor to the icemaking mold, may represent an additional half hour of time. The more significant impact on test burden of the icemaking test would be the additional time required to conduct the test. The product would first have to stabilize at the temperature settings used for the icemaking baseline test. During this first phase of the test, there may be some readjustment of the settings required to assure that compartment temperatures are within the specified tolerance limits of the standardized temperatures. DOE estimates that the stabilization, readjustment, and baseline test duration will typically be 24 hours. The proposed test procedure would require that the duration of the icemaking portion of the test be 24 hours, unless interrupted by defrost or termination of icemaking because the ice storage bin fills. Hence, DOE expects that the icemaking test will typically add two days of test time. While this is not an insignificant addition to the time required to test a refrigeration product, DOE believes it is warranted in light of the complexity associated with making a measurement of icemaking energy use.

DOE welcomes any comment regarding DOE's stance on test burden impacts of the potential amendments discussed in this notice.

2. Changes in Measured Energy Use

When DOE modifies test procedures, it must determine to what extent, if any, the new test procedure would alter the measured energy use of covered products. (42 U.S.C 6293(e)(1)). For the reasons described below, DOE has tentatively determined that the projected impact on measured energy use of covered products would not be significantly altered by any of the proposed test procedure amendments.

The test procedure amendments proposed in this notice would, if adopted, primarily affect aspects related to testing after September 15, 2014, when the new energy conservation standards take effect. Table III–1 indicates which parts of DOE's test procedures would be affected by the proposed amendments. The discussion in this section focuses on the potential impact on energy measurements regarding other aspects of DOE's proposal that would be required starting in 2014 (Appendices A and B).

Impact of Proposed Changes To Testing Using Appendices A and B

Many of the proposed changes to Appendices A and B would clarify how the test should be conducted, or otherwise represent minor changes to the test or reporting requirements that would not affect measured energy use. These proposed amendments include changes to the anti-circumvention language, clarifications for setting mechanical temperature controls, modified ambient temperature gradient requirements, new definitions to help clarify test requirements, elimination of the requirement to report product height, use of CAD models for measuring refrigerated volume, and corrections to the temperature setting logic tables.

The proposed change that would modify the test period of those products that experience incomplete cycling could increase or decrease measured energy use for a small minority of products and only to a minimal extent. To DOE's knowledge, the only products that exhibit incomplete cycling are chest freezers. As described in section III.5, the energy use measured for such products could increase or decrease, depending on how test laboratories currently interpret the requirements for the test period for such products, but the measured energy use would be more likely to decrease. For these reasons, DOE does not believe an adjustment of the energy conservation standard is necessary for this test procedure change.

The proposed modification to address products with multiple compressors is not expected to alter the measured energy use for these products. The test procedure is functionally equivalent to the test procedure of the Sub-Zero waiver, differing primarily in the requirements for confirming that the unit has reached steady state and in the length and composition of test periods. It also provides guidelines for testing multiple-compressor units that may differ in design details from the Sub-Zero products identified in the waiver, such as multiple compressor products with non-cycling compressors, and it provides more flexibility in how to define test periods. None of these changes would be likely to affect the measured use of any products currently known to DOE.

As described in section III.3, the triangulation test method may, in certain cases, provide a slightly more accurate measurement of the actual energy consumption of a given product. This method would yield lower energy use measurements for some products as compared with the two-test method of the current DOE test procedures (see Appendix A1, section 3.1.2). However, the proposed alternative test would be optional. DOE believes that the majority of products would continue to be tested using the current two-test method, since the test time required for the triangulation approach would be roughly 50 percent greater. Further, DOE testing showed that the products for which the energy use measurement would be most likely to change, i.e., those products for which the two interpolations of the current test procedures (based on the freezer temperature for one calculation and the fresh food temperature for the other), would yield, at most, a 1.2 percent decrease in measured energy usage when using the triangulation method. Therefore, DOE tentatively concludes that the overall impact of this optional test on energy use measurement will likely be insignificant and that it would not require any change to the relevant standards.

In addition to the amendments discussed above for Appendices A and B, DOE is considering adopting a laboratory-based test procedure to measure the energy use associated with automatic icemaking. DOE conducted testing to validate the feasibility of the proposed icemaking test procedure and to evaluate if icemaking energy measurements using the procedure detailed above differ significantly from the 84 kWh/year fixed value used for automatic icemakers in the current test procedures. The test data and discussion of the results are presented in section III.1. Measured icemaker energy consumption values in the sample of products that DOE and NIST tested ranged from 60 kWh/year to 126 kWh/year, with an average of 92 kWh. While it is unclear precisely how well the group of products DOE tested represents any given set of products equipped with automatic icemakers, DOE believes that the average icemaking energy use of the group is sufficiently close to the fixed value of the current test procedure as to demonstrate that the test method proposed in today's notice is likely to have a minimal impact on the measured energy use of the products that would be evaluated using this method. Hence, DOE tentatively concludes that this potential impact would be de minimus and, if adopted, would not require a change to the energy conservation standard. (See 42 U.S.C 6293(e)(1–2)) DOE seeks additional input from the public regarding the accuracy of this assessment.

However, because the DOE test procedure for measurement of icemaking energy use has not yet been finalized, DOE expects that manufacturers will require additional time after the test method is finalized to conduct testing of their products and assess their ability to comply with a measurement-based standard. In anticipation of such factors, the joint petition submitted to DOE during the energy conservation standards rulemaking had requested that any measurement-based standard for icemaking energy use take effect three years after publication of the final rule establishing such a standard (see Docket EERE–2008–BT–STD–0012, No. 49, p. 17). The schedule laid out in the joint petition would have resulted in a final rule establishing a measurement-based standard for icemaking energy use in mid-2013 with a compliance date in mid-2016. Although the standards and test procedure final rules did not commit to a specific timeline for implementing a standard based on a test requiring laboratory measurement of icemaking energy use, DOE acknowledges that development of this test has required additional time to ensure that any potential issues have been sufficiently addressed.

In addition, because EPCA requires that, not later than 6 years after publication of a final rule establishing new or amended standards for a covered product, DOE must publish either a notice of proposed rulemaking with new proposed standards or a notice of determination that such standards do not need to be amended, DOE expects to commence an energy conservation standards rulemaking for residential refrigerators, refrigerator-freezers, and freezers that would result in publication of such a notice by late 2017. 42 U.S.C. 6295(m)(1). Because of the expected overlap between this future energy conservation standards rulemaking and the potential compliance delay period for the icemaking energy standard if an adjustment proved to be necessary, along with the potential difficulties that a short transition period to 2014 could impose if an icemaking test were required by September 15, 2014, DOE has tentatively concluded that adoption of an energy conservation standard for icemaking energy use would more appropriately occur as part of this future rulemaking. DOE would also link the required use of a new test procedure that includes an icemaking energy use measurement test with any new standards rulemaking. By following this approach, DOE believes that there will be more than sufficient time to address any remaining technical issues and for manufacturer compliance once those dates are set. Thus, until the compliance date of any such standard, the 84 kWh per year placeholder value would remain in effect for both the test procedure and the energy conservation standards.

Depending upon the comments DOE receives on this proposed approach, DOE may also consider alternatives. DOE invites commenters to offer other alternatives to help ensure both the maximum amount of energy savings along with ensuring that the test procedures that are ultimately adopted will sufficiently address icemaking energy use.

DOE also requests comments on its assessment of the impacts on energy use measurements of the proposed test procedure amendments. DOE further requests comments to support any potentially claimed change in the measured energy use, including data, if any, that would weigh in favor of adjusting the standards set to take effect on September 15, 2014, for products with automatic icemakers. DOE further requests comment on whether the fixed placeholder value for the icemaking energy use should be retained, rather than adopting a laboratory measurement, and whether to consider adopting a measurement-based standard to occur as part of a future energy conservation standards rulemaking for refrigerators, refrigerator-freezers, and freezers.

3. Standby and Off Mode Energy Use

EPCA directs DOE to amend test procedures to include standby mode and off mode energy consumption, and requires that this energy consumption be integrated into the overall energy consumption descriptor for the product, unless DOE determines that the current test procedures for the product already fully account for and incorporate the standby and off mode energy consumption of the covered product. (42 U.S.C. 6295(gg)(2)(A)(i)). The DOE test procedures for refrigeration products involve measuring the energy use of these products during extended time periods that include periods when the compressor and other key components are cycled off. All of the energy these products use during the ''off cycles'' is already included in the measurements. A given refrigeration product being tested could include auxiliary features that draw power in a standby or off mode. In such instances, HRF–1–1979 and HRF–1–2008, both of which are incorporated in relevant part into DOE's test procedure, generally instruct manufacturers to set certain auxiliary features to the lowest power position during testing. In this lowest power position, any standby or off mode energy use of such auxiliary features would be included in the energy measurement. Hence, no separate changes are needed to account for standby and off mode energy consumption, since the current (and as proposed) procedures address these modes. DOE requests comments on this determination.

IV. Procedural Requirements

A. Review Under Executive Order 12866

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

B. Review Under the Regulatory Flexibility Act

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

DOE reviewed the test procedures in today's proposed rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. This proposed rule would prescribe test procedures to test compliance with energy conservation standards for the products that are the subject of this rulemaking.

Specifically, DOE proposes to make changes and additions to the existing test procedure for refrigerators, refrigerator-freezers, and freezers. Changes to the existing rule as described above have potential impacts on manufacturers who will be required to revise their current testing procedures for compliance. As described in section 1, DOE believes the implementation of an icemaking test procedure is the only test procedure amendment proposed in today's notice that would represent an increase in test burden.

The Small Business Administration (SBA) considers an entity to be a small business if, together with its affiliates, it employs less than a threshold number of workers specified in 13 CFR part 121, which relies on size standards and codes established by the North American Industry Classification System (NAICS). The threshold number for NAICS code 335222, which applies to Household Refrigerator and Home Freezer Manufacturing, is 1,000 employees.

DOE conducted a market survey to determine whether any manufacturers of products covered by this rulemaking were small businesses. During its market survey, DOE used all available public information to create a list of companies that manufacture refrigerators, refrigerator-freezers, or freezers covered by this rulemaking. DOE reviewed these data to determine whether the entities met the SBA's definition of a small business manufacturer of refrigerators, refrigerator-freezers, or freezers and screened out companies that do not offer products covered by this rulemaking, do not meet the definition of a ''small business,'' or are foreign owned and operated. DOE identified three small businesses that manufacture refrigeration products.

DOE then determined the expected impacts of the rule on affected small businesses and whether an IRFA was needed (*i.e.,* whether DOE could certify that this rulemaking would not have a significant economic impact on a substantial number of small entities).

One of the three small businesses identified by DOE primarily manufactures compact refrigerators and related compact products such as wine chillers and stand-alone ice makers. These ice makers differ from the automatic icemakers installed in many refrigeration products in that they are separate icemaking appliances designed solely for the production and storage of ice. DOE reviewed the refrigerator, refrigerator-freezer, and freezer products manufactured by this small business and concluded that none of them are sold with automatic icemakers installed. Hence, it would not be required to rate products using the proposed icemaking test procedure. A second of the three small businesses primarily manufactures undercounter refrigeration products, most of which are compact. DOE reviewed the products manufactured by this small business and concluded that none of them are sold with automatic icemakers installed. The third small business, on the other hand, was found to manufacture refrigeration products with automatic icemakers and thus would be subject to the additional testing requirements proposed in today's test procedure. This small business has 800 employees.

Most of the test procedure amendments proposed in this notice would not affect test burden. One of the amendments would simply incorporate a test procedure for multiple compressor products that manufacturers already use in accordance with test procedure waivers they have received from DOE in order to test and rate these products.

Many of the other amendments clarify how to conduct the test rather than create any fundamental change in the way the test is conducted. An amendment addressing incomplete cycling would apply to a very small minority of products, much less than one percent of refrigeration product models. Amendments addressing the reporting of product height and the measurement of refrigerated volume would reduce measurement and reporting burden. Also, an amendment allowing for use of a third test for products whose control systems are not tuned to match both fresh food and freezer compartment standardized temperatures simultaneously (triangulation) is optional.

The primary incremental cost for small businesses under this rulemaking would result from the aforementioned automatic icemaker testing requirements. The cost to provide a required water supply for a test facility to address icemaking testing is estimated at $800. The buildings in which the test facilities are housed would already have a water supply—this additional cost would be the cost of extending that supply to the interior of a test facility. The additional test burden impact estimated by DOE is associated with additional test time. DOE estimates that the additional cost associated with this test time is $1,250 per test, based on an assumption that test time would increase 50% as compared with the current test (e.g., extension of test duration from four to six days) and based also on the costs DOE incurred to conduct testing using the proposed procedure. Since certification for refrigeration products is generally based on testing of three products, the incremental testing cost impact for this small business manufacturer associated with test time is estimated to be $3,750 per refrigeration product.

These costs were applied to the number of existing models subject to testing requirements outlined in this rulemaking, which DOE estimated at 20 basic models, based on its review of the number of products that would have automatic icemakers offered by the examined manufacturer. DOE assumed that the costs would be incurred in the year preceding the implementation of the new testing requirements, which, for the purposes of the analysis, is assumed to take effect coincident with a revision of the 2014 energy conservation standards in 2021. The test costs are assumed to occur in the preceding year as the manufacturer certifies the new product models in preparation for the potential adjustment in energy conservation standards. Based on these assumptions, incremental testing costs for small businesses were estimated at $76,000 in 2020.

As explained below, the findings of the DOE analysis suggest that small business manufacturers of refrigerators, refrigerator-freezers, and freezers would not be disproportionately impacted by the proposed test procedure, relative to their competition. DOE conducted an analysis to evaluate the testing cost burden that would likely be affected by the inclusion of the proposed procedure for automatic icemakers relative to the estimated annual R&D budget of the small manufacturer. The analysis utilized financial data gathered from other public sources (including Hoover's and financial statements from publicly-traded manufacturers in the industry) to derive the estimated average annual R&D budget of the small business impacted by this rule. The average industry R&D expenditure was estimated at 2.4 percent of revenues. The average annual revenues for a small business manufacturer of residential refrigeration products was estimated based on revenues of these manufacturers as reported by Hoover's. The annualized costs associated with this rulemaking were then compared to estimated R&D expenditures to determine the magnitude of the cost impacts of this test procedure on small businesses. Based on this analysis, DOE estimates that the cost burden of the proposed test procedure to this small manufacturer represents a one-time cost of approximately 5 percent of the annual R&D budget for an average small business manufacturer of residential refrigeration products. Based on this analysis, DOE concludes that this value would be unlikely to represent a significant economic impact on this small manufacturer in light of the small additional one-time cost that would be incurred to conduct the proposed procedure.

Based on the criteria outlined above, DOE has determined that the proposed test procedure amendments would not have a ''significant economic impact on a substantial number of small entities,'' and the preparation of a regulatory flexibility analysis is not warranted. DOE will transmit the certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the Small Business Administration for review under 5 U.S.C. 605(b).

DOE seeks comment on its estimated additional cost of testing due to the new requirements for testing presented in this NOPR. Specifically, DOE seeks comment on the impacts of the additional cost of testing on small manufacturers. DOE also seeks comment on its reasoning that the proposed test procedure changes would not have a significant impact on a substantial number of small entities.

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of refrigeration products must certify to DOE that their products comply with the applicable energy conservation standard. In certifying compliance, manufacturers must test their products according to the DOE test procedure for refrigeration products, including any amendments adopted for that test procedure. The information collection requirement for certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been submitted to OMB for approval. DOE received OMB approval to collect this information and has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including the refrigeration products addressed by today's proposed rule. 76 FR 12422 (March 7, 2011). The public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. While DOE has proposed to add a new reporting requirement (whether the manufacturer used the triangulation method for its certification tests), it has also proposed to remove a requirement (reporting of product height). Thus, DOE has determined that there is effectively no change in the reporting burden for these products.

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

D. Review Under the National Environmental Policy Act of 1969

In this notice, DOE proposes to amend its test procedure for refrigerators, refrigerator-freezers, and freezers. These proposed amendments would improve the ability of DOE's procedures to more accurately account for the energy consumption of products that incorporate a variety of new technologies that were not contemplated when the current procedure was promulgated. DOE has determined that this proposed rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this rule proposes to amend an existing rule without changing its environmental effect, and, therefore, is covered by the Categorical Exclusion in 10 CFR part 1021, subpart D, appendix A6. *See* 76 FR 63764, 63788 (Oct. 13, 2011). The exclusion applies because this proposed rule would establish a strictly procedural requirement by revising existing test procedures. These proposed revisions will not affect the amount, quality, or distribution of energy usage, and, therefore, will not result in any environmental impacts. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. 64 FR 43255 (Aug. 10, 1999). 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 that it will follow in developing such regulations. 65 FR 13735. DOE examined this proposed rule and determined that it will not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation specifies the following: (1) the preemptive effect, if any; (2) any effect on existing Federal law or regulation; (3) a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) the retroactive effect, if any; (5) definitions of key terms; and (6) 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 whether 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 proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) (Pub. L. 104–4; 2 U.S.C. 1501 *et seq.*) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. For a regulatory action resulting in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish estimates of the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a)–(b)) UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially-affected small governments before establishing any requirements that might significantly or uniquely affect such governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. (The policy is also available at *http:/www.gc.doe.gov/gc/office-general-counsel*). Today's proposed rule contains neither an intergovernmental mandate nor a mandate that may result in an expenditure of $100 million or more in any year, so these requirements do not apply.

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

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

I. Review Under Executive Order 12630

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

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

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

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA 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 significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use if the regulation is implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use. Today's proposed regulatory action is not a significant regulatory action under Executive Order 12866. It has likewise not been designated as a significant energy action by the Administrator of OIRA. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

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

Under section 301 of the DOE Organization Act (Pub. L. 95–91; 42 U.S.C. 7101 *et seq.*), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977 (FEAA). (15 U.S.C. 788) Section 32 essentially provides in part that, where a rule authorizes or requires use of commercial standards, the rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

The proposed modifications to the test procedures addressed by this proposed action incorporate testing methods contained in certain sections of the commercial standard, HRF–1–2008, and a separate standard adopted by the Australian and New Zealand governments—Australian/New Zealand Standard 44474.1:2007, Performance of household electrical appliances—Refrigerating appliances, Part 1: Energy consumption and performance. DOE has evaluated this standard and is unable to conclude whether it fully complies with the requirements of section 32(b) of the FEAA (i.e., whether it was developed in a manner that fully provides for public participation, comment, and review). The Attorney General and FTC will be consulted about the impact on competition of using the methods contained in this standard, prior to the issuance of a final rule.

V. Public Participation

A. Attendance at the Public Meeting

The time, date, and location of the public meeting are listed in the **DATES** and **ADDRESSES** sections at the beginning of this document. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945 or *Brenda.Edwards@ee.doe.gov.* Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Edwards to initiate the necessary procedures. Please also note that those wishing to bring laptops into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes. Persons can attend the public meeting via webinar. For more information, refer to the Public Participation section near the end of this notice.

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

B. Procedure for Submitting Requests to Speak

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

C. Conduct of Public Meeting

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

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

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

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

D. Submission of Comments

DOE will accept comments, data, and information regarding the proposed rule before or after the public meeting, but no later than the date provided in the **DATES** section at the beginning of this notice. Interested parties may submit comments using any of the methods described in the **ADDRESSES** section at the beginning of this notice.

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

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

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

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

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

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

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

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

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

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

E. Issues on Which DOE Seeks Comment

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

1. Modifications to Appendices A1 and B1

DOE is primarily proposing changes to the test procedures that will be required for certification starting in 2014. Many of these changes would help improve measurement accuracy by clarifying certain aspects of the test procedures, and would reduce test burden, but would not affect measured energy use. While the current test procedures are scheduled to be obsolete after September 2014, DOE may consider proposing these amendments also in the current test procedures to allow for the earlier adoption of these improvements and to smooth the path for their possible adoption in the test procedures that will be applicable after September 2014. DOE requests comments on whether any of the proposed amendments should also be considered for the current test procedures of Appendices A1 and B1.

2. Icemaking Test Procedure Request for Comments

DOE requests comments on any aspects of the proposal for measurement of energy use associated with icemaking. DOE further requests comment on the following details of the test procedure proposal.

a. Refrigerators With Automatic Icemakers

DOE requests comment on whether any refrigerators (*i.e.,* ''electric refrigerator'' as defined in 10 CFR 430.2 rather than ''electric refrigerator-freezer'') are sold with automatic icemakers. If so, DOE also seeks comment on whether test procedures for automatic icemakers should cover these ''electric refrigerators'' and to what extent, if any, the test procedure would need to be modified to accommodate the testing of these products. DOE is seeking comment on this issue in part to ascertain whether this aspect of today's proposal should apply to refrigerators as opposed to only refrigerator-freezers. DOE is currently unaware of any refrigerators that are also equipped with an automatic icemaker.

b. Manual Defrost Products With Automatic Icemakers

DOE requests comment on whether any manual defrost refrigerator-freezers or freezers are sold with automatic icemakers and whether any modifications to the proposed test procedure are required to address such products.

c. Icemaking Definitions

DOE requests comment on the proposal to establish definitions for ''Harvest'', ''Ice storage bin'', and ''Ice piece'' in the test procedures.

d. Anti-Sweat Heater Switch

DOE requests comment on the proposed requirements that products with anti-sweat heater switches be tested with the switches in the off position and that products with variable anti-sweat heater control without an anti-sweat heater switch be tested in an ambient environment with sufficiently low humidity to prevent the anti-sweat heaters from being energized. DOE also requests suggestions regarding how the objectives of these requirements could be satisfied with alternative approaches.

e. Setup for Icemaking

DOE requests comment on the proposed modification of the setup requirements, specifically the requirements addressing water lines, water filters, and ice storage bins.

f. Icemaking Water Temperature and Pressure Conditions

DOE seeks comment on its proposal to require 90 +/− 2 °F water inlet temperature and 60 ± 15 psig inlet pressure conditions.

g. Icemaking Data Collection Rate for Icemaking Test

DOE requests comments on the proposed one minute maximum data collection interval for the proposed icemaking test and its assumption that most test facilities record data for refrigeration product energy tests at a frequency of at least once per minute.

h. Icemaker Cycles

DOE requests comment on its proposed delineation between icemaker cycles at the end of the harvest of a batch of ice.

i. Alternative Icemaker Cycle Indication

DOE requests comment on its proposal for monitoring icemaker cycles for products whose icemakers have no mold heaters, on the details of the three proposed methods, on the requirements that one of the three identified methods be used to indicate icemaker cycles and that the test report indicate which one was used, and whether DOE should propose requirements indicating under what circumstances which of the three alternatives must be used. DOE further requests comment on whether additional alternative methods should be allowed by the test procedure. Finally, DOE requests comments on its proposal that the delineation between icemaking cycles determined by the proposed alternative methods would be when water is flowing into the icemaker mold.

j. Icemaker Field Operation

DOE assumes that in the field, continuous icemaking would typically occur only for initial filling of the bin and successive icemaker cycles would occur after a portion of ice has been withdrawn from the ice bin. DOE seeks comment and data confirming DOE's assumption or, if that assumption is incorrect, information suggesting an alternative approach and description with respect to icemaking operation in the field.

k. Icemaking Temperature Setting

DOE requests comments on its proposed variation limits on compartment temperatures during different parts of the icemaking test, which would require that (1) Compartment temperatures be set to their warmest setting for which compartment temperatures are no more than 1 °F warmer than their standardized temperatures for the baseline test, (2) if the compartment temperatures increase during icemaking that they be adjusted to their warmest setting for which compartment temperatures are no more than 1 °F warmer during the icemaking test than they were in the baseline test, (3) for mechanical controls these settings be aligned with symbols on the temperature dial, and (4) products that use quick-freeze control during icemaking be tested without disabling this feature during the test.

l. Test Period for Baseline Part of Test

DOE requests comments on its proposal to adopt a test period for the baseline part of the test that is equivalent to its existing test period for products with manual defrost, i.e. consisting of a period of time at least three hours in duration and, if the product's compressor cycles, comprising at least two complete compressor cycles. DOE further requests comment on the proposal to allow overlap of the stabilization period and the test period for the baseline part of the test as long as the stabilization period ends no later than the test period for the baseline part of the test.

m. Test Periods for Icemaking Part of Test

With respect to refrigeration products that cycle their compressors during icemaking, DOE requests comments on its proposal to (1) establish test periods for the icemaking part of the test based both on icemaker cycles and on compressor cycles and (2) require that energy use be calculated using both of these test periods and applying them to the same period of icemaking in order to provide a more accurate calculation of icemaking energy use. Likewise, DOE requests comment on its proposal to allow use of only the test period based on icemaker cycles for refrigeration products that do not cycle their compressors during icemaking.

n. Icemaking Test Period Stability Tolerance

DOE requests comment on its proposal to include a temperature stability requirement in the icemaking test procedure that would require the temperature in the freezer compartment, measured for any compressor cycle (if the refrigeration product cycles its compressor during icemaking) or any icemaker cycle (if the refrigeration product does not cycle its compressor during icemaking) within the test period, to be within 3 °F of the compartment's temperature average for the full test period.

o. Icemaking Test Period Duration

DOE requests comment on its proposal to adopt a minimum test period duration of 24 hours for the icemaking portion of the test, if this is possible prior to a defrost cycle occurrence or filling of the ice storage bin. Additionally, DOE requests comments on its proposal to require icemaking to be initiated shortly after the start of compressor operation following a defrost cycle.

p. Ice Mass

DOE requests comment on its proposed method of measuring ice mass.

q. Multiple Icemakers

The DOE proposal addresses refrigeration products with one icemaker serving a through-the-door feature and another not serving this feature, proposing that icemaking energy use be measured only for the icemaker serving the through-the-door feature. DOE requests comment on this approach for testing these products. DOE also requests comment on whether products with multiple icemakers using other configurations exist, what their design details are, whether DOE should consider modifying the proposed test procedure to address these products, and how the proposed test procedure should be modified to address them.

r. Ice Production Rate

DOE seeks information on consumer daily ice production to help determine the most appropriate ice production rate for the test procedure. DOE further seeks comment on whether the proposed 1.8 pounds per day ice production rate should be retained or whether a lower rate, as suggested by data provided by the Northwest Energy Efficiency Alliance, should be considered.

s. Measurements of Energy Use Associated With Icemaking

DOE seeks icemaking energy use data for typical products sold with automatic icemakers, using the test procedure proposed in this notice. DOE seeks these data in order to improve confidence in the understanding of typical icemaking energy use per pound of ice of residential refrigeration products.

t. Impact on Energy Use Measurement

DOE requests comments on its assessment of the impacts on energy use measurements of the proposed test procedure amendments. DOE further requests comments to support any potentially claimed change in the measured energy use, including data, if any, that would weigh in favor of adjusting the standards set to take effect on September 15, 2014, for products with automatic icemakers. DOE further requests comment on whether the fixed placeholder value for the icemaking energy use should be retained, rather than adopting a laboratory measurement, with adoption of a measurement-based standard to occur as part of a future energy conservation standards rulemaking for refrigerators, refrigerator-freezers, and freezers.

3. Multiple Compressor Test Procedure Request for Comments

DOE is interested in receiving general comments regarding the proposed multiple compressor test procedure and specific comments regarding the following items.

a. Multiple Compressor Definition

DOE requests comment on its proposed definition of refrigerator-freezers or refrigerators with multiple compressors.

b. Temperature Cycles

DOE requests comment on its proposal to allow use of temperature cycles as alternative indicators for start and stop times for multiple compressor test periods.

c. Data Collection Rate

DOE requests comments on the proposed one minute maximum data collection interval for the proposed multiple compressor test.

d. Multiple Compressor Stabilization Period

DOE requests comment on its proposal to apply the current stabilization requirement of Appendix A, section 2.9 to multiple compressor products and also on its proposal to allow evaluation of temperatures based either on temperature cycles or compressor cycles when evaluating stabilization.

e. One-Part Multiple Compressor Test

DOE requests comments on its proposal to allow a one-part test for multiple compressor products where only one compressor system has a defrost cycle (but this system's defrost control is neither long-time nor variable).

f. Test Periods for Products With One or No Cycling Compressors

DOE requests comment on its proposal allowing simplified test periods for both the first and second parts of the test (consistent with the test periods used for products with single compressors) when testing multiple-compressor products in which one or no compressor cycles during a test.

g. Duration of the First Part of the Test

DOE seeks comment on its proposal to require the first part of the test to be a single continuous period lasting at least 24 hours, if this period is not interrupted by a defrost, and that the test period be no less than 18 hours long if it is interrupted by a defrost. Further, DOE seeks comment on its proposal that this test period comprise a whole number of cycles of a ''primary'' compressor (or a whole number of temperature cycles of the compartment associated with the ''primary'' compressor), and that the ''primary'' compressor be the freezer compressor, if the freezer compressor cycles during the test.

h. Stabilization for the First Part of the Test

DOE requests comment on its proposal to require that the first part of the test consist of a period of stable operation. DOE also seeks comment on its proposed definition for stable operation, which would require compartment temperature changes during the period to not exceed 0.042 °F per hour.

i. Second Part of the Test

DOE requests comment on its proposal that the second part of the test that would be conducted for each compressor system that has a defrost cycle must include start and end points that occur during stable operation while surrounding the defrost cycle being measured. Further, DOE requests comment on the proposal that both the start and end of the test period occur either (a) when the primary compressor on-cycle starts or (b) when the primary compressor on-cycle stops—or alternatively that both the start and end of the test period occur either (c) when the compartment temperature associated with the primary compressor is at a maximum or (d) when the compartment temperature associated with the primary compressor is at a minimum. Finally, DOE requests comment on its proposal to allow start and end times for the test period for products with non-cycling compressors to occur when the compartment temperatures are within 0.5 °F of their averages for the first part of the test.

j. Measurement Changes for Multiple Compressor Products

DOE requests information regarding any refrigeration products with multiple compressors (other than those already covered by test procedure waivers) and whether the proposed test procedure would alter the measurement of energy use of any multiple compressor products. If the proposed test procedure would alter the measured energy use, DOE requests information regarding how large the change would be and what aspects of the proposed test would be most responsible for that change.

k. Multiple Compressor Products With Manual Defrost

DOE requests comment on whether any multiple compressor refrigeration products with manual defrost exist and whether the test procedure proposal should address such products.

4. Triangulation Approach

DOE welcomes comment on its proposal to include the triangulation approach as an optional interpolation method in the test procedure, including comment on the proposed approach for implementing this method in the test procedure and the proposed requirement to indicate in certification reports that triangulation has been used for certification. DOE also welcomes comment on its proposal to use triangulation for assessment and enforcement testing if (a) the product was certified using this method, or (b) the measurement results calculated based on the first two tests differ by more than five percent using the two different compartment temperatures for the interpolations.

5. Anti-Circumvention Language

a. Modification to Anti-Circumvention Language

DOE invites stakeholder comment on its proposal to modify the anti-circumvention language.

b. Components That Operate Differently During Testing

DOE seeks comment on potential revisions to the anti-circumvention language that would, in limited circumstances, permit the use of control algorithms that may cause a system to operate differently during testing from how it would operate in the field.

6. Incomplete Cycling

DOE seeks comment on its proposed amendment to the incomplete cycling definition and the associated modification of the test period for such products from 24 hours to one whole compressor cycle. DOE also seeks comment on its proposal to alter the test period requirements of Appendices A and B for products with automatic (but not long-time or variable) defrost so that the temperature measurements are made during test periods that do not include any of the events associated with defrost cycles. DOE also requests comment on whether temperature measurement requirements for incomplete cycling or non-cycling products in Appendices A1 and B1 should be made consistent with the temperature measurement requirements in Appendices A and B, i.e., that the temperature measurement and energy measurement test periods would coincide.

7. Mechanical Control Settings

DOE invites stakeholder comment on its proposal to modify its test procedures to clarify the setting of mechanical controls during testing.

8. Ambient Temperature Conditions

DOE requests comment on its proposed changes to ambient temperature and ambient temperature gradient requirements and its proposed approach to implementing these changes.

9. Definitions Associated With Defrost Cycles

DOE welcomes comment on the proposed definitions for terms associated with defrost cycles—''precooling'', ''recovery'', ''stable operation'', and ''stable period of compressor operation''.

10. Elimination of Product Height Reporting

DOE invites comment on its proposal to eliminate the certification requirement for reporting product height starting September 15, 2014.

11. Measurement of Product Volume

DOE seeks comment on its proposal to permit the use of CAD models to measure product volumes for the purposes of certification, the proposed 2 percent (or 0.5/0.2 cubic foot) allowance with respect to differences between the certified and measured volumes, and the requirements for retention of CAD-generated volume calculations as part of certification test reports. DOE also requests information on the documentation kept by manufacturers of CAD modeling used for calculations of volume and whether this documentation is in or could be converted to a format that would allow review by DOE without use of CAD software.

12. Package Loading

DOE requests comment on its clarifications of the appropriate method for determining that the 75% package loading requirement for manual defrost freezers in section 5.5.5.3 of HRF–1–2008 has been met and the proposed amendments to the text of Appendix B to address this issue.

13. Product Clearance to the Wall During Testing

DOE requests comment on its proposed revisions to the text of Appendices A and B to address product clearance to the wall during testing.

14. Relocation of Shelving

DOE requests comments on its proposal to require that shelving and/or other components whose position is adjustable by consumers be relocated to assure that temperature sensors maintain the required clearance from hardware, while indicating that the shelving be installed as evenly as possible if relocation for temperature sensors is required.

15. Built-in Refrigerators

DOE requests comment on whether testing in a built-in condition would generally be more representative of energy consumption in average use and, if so, the extent to which testing in this condition would be expected to affect the measured energy use of these products. DOE is also interested in receiving comment on whether there would be a significant additional test burden resulting from a requirement that specifies these products be tested in a built-in condition.

16. Measurement of Product Volume

DOE requests comment on its interpretations of the volume measurement provisions of AHAM HRF–1–2008 pertaining to air ducts and water coolers, and its proposed revisions to section 5.3 of the test procedures in Appendices A and B addressing volume measurement.

17. Test Burden

DOE seeks comment regarding its assessment of the test burden impacts of the test procedure amendments proposed in this notice.

18. Changes in Measured Energy Use

DOE invites stakeholder comment regarding DOE's assessments of the potential changes in measured energy use associated with the proposed test procedure changes. DOE requests comment on whether any of the proposed amendments to the test procedures could alter energy use measurements, and, if so, DOE requests data showing the magnitude of the measurement changes.

19. Standby and Off/Mode Energy Use

DOE tentatively proposed that no separate changes are needed to account for standby and off mode energy consumption, since the current (and as proposed) procedures already address energy consumed in standby and off modes. DOE requests comments on this determination.

20. Regulatory Flexibility

DOE requests comment on its initial conclusion that there are no small business manufacturers of refrigeration products that would be affected by the proposed changes in the test procedures for products with automatic icemakers.

VI. Approval of the Office of the Secretary

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

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Reporting and recordkeeping requirements.

10 CFR Part 430

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

Issued in Washington, DC, on June 28, 2013.

Kathleen B. Hogan,

Deputy Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons stated in the preamble, DOE proposes to amend parts 429 and 430 of chapter II of title 10, of the Code of Federal Regulations, as set forth below:

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

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

Authority: 42 U.S.C. 6291–6317.

■ 2. Section 429.14 is amended by adding paragraphs (a)(3) and (a)(4), and by revising paragraphs (b)(2) and (b)(3) to read as follows:

§ 429.14 Residential refrigerators, refrigerator-freezers and freezers.

(a) * * *

(3) Where the test procedures for these products provide more than one means for measuring the energy consumption of a basic model, all units of the basic model must be tested using the same method.

(4) The value of total refrigerated volume of a basic reported in accordance with paragraph (b)(2) of this section shall be the mean of the total refrigerated volumes measured for each tested unit of the basic model or the total refrigerated volume of the basic model as calculated in accordance with § 429.72.

(b) * * *

(2) Pursuant to § 429.12(b)(13), a certification report shall include the following public product-specific information: The annual energy use in kilowatt hours per year (kWh/yr); the fresh food compartment volume in cubic feet (ft^3) and the freezer compartment volume in cubic feet (ft^3), as applicable; whether the basic model has variable defrost control; whether the basic model has variable anti-sweat heater control; whether testing has been conducted with modifications to the standard temperature sensor locations specified by the figures referenced in section 5.1 of appendices A1, B1, A, and B to subpart B of part 430; and whether the optional triangulation approach of section 3.3 of appendix A was used for certification testing.

(3) Pursuant to § 429.12(b)(13), a certification report shall include the following additional product-specific information: for models with variable defrost control, the values, if any, of CT_L and CT_M (for an example, see section 5.2.1.3 in appendix A to subpart B of part 430) used in the calculation of energy consumption; and, for models with variable anti-sweat heater control, the values of heater watts at the ten relative humidity levels (5%, 15%, 25%, 35%, 45%, 55%, 65%, 75%, 85%, and 95%) used to calculate the variable anti-sweat heater ''Correction Factor''.

■ 3. Add § 429.72 to read as follows:

§ 429.72 Alternative methods for determining non-energy ratings.

(a) *General.* Where §§ 429.14 through 429.54 authorize the use of an alternative method for determining a physical or operating characteristic other than the energy consumption or efficiency, such characteristics must be determined either by testing in accordance with the applicable test procedure and applying the specified sampling plan provisions established in those sections or as described in the appropriate product-specific paragraph below. In all cases, the models, measurements, and calculations used to determine the rating for the physical or operating characteristic shall be retained as part of the test records underlying the certification of the basic model in accordance with 10 CFR 429.71.

(b) *Testing.* [Reserved]

(c) *Residential refrigerators, refrigerator-freezers, and freezers.* The total refrigerated volume of a basic model of refrigerator, refrigerator-freezer, or freezer may be determined by performing a calculation of the volume based upon computer-aided design (CAD) models of the basic model in lieu of physical measurements of a production unit of the basic model. Any value of total refrigerated volume of a basic model reported to DOE in a certification of compliance in accordance with § 429.14(b)(2) must be calculated using the CAD-derived volume(s) and the applicable provisions in the test procedures in part 430 for measuring volume, and must be within two percent, or 0.5 cubic feet (0.2 cubic feet for compact products), whichever is greater, of the volume of a production unit of the basic model measured in accordance with the applicable test procedure in part 430.

■ 4. Add § 429.134 to read as follows:

§ 429.134 Product-specific enforcement provisions.

(a) General. The following provisions apply to enforcement testing of the relevant products.

(b) *Refrigerators, refrigerator-freezers, and freezers.*

(1) *Verification of total refrigerated volume.* The total refrigerated volume of the basic model will be measured pursuant to the test requirements of part 430 for each unit tested. The results of the measurement(s) will be averaged and compared to the value of total refrigerated volume certified by the manufacturer. The certified volume will be considered valid only if:

(i) The measurement is within two percent, or 0.5 cubic feet (0.2 cubic feet for compact products), whichever is greater, of the certified volume, or

(ii) The measurement is greater than the certified volume.

(A) If the certified total refrigerated volume is found to be valid, that volume will be used as the basis for calculation of maximum allowed energy use for the basic model.

(B) If the certified total refrigerated volume is found to be invalid, the average measured volume will serve as the basis for calculation of maximum allowed energy use for the tested basic model.

(2) Reserved.

(b) *Test for Models with Two Compartments and User Operable Controls.* The test described in section 3.3 of the applicable test procedure for refrigerators or refrigerator-freezers shall be used if:

(1) The certification report indicates that the basic model was certified using this method, or

(2) The difference between the two values calculated as described in section 6.2.2.2 of the test procedure is greater than five percent of the larger value for any one unit of the basic model.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

■ 6. Section 430.2 is amended by revising the definition of ''compact refrigerator/refrigerator-freezer/freezer'' to read as follows:

§ 430.2 Definitions.

* * * * *

Compact refrigerator/refrigerator-freezer/freezer means any refrigerator, refrigerator-freezer or freezer with total refrigerated volume less than 7.75 cubic foot (220 liters) (total refrigerated volume as determined in appendices A1 and B1 of subpart B of this part before appendices A and B become mandatory and as determined in appendices A and B of this subpart once appendices A and B become mandatory (see the notes at the beginning of appendices A and B)).

* * * * *

■ 7. Section 430.3 is amended by adding paragraph (e) to read as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(e) *AS/NZS.* Australian/New Zealand Standard, GPO Box 476, Sydney NSW 2001, (02) 9237–6000 or (12) 0065–4646, or go to www.standards.org.au/ Standards New Zealand, Level 10 Radio New Zealand House 144 The Terrace Wellington 6001 (Private Bag 2439 Wellington 6020), (04) 498–5990 or (04) 498–5991, or go to *www.standards.co.nz.*

(1) AS/NZS 4474.1:2007, Performance of Household Electrical Appliances—Refrigerating Appliances; Part 1: Energy Consumption and Performance, August 15, 2007, IBR approved for Appendix A to Subpart B.

(2) Reserved.

* * * * *

■ 8. Section 430.23 is amended by revising paragraphs (a)(10) and (b)(7) to read as follows:

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

* * * * *

(a) * * *

(10) The following principles of interpretation should be applied to the test procedure. The intent of the energy test procedure is to simulate typical room conditions (approximately 70 °F (21 °C)) with door openings by testing at 90 °F (32.2 °C) without door openings. Except for operating characteristics that are affected by ambient temperature (for example, compressor percent run time), the unit, when tested under this test procedure, shall operate in a manner equivalent to the unit in typical room conditions.

(i) The energy used by the unit shall be calculated when a calculation is provided by the test procedure. Energy consuming components that operate in typical room conditions (including as a result of door openings, or a function of humidity), and that are not exempted by this test procedure, shall operate in an equivalent manner during energy testing under this test procedure, or be accounted for by all calculations as provided for in the test procedure.

Examples:

A. Energy saving features that are designed to operate when there are no door openings for long periods of time shall not be functional during the energy test.

B. The defrost heater shall not either function or turn off differently during the energy test than it would when in typical room conditions. Also, the product shall not recover differently during the defrost recovery period than it would in typical room conditions.

C. Electric heaters that would normally operate at typical room conditions with door openings shall also operate during the energy test.

D. Energy used during adaptive defrost shall continue to be tested and adjusted per the calculation provided for in this test procedure.

(ii) DOE recognizes that there may be situations that may not be completely addressed by the test procedures. A manufacturer must obtain a waiver in accordance with the relevant provisions of 10 CFR part 430 in such cases, if:

A. A product contains energy consuming components that operate differently during the prescribed testing than they would during representative average consumer use; and

B. Applying the prescribed test to that product would evaluate it in a manner that is unrepresentative of its true energy consumption (thereby providing materially inaccurate comparative data).

(b) * * *

(7) The following principles of interpretation should be applied to the test procedure. The intent of the energy test procedure is to simulate typical room conditions (approximately 70 °F (21 °C)) with door openings by testing at 90 °F (32.2 °C) without door openings. Except for operating characteristics that are affected by ambient temperature (for example, compressor percent run time), the unit, when tested under this test procedure, shall operate in a manner equivalent to the unit in typical room conditions.

(i) The energy used by the unit shall be calculated when a calculation is provided by the test procedure. Energy consuming components that operate in typical room conditions (including as a result of door openings, or a function of humidity), and that are not exempted by this test procedure, shall operate in an equivalent manner during energy testing under this test procedure, or be accounted for by all calculations as provided for in the test procedure.

Examples:

A. Energy saving features that are designed to operate when there are no door openings for long periods of time shall not be functional during the energy test.

B. The defrost heater shall not either function or turn off differently during the energy test than it would when in typical room conditions. Also, the product shall not recover differently during the defrost recovery period than it would in typical room conditions.

C. Electric heaters that would normally operate at typical room conditions with door openings shall also operate during the energy test.

D. Energy used during adaptive defrost shall continue to be tested and adjusted per the calculation provided for in this test procedure.

(ii) DOE recognizes that there may be situations that may not be completely addressed by the test procedures. A manufacturer must obtain a waiver in accordance with the relevant provisions of 10 CFR part 430 in such cases, if:

A. A product contains energy consuming components that operate differently during the prescribed testing than they would during representative average consumer use; and

B. Applying the prescribed test to that product would evaluate it in a manner that is unrepresentative of its true energy consumption (thereby providing materially inaccurate comparative data).

* * * * *

■ 9. Appendix A to subpart B of part 430 is amended:

■ a. In section 1. Definitions, by:

■ 1. Redesignating section 1.5 as 1.6;

■ 2. Redesignating section 1.6 as 1.7;

■ 3. Redesignating section 1.7 as 1.9;

■ 4. Redesignating section 1.8 as 1.10;

■ 5. Redesignating section 1.9 as 1.11 and revising the newly designated section 1.11;

■ 6. Redesignating section 1.10 as 1.12;

■ 7. Redesignating section 1.11 as 1.14;

■ 8. Redesignating section 1.12 as 1.17;

■ 9. Redesignating section 1.13 as 1.21;

■ 10. Redesignating section 1.14 as 1.22;

■ 11. Redesignating section 1.15 as 1.23;

■ 12. Redesignating section 1.16 as 1.26;

■ 13. Redesignating section 1.17 as 1.28;

■ 14. Redesignating section 1.18 as 1.29;

■ 15. Adding sections 1.5, 1.8, 1.11, 1.13, 1.15, 1.16, 1.18, 1.19, 1.20, 1.24 1.25, and 1.26;

■ b. In section 2. Test Conditions, by:

■ 1. Revising sections 2.1, 2.2, 2.6, and 2.8;

■ 2. Adding sections, 2.1.1, 2.1.2, 2.1.3, and 2.11;

■ c. In section 3. Test Control Setting, by:

■ 1. Revising section 3.2.1;

■ 2. Adding section 3.3;

■ 3. Revising Tables 1 and 2;
■ d. In section 4. Test period, by:
■ 1. Revising sections 4.1, 4.2, and 4.2.3;
■ 2. Adding sections 4.2.3.1, 4.2.3.2, 4.2.3.3, 4.2.3.4, 4.2.3.4.1, 4.2.3.4.2, 4.2.3.4.3;
■ 3. In section 5. Test Measurements, by revising sections 5.1, 5.1.1, 5.1.2, 5.2.1.1, 5.2.1.3, 5.2.1.4, 5.2.1.5, and 5.3;
■ e. In section 6. Calculation of Derived Results from Test Measurements, by:
■ 1. Revising sections 6.2, 6.2.1, 6.2.2, 6.2.2.1, 6.2.2.2; and;
■ 2. Adding section 6.2.2.3;
■ f. Adding section 8. Icemaking Test.

The additions and revisions read as follows:

Appendix A to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Electric Refrigerators and Electric Refrigerator-Freezers

* * * * *

1. Definitions

* * * * *

1.5 ''AS/NZS 44474.1:2007'' means Australian/New Zealand Standard 44474.1:2007, Performance of household electrical appliances—Refrigerating appliances, Part 1: Energy consumption and performance. Only sections of AS/NZS 44474.1:2007 (incorporated by reference; see § 430.3) specifically referenced in this test procedure are part of this test procedure. In cases where there is a conflict, the language of the test procedure in this appendix takes precedence over AS/NZS 44474.1:2007.

* * * * *

1.8 ''Complete temperature cycle'' means a time period defined based upon the cycling of compartment temperature that starts when the compartment temperature is at a maximum and ends when the compartment temperature returns to an equivalent maximum (within 0.5 °F of the starting temperature), having in the interim fallen to a minimum and subsequently risen again to reach the second maximum. Alternatively, a complete temperature cycle can be defined to start when the compartment temperature is at a minimum and ends when the compartment temperature returns to an equivalent minimum (within 0.5 °F of the starting temperature), having in the interim risen to a maximum and subsequently fallen again to reach the second minimum.

* * * * *

1.11 ''Defrost cycle type'' means a distinct sequence of control whose function is to remove frost and/or ice from a refrigerated surface. There may be variations in the defrost control sequence such as the number of defrost heaters energized. Each such variation establishes a separate distinct defrost cycle type. However, defrost achieved regularly during the compressor off-cycles by warming of the evaporator without active heat addition, although a form of automatic defrost, does not constitute a unique defrost cycle type for the purposes of identifying the test period in accordance with section 4 of this appendix.

* * * * *

1.13 ''Harvest'' means the process of freeing or removing ice pieces from an automatic icemaker.

* * * * *

1.15 ''Ice piece'' means a piece of ice made by an automatic icemaker that has not been reduced in size by crushing or other mechanical action.

1.16 ''Ice storage bin'' means a container in which ice can be stored.

* * * * *

1.18 ''Multiple compressor'' refrigerator or refrigerator-freezer means a refrigerator or refrigerator-freezer with more than one compressor.

1.19 ''Precooling'' means operating a refrigeration system before initiation of a defrost cycle to reduce one or more compartment temperatures significantly (more than 0.5 °F) below its minimum during stable operation between defrosts.

1.20 ''Recovery'' means operating a refrigeration system after the conclusion of a defrost cycle to reduce the temperature of one or more compartments to the temperature range that the compartment(s) exhibited during stable operation between defrosts.

* * * * *

1.24 ''Stable operation'' means operation after steady-state conditions have been achieved but excluding any events associated with defrost cycles. During stable operation the rate of change of all compartment temperatures must not exceed 0.042 °F (0.023 °C) per hour. Such a calculation performed for compartment temperatures at any two times, or for any two complete cycles, during stable operation must meet this requirement.

(A) If compartment temperatures do not cycle, the relevant calculation shall be the difference between the temperatures at two points in time divided by the difference, in hours, between those points in time.

(B) If compartment temperatures cycle as a result of compressor cycling or other cycling operation of any system component (e.g., a damper, fan, or heater), the relevant calculation shall be the difference between compartment temperature averages evaluated for whole compressor cycles or complete temperature cycles divided by the difference, in hours, between either the starts, ends, or mid-times of the two cycles.

1.25 ''Stable period of compressor operation'' is a period of stable operation of a refrigeration system that has a compressor.

1.26 ''Through-the-door ice/water dispenser'' means a device incorporated within the cabinet, but outside the boundary of the refrigerated space, that delivers to the user on demand ice or water from within the refrigerated space without opening an exterior door. This definition includes dispensers that are capable of dispensing ice and water, ice only, or water only.

* * * * *

2. Test Conditions

2.1 Ambient Temperature Measurement. Temperature measuring devices shall be shielded so that indicated temperatures are not affected by the operation of the condensing unit or adjacent units.

2.1.1 Ambient Temperature. The ambient temperature shall be recorded at points located 3 feet (91.5 cm) above the floor and 10 inches (25.4 cm) from the center of the two sides of the unit under test. The ambient temperature shall be 90.0 ±1.0 °F (32.2 ±0.6 °C) during the stabilization period and the test period.

2.1.2 Ambient Temperature Gradient. The test room vertical ambient temperature gradient in any foot of vertical distance from 2 inches (5.1 cm) above the floor or supporting platform to a height of 7 feet (2.2 m) or to a height 1 foot (30.5 cm) above the top of the unit under test, whichever is greater, is not to exceed 0.5 °F per foot (0.9 °C per meter). The vertical ambient temperature gradient at locations 10 inches (25.4 cm) out from the centers of the two sides of the unit being tested is to be maintained during the test. To demonstrate that this requirement has been met, test data must include measurements taken using temperature sensors at locations 2 inches (5.1 cm) and 36 inches (91.4 cm) above the floor or supporting platform and at a height of 1 foot (30.5 cm) above the unit under test.

2.1.3 Platform. A platform must be used if the floor temperature is not within 3 °F (1.7 °C) of the measured ambient temperature. If a platform is used, it is to have a solid top with all sides open for air circulation underneath, and its top shall extend at least 1 foot (30.5 cm) beyond each side and front of the unit under test and extend to the wall in the rear.

2.2 Operational Conditions. The unit under test shall be installed and its operating conditions maintained in accordance with HRF–1–2008, (incorporated by reference; see § 430.3), sections 5.3.2 through section 5.5.5.5 (excluding section 5.5.5.4). Exceptions and clarifications to the cited sections of HRF–1–2008 are noted in sections 2.3 through 2.8, and 5.1 of this appendix.

* * * * *

2.6 The unit under test and its refrigerating mechanism shall be assembled and set up in accordance with the printed consumer instructions supplied with the unit. Set-up of the unit shall not deviate from these instructions, unless explicitly required or allowed by this test procedure. Specific required or allowed deviations from such set-up include the following:

(a) Connection of water lines and installation of water filters are required only when conducting the icemaking test described in section 8 of this appendix;

(b) Clearance requirements from surfaces of the unit shall be as described in section 2.8 of this appendix;

(c) The electric power supply shall be as described in HRF–1–2008 (incorporated by reference; see § 430.3), section 5.5.1;

(d) Temperature control settings for testing shall be as described in section 3 of this appendix. Settings for convertible compartments and other temperature-controllable or special compartments shall be as described in section 2.7 of this appendix;

(e) The unit does not need to be anchored or otherwise secured to prevent tipping during energy testing;

(f) All the unit's chutes and throats required for the delivery of ice shall be free of packing, covers, or other blockages that may be fitted for shipping or when the icemaker is not in use; and

(g) Ice storage bins shall be emptied of ice except as required for the icemaking test described in section 8 of this appendix.

For cases in which set-up is not clearly defined by this test procedure, manufacturers must submit a petition for a waiver (see section 7 of this appendix).

* * * * *

2.8 Rear Clearance.

(a) General. The space between the lowest edge of the rear plane of the cabinet and a vertical surface (the test room wall or simulated wall) shall be the minimum distance in accordance with the manufacturer's instructions, unless other provisions of this section apply. The rear plane shall be considered to be the largest flat surface at the rear of the cabinet, excluding features that protrude beyond this surface, such as brackets, the compressor, or rear-wall-mounted condensers.

(b) Maximum clearance. The clearance shall not be greater than 2 inches (51 mm) from the lowest edge of the rear plane to the vertical surface, unless the provisions of subsection (c) of this section apply.

(c) If permanent rear spacers or other components that protrude beyond the rear plane extend further than the 2 inch (51 mm) distance, or if the highest edge of the rear plane is in contact with the vertical surface when the unit is positioned with the lowest edge of the rear plane at or further than the 2 inch (51 mm) distance from the vertical surface, the appliance shall be located with the spacers or other components protruding beyond the rear plane, or the highest edge of the rear plane, in contact with the vertical surface.

* * * * *

2.11 Refrigerators and Refrigerator-Freezers with Demand-Response Capability. For refrigerators and refrigerator-freezers that have a communication module for demand-response functions, whether integrated within the cabinet or external to the cabinet and connected by the consumer, the communication module must be installed, energized, and connected to a network, but there shall be no active communication during testing.

* * * * *

3. Test Control Settings

3.2 * * *

3.2.1 A first test shall be performed with all compartment temperature controls set at their median position midway between their warmest and coldest settings. For mechanical control systems, (a) knob detents shall be mechanically defeated if necessary to attain a median setting, and (b) the warmest and coldest settings shall correspond to the positions in which the indicator is aligned with control symbols indicating the warmest and coldest settings. For electronic control systems, the test shall be performed with all compartment temperature controls set at the average of the coldest and warmest settings—if there is no setting equal to this average, the setting closest to the average shall be used. If there are two such settings equally close to the average, the higher of these temperature control settings shall be used. A second test shall be performed with all controls set at their warmest setting or all controls set at their coldest setting (not electrically or mechanically bypassed). For all-refrigerators, this setting shall be the appropriate setting that attempts to achieve compartment temperatures measured during the two tests that bound (*i.e.,* one is above and one is below) the standardized temperature for all refrigerators. For refrigerators and refrigerator-freezers, the second test shall be conducted with all controls at their coldest setting, unless all compartment temperatures measured during the first part of the test are lower than the standardized temperatures, in which case the second test shall be conducted with all controls at their warmest setting. Refer to Table 1 of this appendix for all refrigerators or Table 2 of this appendix for refrigerators with freezer compartments and refrigerator-freezers to determine which test results to use in the energy consumption calculation. If any compartment is warmer than its standardized temperature for a test with all controls at their coldest position, the tested unit fails the test and cannot be rated.

TABLE 1—TEMPERATURE SETTINGS FOR ALL REFRIGERATORS

First test		Second test		Energy calculation based on—
Settings	Results	Settings	Results	
Mid	Low	Warm	Low	Second Test Only.
			High	First and Second Tests.
	High	Cold	Low	First and Second Tests.
			High	No Energy Use Rating.

TABLE 2—TEMPERATURE SETTINGS FOR REFRIGERATORS WITH FREEZER COMPARTMENTS AND REFRIGERATOR-FREEZERS

First test		Second test		Energy calculation based on—
Settings	Results	Settings	Results	
Fzr Mid	Fzr Low	Fzr Warm	Fzr Low	Second Test Only.
FF Mid	FF Low	FF Warm	FF Low	
		Fzr Low	First and Second Tests.	
		FF High		
		FF High		
		Fzr High	First and Second Test.	
		FF Low		
		Fzr High	First and Second Test.	
		FF High		
	Fzr Low	Fzr Cold	Fzr Low	No Energy Use Rating.
	FF High	FF Cold	FF High	No Energy Use Rating.
			Fzr Low	First and Second Tests
			FF Low	
	Fzr High	Fzr Cold	Fzr High	No Energy Use Rating.
	FF Low	FF Cold	FF Low	
Fzr Low	First and Second Tests..			
			FF Low	
	Fzr High	Fzr Cold	Fzr Low	First and Second Tests.
	FF High	FF Cold	FF Low	
Fzr Low	No Energy Use Rating.			

TABLE 2—TEMPERATURE SETTINGS FOR REFRIGERATORS WITH FREEZER COMPARTMENTS AND REFRIGERATOR-FREEZERS—Continued

First test		Second test		Energy calculation based on—
Settings	Results	Settings	Results	
			FF High	
Fzr High	No Energy Use Rating.		FF Low	
Fzr High	No Energy Use Rating.			
FF High				

NOTES: Fzr = Freezer Compartment, FF = Fresh Food Compartment.

* * * * *

3.3 Optional Test for Models with Two Compartments and User Operable Controls. As an alternative to section 3.2, in addition to the two tests described in section 3.2.1, perform a third test such that the set of tests meets the ''minimum requirements for interpolation'' of AS/NZS 44474.1:2007 (incorporated by reference; see § 430.3) appendix M, section M3, paragraphs (a) through (c) and as illustrated in Figure M1. The target temperatures t_{xA} and t_{xB} defined in section M4(a)(i) of AS/NZ 44474.1:2007 shall be the standardized temperatures defined in section 3.2 of this appendix.

4. Test Period

* * * * *

4.1 Non-Automatic Defrost. If the model being tested has no automatic defrost system, the test period shall start after steady-state conditions (see section 2.9 of this appendix) have been achieved and be no less than three hours in duration. During the test period, the compressor motor shall complete two or more whole compressor cycles. (A compressor cycle is a complete ''on'' and a complete ''off'' period of the motor.) If no ''off'' cycling occurs, the test period shall be three hours. If incomplete cycling occurs (fewer than two compressor cycles during a 24-hour period), then a single complete compressor cycle may be used.

4.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test period shall start after steady-state conditions have been achieved and be from one point during a defrost period to the same point during the next defrost period. If the model being tested has a long-time automatic defrost system, the alternative provisions of section 4.2.1 may be used. If the model being tested has a variable defrost control, the provisions of section 4.2.2 shall apply. If the model is a multiple compressor product with automatic defrost, the provisions of section 4.2.3 shall apply. If the model being tested has long-time automatic or variable defrost control involving multiple defrost cycle types, such as for a product with a single compressor and two or more evaporators in which the evaporators are defrosted at different frequencies, the provisions of section 4.2.4 shall apply. If the model being tested has multiple defrost cycle types for which compressor run time between defrosts is a fixed time of less than 14 hours for all such cycle types, and for which the compressor run times between defrosts for different defrost cycle types are equal to or multiples of each other, the test period shall be from one point of the defrost cycle type with the longest compressor run time between defrosts to the same point during the next occurrence of this defrost cycle type. For such products not using the procedures of section 4.2.4, energy consumption shall be calculated as described in section 5.2.1.1 of this appendix.

* * * * *

4.2.3 Multiple Compressor Products with Automatic Defrost.

4.2.3.1 Measurement Frequency. Measurements shall be taken at regular intervals not exceeding one minute.

4.2.3.2 Steady-state Condition. The requirements of section 2.9 of this appendix shall be met for the compartment temperature of each compartment served by each of the compressors of the multiple compressor product. As an alternative to evaluating steady-state conditions based on complete compressor cycles, this evaluation may be based on complete temperature cycles for the compartments served by each of the compressors.

4.2.3.3 Short-Time Defrost for a Single Compressor. For multiple compressor products where (a) only one compressor system has automatic defrost and (b) this is a short-time defrost (*i.e.,* not long-time or variable), the test period shall start after steady-state conditions have been achieved and be from one point during a defrost period to the same point during the next defrost period.

4.2.3.4 If the conditions of section 4.2.3.3 do not apply, the two-part method shall be used. The first part is a stable period of compressor operation that includes no defrost cycles or events associated with a defrost cycle, such as precooling or recovery, for any compressor system. The second part is designed to capture the energy consumed during all of the events occurring with the defrost control sequence that are outside of stable operation. The second part of the test shall be conducted separately for each automatic defrost system present.

4.2.3.4.1 Multiple Compressor Products with at Least Two Cycling Compressors. For a multiple compressor product with at least two cycling compressors, test periods shall be based on compressor or temperature cycles associated with the primary compressor system (these are referred to as primary compressor cycles or primary temperature cycles). If the freezer compressor cycles, it shall be the primary compressor system. The first part of the test shall include a whole number of complete primary compressor cycles or a whole number of complete primary temperature cycles comprising at least 24 hours of stable operation. If a defrost occurs prior to completion of 24 hours of stable operation, the first part of the test shall be at least 18 hours long.

The second part of the test starts during stable operation before all portions of the defrost cycle at the beginning of a complete primary compressor or temperature cycle. The test period for the second part of the test ends after all portions of the defrost cycle and after all compartment temperatures have fully recovered to their stable operation conditions at the termination of a complete primary compressor or temperature cycle. If the test period is based on compressor cycles, the start and stop shall both occur either when the primary compressor starts or when the primary compressor stops. If the test period is based on temperature cycles, the start and stop shall both occur either when the primary compartment temperature is at a maximum or when it is at a minimum. For each compressor system, the compartment temperature averages for the first and last complete compressor or temperature cycles that lie completely within the second part of the test must be within 0.5 °F (0.3 °C) of the average compartment temperature measured for the first part of the test. If any one of the compressor systems is non-cycling, its compartment temperature averages during the first and last complete primary compressor or temperature cycles of the second part of the test must be within 0.5 °F (0.3 °C) of the average compartment temperature measured for the first part of the test.

4.2.3.4.2 Multiple Compressor Products with Non-Cycling Compressors. For a multiple compressor product with no cycling compressors, the first part of the test is a stable period of compressor operation that includes no defrost cycles or events associated with a defrost cycle, such as precooling or recovery, that shall start after steady-state conditions (see section 2.9 of this appendix) have been achieved, and shall be three hours in duration.

The second part of the test starts during stable operation before all portions of the defrost cycle when the compartment temperatures of all compressor systems are within 0.5 °F (0.3 °C) of their average temperatures measured for the first part of the test. The second part stops during stable operation after all portions of the defrost cycle when the compartment temperatures of all compressor systems are within 0.5 °F (0.3 °C) of their average temperatures measured for the first part of the test.

4.2.3.4.3 Multiple Compressor Products with One Cycling Compressor. For a multiple compressor product with one cycling compressor, the first part of the test is a stable period of compressor operation that includes no defrost cycles or events associated with a defrost cycle, such as precooling or recovery, that shall start after steady-state conditions (see section 2.9 of this appendix) have been achieved, shall be no less than three hours in duration, and shall consist of two or more whole compressor or temperature cycles of the cycling compressor system.

The second part of the test shall be as described in section 4.2.3.4.1 for the second part of the test for multiple compressor products with at least two cycling compressors. The single cycling compressor system shall be considered the primary compressor system.

* * * * *

5. Test Measurements

* * * * *

5.1 Temperature Measurements. Temperature measurements shall be made at the locations prescribed in Figures 5.1 and 5.2 of HRF–1–2008 (incorporated by reference; see § 430.3) and shall be accurate to within ±0.5 °F (0.3 °C). No freezer temperature measurements need be taken in an all-refrigerator model.

If the interior arrangements of the unit under test do not conform with those shown in Figure 5.1 and 5.2 of HRF–1–2008, the unit may be tested by relocating the temperature sensors from the locations specified in the figures to avoid interference with non-adjustable hardware or components within the unit, in which case the specific locations used for the temperature sensors shall be noted in the test data records maintained by the manufacturer in accordance with 10 CFR 429.71, and the certification report shall indicate that non-standard sensor locations were used. If the temperature sensor placement required by this section is impeded by adjustable shelves or other components that could be relocated by the consumer, those components shall be repositioned as necessary to allow for placement of the sensors in the required locations. Any repositioning of components shall adhere as closely as practicable to the set-up instructions specified in section 5.5.2 of HRF–1–2008 while maintaining a minimum 1-inch air space between the sensor thermal mass and adjacent hardware.

5.1.1 Measured Temperature. The measured temperature of a compartment is the average of all sensor temperature readings taken in that compartment at a particular point in time. Measurements shall be taken at regular intervals not to exceed 4 minutes. Measurements for products with multiple compressor systems shall be taken at regular intervals not to exceed one minute.

5.1.2 Compartment Temperature. The compartment temperature for each test period shall be an average of the measured temperatures taken in a compartment during the test period as defined in section 4 of this appendix. For long-time automatic defrost models, compartment temperatures shall be those measured in the first part of the test period specified in section 4.2.1 of this appendix. For models with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.2.2 of this appendix. For models with automatic defrost that is neither long-time nor variable defrost, the compartment temperature shall be an average of the measured temperatures taken in a compartment during a stable period of compressor operation that (a) includes no defrost cycles or events associated with a defrost cycle, such as precooling or recovery, (b) is no less than three hours in duration, and (c) includes two or more whole compressor cycles or two or more complete temperature cycles. If neither the compressor nor the temperature cycles, the stable period used for the temperature average shall be three hours in duration.

* * * * *

5.2 * * *

5.2.1 * * *

5.2.1.1 Non-automatic Defrost, Automatic Defrost, and Multiple Compressor Products in which only one compressor system uses automatic defrost (but not long-time or variable). The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET = EP \times 1440/T$

Where:

ET = test cycle energy expended in kilowatt-hours per day;

EP = energy expended in kilowatt-hours during the test period;

T = length of time of the test period in minutes; and

1440 = conversion factor to adjust to a 24-hour period in minutes per day.

* * * * *

5.2.1.3 Variable Defrost Control. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$ET = (1440 \times EP1/T1) + (EP2 - (EP1 \times T2/T1)) \times (12/CT)$,

Where:

1440 is defined in 5.2.1.1 and EP1, EP2, T1, T2, and 12 are defined in 5.2.1.2;

$CT = (CT_L \times CT_M)/(F \times (CT_M - CT_L) + CT_L)$;

CT_L = the shortest compressor run time between defrosts observed for the test—or the shortest compressor run time between defrosts used in the variable defrost control algorithm (greater than or equal to 6 but less than or equal to 12 hours)—whichever is shorter, in hours rounded to the nearest tenth of an hour;

CT_M = maximum compressor run time between defrosts in hours rounded to the nearest tenth of an hour (greater than CT_L but not more than 96 hours);

F = ratio of per day energy consumption in excess of the least energy and the maximum difference in per-day energy consumption and is equal to 0.20.

For variable defrost models with no values for CT_L and CT_M in the algorithm, the default values of 6 and 96 shall be used, respectively. However, the shortest compressor run time between defrosts observed for the test shall be used for CT_L, if it is less than 6.

5.2.1.4 Multiple Compressor Products with Automatic Defrost. For multiple compressor products that do not meet the conditions of section 4.2.3.3 of this appendix, the two-part test method in section 4.2.3.4 of this appendix must be used. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$$ET = \left(1440 \times \frac{EP1}{T1}\right) + \sum_{i=1}^{D}\left[\left(EP2_i - \left(EP1 \times \frac{T2_i}{T1}\right)\right) \times \left(\frac{12}{CT_i}\right)\right]$$

Where:

1440, EP1, T1, and 12 are defined in 5.2.1.2;

i = a variable that can equal 1, 2, or more that identifies each individual compressor system that has automatic defrost;

D = the total number of compressor systems with automatic defrost.

$EP2_i$ = energy expended in kilowatt-hours during the second part of the test for compressor system i;

$T2_i$ = length of time in minutes of the second part of the test for compressor system i;

CT_i = the compressor run time between defrosts for compressor system i in hours rounded to the nearest tenth of an hour, for long-time automatic defrost control equal to a fixed time in hours, and for variable defrost control equal to

$(CT_{Li} \times CT_{Mi})/(F \times (CT_{Mi} - CT_{Li}) + CT_{Li})$;

Where:

CT_{Li} = for compressor system i, the shortest compressor run time between defrosts observed for the test—or the shortest compressor run time between defrosts used in the variable defrost control algorithm (greater than or equal to 6 but less than or equal to 12 hours)—whichever is shorter, in hours rounded to the nearest tenth of an hour;

CT_{Mi} = maximum compressor run time between defrosts for compressor system i in hours rounded to the nearest tenth of an hour (greater than CT_{Li} but not more than 96 hours);

F = default defrost energy consumption factor, equal to 0.20.

For variable defrost models with no values for CT_{Li} and CT_{Mi} in the algorithm, the default values of 6 and 96 shall be used, respectively. However, the shortest compressor run time between defrosts observed for compressor system i during the test shall be used for CT_{Li}, if it is less than 6.

5.2.1.5 Long-time or Variable Defrost Control for Systems with Multiple Defrost Cycle Types. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$$ET = (1440 \times EP1/T1) + \sum_{i=1}^{D} [(EP2_i - (EP1 \times T2_i/T1)) \times (12/CT_i)]$$

Where:

1440 is defined in 5.2.1.1 and EP1, T1, and 12 are defined in 5.2.1.2;

i is a variable that can equal 1, 2, or more that identifies the distinct defrost cycle types applicable for the refrigerator or refrigerator-freezer;

$EP2_i$ = energy expended in kilowatt-hours during the second part of the test for defrost cycle type i;

$T2_i$ = length of time in minutes of the second part of the test for defrost cycle type i;

CT_i is the compressor run time between instances of defrost cycle type i, for long-time automatic defrost control equal to a fixed time in hours rounded to the nearest tenth of an hour, and for variable defrost control equal to

$(CT_{Li} \times CT_{Mi})/(F \times (CT_{Mi} - CT_{Li}) + CT_{Li})$;

CT_{Li} = for defrost cycle type i, the shortest compressor run time between defrosts of this type observed for the test—or the shortest compressor run time between defrosts of this type used in the variable defrost control algorithm (greater than or equal to 6 but less than or equal to 12 hours for the defrost cycle type with the longest compressor run time between defrosts)—whichever is shorter, in hours rounded to the nearest tenth of an hour;

CT_{Mi} = maximum compressor run time between instances of defrost cycle type i in hours rounded to the nearest tenth of an hour (greater than CT_{Li} but not more than 96 hours);

For cases in which there is more than one fixed CT value (for long-time defrost models) or more than one CT_M and/or CT_L value (for variable defrost models) for a given defrost cycle type, an average fixed CT value or average CT_M and CT_L values shall be selected for this cycle type so that 12 divided by this value or values is the frequency of occurrence of the defrost cycle type in a 24 hour period, assuming 50% compressor run time.

F = default defrost energy consumption factor, equal to 0.20.

For variable defrost models with no values for CT_{Li} and CT_{Mi} in the algorithm, the default values of 6 and 96 shall be used, respectively. However, the shortest compressor run time between defrosts observed for defrost cycle type i during the test shall be used for CT_{Li}, if it is less than 6.

D is the total number of distinct defrost cycle types.

5.3 Volume Measurements. The unit's total refrigerated volume, VT, shall be measured in accordance with HRF–1–2008 (incorporated by reference; see § 430.3), section 3.30 and sections 4.2 through 4.3. The measured volume shall include all spaces within the insulated volume of each compartment except for the volumes that must be deducted in accordance with section 4.2.2 of HRF–1–2008, and be calculated equivalent to:

VT = VF + VFF

Where:

VT = total refrigerated volume in cubic feet,
VF = freezer compartment volume in cubic feet, and
VFF = fresh food compartment volume in cubic feet.

In the case of products with automatic icemakers, the volume occupied by the automatic icemaker, including its ice storage bin, is to be included in the volume measurement.

Total refrigerated volume is determined by physical measurement of the test unit. Measurements and calculations used to determine the total refrigerated volume shall be retained as part of the test records underlying the certification of the basic model in accordance with 10 CFR 429.71.

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6. Calculation of Derived Results From Test Measurements

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6.2 Average Per-Cycle Energy Consumption. The average per-cycle energy consumption for a cycle type, E, is expressed in kilowatt-hours per cycle to the nearest one hundredth (0.01) kilowatt-hour and shall be calculated according to the sections below.

6.2.1 All-Refrigerator Models. The average per-cycle energy consumption shall depend upon the temperature attainable in the fresh food compartment as shown below.

* * * * *

6.2.2 Refrigerators and Refrigerator-Freezers. The average per-cycle energy consumption shall be defined in one of the following ways as applicable.

6.2.2.1 If the fresh food compartment temperature is at or below 39 °F (3.9 °C) during both tests and the freezer compartment temperature is at or below 15 °F (−9.4 °C) during both tests of a refrigerator or at or below 0 °F (−17.8 °C) during both tests of a refrigerator-freezer, the average per-cycle energy consumption shall be:

E = ET1 + IET

Where:

ET is defined in 5.2.1;

IET, expressed in kilowatt-hours per cycle, equals 0 (zero) for products without an automatic icemaker, and for products with an automatic icemaker, shall be equal to 0.23 until the energy conservation standards at 10 CFR 430.32(a) are amended. Beginning on the compliance date of any such amended standards, the icemaking energy shall be calculated as described in section 8.3.6 of this appendix; and

The number 1 indicates the test period during which the highest freezer compartment temperature was measured.

6.2.2.2 If the conditions of 6.2.2.1 do not exist, the average per-cycle energy consumption shall be defined by the higher of the two values calculated by the following two formulas:

E = ET1 + ((ET2 − ET1) × (39.0 − TR1)/(TR2 − TR1)) + IET

and

E = ET1 + ((ET2 − ET1) × (k − TF1)/(TF2 − TF1)) + IET

Where:

ET is defined in 5.2.1;

IET is defined in 6.2.2.1;

TR and the numbers 1 and 2 are defined in 6.2.1.2;

TF = freezer compartment temperature determined according to 5.1.4 in degrees F;

39.0 is a specified fresh food compartment temperature in degrees F; and k is a constant 15.0 for refrigerators or 0.0 for refrigerator-freezers, each being standardized freezer compartment temperatures in degrees F.

6.2.2.3 Optional Test for Models with Two Compartments and User Operable Controls. If the procedure of section 3.3 of this appendix is used for setting temperature controls, the average per-cycle energy consumption shall be defined as follows:

$E = E_x + IET$

Where:

E is defined in 6.2.1.1;

IET is defined in 6.2.2.1; and

E_x is defined and calculated as described in AS/NZS 44474.1:2007 (incorporated by reference; see § 430.3) appendix M, section M4(a). The target temperatures t_{xA} and t_{xB} defined in section M4(a)(i) of AS/NZS 44474.1:2007 shall be the standardized temperatures defined in section 3.2 of this appendix.

* * * * *

8. Icemaking Test

This section would apply to manufacturers seeking to demonstrate compliance with any new or amended energy conservation standard that DOE may issue in a final rule for refrigerators, refrigerator-freezers, and freezers that DOE may issue after September 15, 2014. Absent the issuance of a test procedure waiver by the Department of Energy permitting the earlier use of this section, this section is not required unless and until such final rule is issued.

8.1 Special Test Conditions.

8.1.1 Multiple Icemakers. If one of the automatic icemakers in a product with multiple icemakers serves a through-the-door ice dispenser, initiate icemaking only for this icemaker when conducting the icemaking part of the test of section 8.3.

8.1.2 Anti-sweat Heater. The anti-sweat heater switch shall be off for the icemaking test. In the case of a product equipped with variable anti-sweat heater control but without an anti-sweat heater switch, the test shall be conducted in an ambient humidity condition that will prevent the anti-sweat heater from being energized.

8.1.3 Connection of water lines and installation of water filters are required. Inlet water temperature shall be 90 +/− 2 °F. The water supply system shall be designed to assure that inlet water temperature stays within this specified range at all times during the test. Inlet water pressure shall be 60 +/ − 15 psig.

8.1.4 Data collection frequency for temperatures, power, and energy shall be no less than once per minute.

8.1.5 Icemaker Cycle Indication. The end of one icemaker cycle and the start of the following icemaker cycle is defined to occur when the mold heater (to release ice pieces) is turned off. When measuring energy use for an icemaker (a) without a mold heater or (b) for which review of test data does not allow easy determination of the times that a mold heater was turned off, the end of one icemaker cycle and the start of the following icemaker cycle is defined to occur when one of the methods described in this section indicates the initiation of water flow into the icemaker mold. One of the following measurement approaches shall be used to indicate the start and end of icemaker cycles using measurements at a data acquisition time interval no greater than the data acquisition time interval used for the test's energy and temperature measurements. The test data record maintained in accordance with 10 CFR 429.71 shall indicate which of these three methods is used.

8.1.5.1 Mold Temperature. Measure icemaker mold temperature during the test with a temperature sensor adhered to the bottom of the icemaker mold. Ensure that the temperature sensor is installed so that the icemaker operation, including operations such as twisting of the icemaker mold and ice dropping into the ice bin, will not be impeded by the temperature sensor and its connecting wire(s), and that neither the temperature sensor nor its connecting wire(s) will be dislodged or damaged by icemaker operation.

8.1.5.2 Water Supply Temperature. Measure the temperature of the water at a location in the water supply line where the measured temperature changes (within the 90 +/−2F supply temperature range) when water is supplied to the icemaker, thus reliably indicating the start of an icemaking cycle. If the temperature changes measurably when the icemaker water supply valve opens, this change may be used to provide an indication of when a new icemaker cycle has started.

8.1.5.3 Solenoid Valve Activation. Measure power input, voltage, or current supplied to the icemaker water supply solenoid valve to indicate when the valve is energized. Make this measurement at a frequency sufficient to identify individual valve activation events, or use an event counter to track valve activation events. Alternatively, measure energy use of the valve with a precision sufficient to indicate individual activation events.

8.2 Baseline Test. Render the icemaker inoperative as described in HRF–1–2008 (incorporated by reference; see § 430.3), section 5.5.2(c), and empty the ice storage bin before beginning the baseline test.

8.2.1 Baseline Test Temperature Control Settings. Baseline test compartment temperatures shall be as defined in sections 5.1.3 and 5.1.4 of this appendix and measured during the same test period used to determine baseline test average power, as described in section 8.2.3. Temperature controls shall be adjusted to their warmest settings for which baseline test compartment temperatures are no more than 1 °F (0.6 °C) warmer than their standardized temperatures, as defined in section 3.2 of this appendix. For products with a single temperature control, this requirement shall apply to the freezer compartment. For mechanical temperature controls, only settings corresponding to positions in which the indicator is aligned with a control symbol shall be used. Temperature controls shall be readjusted and stabilization shall be repeated, if necessary to meet this requirement. Temperature controls shall not be adjusted between the icemaking baseline test and subsequent parts of the icemaking test except as described in section 8.3.2.2.

8.2.2 Stabilization. After setting the temperature controls as described in section 8.2.1, wait until steady-state conditions have been confirmed, as described in section 2.9 of this appendix.

8.2.3 Baseline Test Average Power. The test period shall be as described in section 4.1 of this appendix and shall not include any defrost cycles or events associated with a defrost cycle, such as precooling or recovery. The stabilization period and the baseline test period may overlap, provided the baseline test period ends no earlier than the stabilization period. The baseline test average power, expressed in Watts (W), shall be calculated as:

$$PI1 = \frac{EPI1 \times 1{,}000}{\left(\frac{TI1}{60}\right)}$$

Where:

EPI1 = Energy use measured for the baseline test period (Icemaking Test Period 1), expressed in kilowatt-hours;

TI1 = Length of time in minutes of the baseline test period;

1,000 = conversion factor to adjust kilowatt-hours to watt-hours; and

60 = conversion factor to adjust minutes to hours.

8.3 Icemaking Test.

8.3.1 Initiation and Duration of Icemaking Operation.

8.3.1.1 For units that can complete 24 hours of icemaking or can fill their ice storage bin without encountering a defrost or the precooling preceding the defrost, or for units for which the defrost can be disabled or bypassed by the tester, verify that the ice storage bin is empty and initiate icemaking during a compressor on cycle. Continue the icemaking operation until either:

(a) The ice storage bin becomes full and stops the icemaker, or

(b) an icemaker harvest occurs at least 24 hours after the initial icemaker harvest.

8.3.1.2 For units that cannot complete 24 hours of icemaking without encountering a defrost or the precooling preceding the defrost, verify that the ice storage bin is empty and initiate icemaking shortly after the start of the compressor after a defrost. Continue the icemaking operation until either (a) the ice storage bin becomes full and stops the icemaker, or (b) the next defrost cycle occurs.

8.3.2 Compartment Temperatures.

8.3.2.1 Compartment Temperature Measurement. For products with cycling compressors during icemaking, the compartment temperatures shall be as measured for Icemaking Test Period 3, which is defined in section 8.3.5.2 and comprises a whole number of compressor cycles. For products with non-cycling compressors during icemaking, compartment temperatures shall be as measured for Icemaking Test Period 2, which is defined in section 8.3.4.1 and comprises a whole number of icemaking cycles.

8.3.2.2 Temperature Control Settings. If either compartment temperature is warmer during the icemaking test than it was during the baseline test without making temperature control setting adjustments, the compartment temperature controls shall be adjusted to their warmest settings for which compartment temperatures are no more than 1 °F warmer than their temperatures measured for the baseline test. For products with a single temperature control, this requirement shall apply to the freezer compartment. For mechanical temperature controls, only settings corresponding to positions in which the indicator is aligned with a control symbol shall be used. For products with controls that automatically reduce compartment temperature settings or automatically increase compressor duty cycle or compressor speed to enhance cooling for icemaking, this enhanced cooling feature shall not be disabled during icemaking, and temperature control settings shall not be adjusted.

8.3.3 Ice Mass per Icemaker Cycle.

8.3.3.1 Total Ice Mass. After completion of icemaking, determine the total mass of ice produced, M_{ICE}, expressed in pounds, by weighing the ice storage bin when it contains the ice made during the test and subtracting the weight of the empty ice storage bin.

8.3.3.2 Total Number of Icemaker Cycles. Count the total number of icemaker cycles (*i.e.,* number of harvests), TN_{CYC}, that have occurred between initiation of icemaking and ice weight measurement based on examination of the recorded power input data or the measurements described in section 8.1.5.

8.3.3.3 The Ice Mass per Icemaker Cycle, expressed in pounds, shall be calculated as:

$M_{ICE\_CYC} = M_{ICE}/TN_{CYC}$

Where:

M_{ICE} is defined in section 8.3.3.1; and
TN_{CYC} is defined in section 8.3.3.2.

8.3.4 Energy Use per Ice Mass for Non-Cycling Compressor During Icemaking. This section describes the calculation of energy use per mass of ice produced if the compressor does not cycle during the icemaking test. Icemaking Test Period 2 can be used to measure both energy use per icemaker cycle and icemaking test average power.

8.3.4.1 Icemaking Test Period 2. The test period shall include a whole number of icemaker cycles (defined in section 8.1.5). The following stability requirement shall apply for the chosen test period: the average temperature of the freezer compartment for each complete icemaker cycle included in the test period shall be within 3 °F (1.7 °C) of its temperature average for the full test period. The number of icemaker cycles within the test period is designated N_{CYC}, which can be less than or equal to TN_{CYC}.

8.3.4.2 Icemaking Test Average Power. The test period shall be as described in section 8.3.4.1. The icemaking test average power, expressed in Watts (W), shall be calculated as:

$$PI2 = \frac{EPI2 \times 1{,}000}{\left(\frac{TI2}{60}\right)}$$

Where:

EPI2 = Energy use measured for the icemaking test period (Icemaking Test Period 2), expressed in kilowatt-hours;
TI2 = Length of time in minutes of the icemaking test period;
1,000 = conversion factor to adjust kilowatt-hours to watt-hours; and
60 = conversion factor to adjust minutes to hours.

8.3.4.3 Energy Use per Ice Mass. The energy use per mass of ice produced, EIM, expressed in kilowatt-hours per pound, shall be calculated as:

$$EIM = \frac{(PI2 - PI1) \times \left(\frac{TI2}{60}\right)}{1{,}000 \times M_{ICE_{CYC}} \times N_{CYC}}$$

Where:

PI2 and TI2 are defined in section 8.3.4.2;
PI1 is defined in section 8.2.3;
M_{ICE_CYC} is defined in section 8.3.3.4;
N_{CYC} is defined in section 8.3.4.1;
1,000 = conversion factor to adjust watt-hours to kilowatt-hours; and
60 = conversion factor to adjust minutes to hours.

8.3.5 Energy Use per Ice Mass for Cycling Compressor During Icemaking. This section describes the calculation of energy use per mass of ice produced if the compressor cycles during the icemaking test. Icemaking Test Period 2 shall be used to measure energy use per icemaker cycle and Icemaking Test Period 3 shall be used to measure icemaking test average power.

8.3.5.1 Icemaking Test Period 2. The icemaking test period for measuring energy use per icemaker cycle shall be as described in section 8.3.4.1, except that the stability requirement shall be evaluated for Icemaking Test Period 3 rather than for Icemaking Test Period 2 as follows: the average temperature of the freezer compartment for each compressor cycle within Test Period 3 must be within 3 °F (1.7 °C) of the average temperature of the freezer compartment during Icemaking Test Period 3, which comprises a whole number of compressor cycles. The stability requirement is satisfied if the freezer compartment temperature determined for each compressor cycle contained in the test period is within 3 °F (1.7 °C) of the compartment's temperature for Icemaking Test Period 3.

8.3.5.2 Icemaking Test Period 3. The test period for measuring icemaking average power shall be the longest period that can be selected from the test data that includes a whole number of compressor cycles starting after the start of Icemaking Test Period 2 and ending before the end of Icemaking Test Period 2.

8.3.5.3 Icemaking Test Average Power. The test period for measuring average power shall be as described in section 8.3.5.2. The icemaking test average power, expressed in Watts (W), shall be calculated as:

$$PI3 = \frac{EPI3 \times 1{,}000}{\left(\frac{TI3}{60}\right)}$$

Where:

EPI3 = Energy use measured for Icemaking Test Period 3, expressed in kilowatt-hours;
TI3 = Length of time in minutes of Icemaking Test Period 3;
1,000 = conversion factor to adjust kilowatt-hours to watt-hours; and
60 = conversion factor to adjust minutes to hours.

8.3.5.4 Energy Use per Ice Mass. The energy use per mass of ice produced, EIM, expressed in kilowatt-hours per pound, shall be calculated as:

$$EIM = \frac{(PI3 - PI1) \times (EPI2)}{PI3 \times M_{ICE_{CYC}} \times N_{CYC}}$$

Where:

PI3 is defined in section 8.3.5.3;
PI1 is defined in section 8.2.3;
EPI2 = Energy use, expressed in kilowatt-hours, measured during Icemaking Test Period 2, defined in section 8.3.4.1;
M_{ICE_CYC} is defined in section 8.3.3.4; and
N_{CYC} is defined in section 8.3.4.1;

8.3.6 The icemaking energy use per cycle, IET, expressed in kilowatt-hours per cycle, shall be calculated as:

$IET = 1.8 \times EIM$

Where:

EIM = Energy use per ice mass, defined in section 8.3.4.3 or 8.3.5.4; and
1.8 = Daily ice production in pounds.

■ 10. Appendix B to subpart B of part 430 is amended:
■ a. In section 1. Definitions, by:
■ 1. Redesignating section 1.6 as 1.7;
■ 2. Redesignating section 1.7 as 1.8;
■ 3. Redesignating section 1.8 as 1.10;
■ 4. Redesignating section 1.9 as 1.13;
■ 5. Redesignating section 1.10 as 1.15;
■ 6. Redesignating section 1.11 as 1.17;
■ 7. Redesignating section 1.12 as 1.18;
■ 8. Redesignating section 1.13 as 1.19;
■ 9. Redesignating section 1.14 as 1.22;
■ 10. Redesignating section 1.15 as 1.24;
■ 11. Adding sections 1.6, 1.9, 1.11, 1.12, 1.14, 1.16, 1.20 1.21, and 1.23;
■ b. In section 2. Test Conditions, by;
■ 1. Revising sections 2.1, 2.2, 2.3, 2.4, and 2.6;
■ 2. Adding sections 2.1.1, 2.1.2, 2.1.3, 2.8, and 2.9;
■ c. Revising section 3.2.1 and Table 1 in section 3. Test Control Settings;
■ d. Revising section 4.1 in section 4. Test Period;
■ e. Revising sections 5.1, 5.1.2, 5.2.1.3, and 5.3 in section 5. Test Measurements;
■ f. In section 6. Calculation of Derived Results from Test Measurements, by:
■ 1. Revising section 6.2;
■ 2. Removing section 6.2.1
■ 3. Redesignating section 6.2.1.1 as 6.2.1 and revising the newly designated section 6.2.1;
■ 4. Redesignating section 6.2.1.2 as 6.2.2 and revising the newly designated section 6.2.2;
■ 5. Redesignating section 6.2.2 as 6.2.3 and revising the newly designated section 6.2.3;
■ g. Adding section 8, Icemaking Test.

The additions and revisions read as follows:

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

* * * * *

1. Definitions

1.6 ''Complete temperature cycle'' means a time period defined based upon cycling of compartment temperature that starts when the compartment temperature is at a maximum and ends when the compartment temperature returns to an equivalent maximum (within 0.5 °F of the starting temperature), having in the interim fallen to a minimum and subsequently risen again to reach the second maximum. Alternatively, a complete temperature cycle can be defined to start when the compartment temperature is at a minimum and ends when the compartment temperature returns to an equivalent minimum (within 0.5 °F of the starting temperature), having in the interim risen to a maximum and subsequently fallen again to reach the second minimum.

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1.9 ''Harvest'' means the process of freeing or removing ice pieces from an automatic icemaker.

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1.11 ''Ice piece'' means a piece of ice made by an automatic icemaker that has not been reduced in size by crushing or other mechanical action.

1.12 ''Ice storage bin'' means a container in which ice can be stored.

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1.14 ''Precooling'' means operating a refrigeration system before initiation of a defrost cycle to reduce one or more compartment temperatures significantly (more than 0.5 °F) below its minimum during stable operation between defrosts.

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1.16 ''Recovery'' means operating a refrigeration system after the conclusion of a defrost cycle to reduce the temperature of one or more compartments to the temperature range that the compartment(s) exhibited during stable operation between defrosts.

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1.20 ''Stable operation'' means operation after steady-state conditions have been achieved but excluding any events associated with defrost cycles. During stable operation the rate of change of all compartment temperatures must not exceed 0.042 °F (0.023 °C) per hour. Such a calculation performed for compartment temperatures at any two times, or for any two complete cycles, during stable operation must meet this requirement.

(A) If compartment temperatures do not cycle, the relevant calculation shall be the difference between the temperatures at two points in time divided by the difference, in hours, between those points in time.

(B) If compartment temperatures cycle as a result of compressor cycling or other cycling operation of any system component (e.g., a damper, fan, or heater), the relevant calculation shall be the difference between compartment temperature averages evaluated for whole compressor cycles or complete temperature cycles divided by the difference, in hours, between either the starts, ends, or mid-times of the two cycles.

1.21 ''Stable period of compressor operation'' is a period of stable operation of a refrigeration system that has a compressor.

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1.23 ''Through-the-door ice/water dispenser'' means a device incorporated within the cabinet, but outside the boundary of the refrigerated space, that delivers to the user on demand ice or water from within the refrigerated space without opening an exterior door. This definition includes dispensers that are capable of dispensing ice and water, ice only, or water only.

* * * * *

2. Test Conditions

2.1 Ambient Temperature Measurement. Temperature measuring devices shall be shielded so that indicated temperatures are not affected by the operation of the condensing unit or adjacent units.

2.1.1 Ambient Temperature. The ambient temperature shall be recorded at points located 3 feet (91.5 cm) above the floor and 10 inches (25.4 cm) from the center of the two sides of the unit under test. The ambient temperature shall be 90.0 ±1.0 °F (32.2 ±0.6 °C) during the stabilization period and the test period.

2.1.2 Ambient Temperature Gradient. The test room vertical ambient temperature gradient in any foot of vertical distance from 2 inches (5.1 cm) above the floor or supporting platform to a height of 7 feet (2.2 m) or to a height 1 foot (30.5 cm) above the top of the unit under test, whichever is greater, is not to exceed 0.5 °F per foot (0.9 °C per meter). The vertical ambient temperature gradient at locations 10 inches (25.4 cm) out from the centers of the two sides of the unit being tested is to be maintained during the test. To demonstrate that this requirement has been met, test data must include measurements taken using temperature sensors at locations 2 inches (5.1 cm) and 36 inches (91.4 cm) above the floor or supporting platform and at a height of 1 foot (30.5 cm) above the unit under test.

2.1.3 Platform. A platform must be used if the floor temperature is not within 3 °F (1.7 °C) of the measured ambient temperature. If a platform is used, it is to have a solid top with all sides open for air circulation underneath, and its top shall extend at least 1 foot (30.5 cm) beyond each side and front of the unit under test and extend to the wall in the rear.

2.2 Operational Conditions. The freezer shall be installed and its operating conditions maintained in accordance with HRF–1–2008 (incorporated by reference; see § 430.3), sections 5.3.2 through section 5.5.5.5 (but excluding sections 5.5.5.2 and 5.5.5.4). The quick freeze option shall be switched off except as specified in section 3.1 of this appendix. Additional clarifications are noted in sections 2.3 through 2.9 of this appendix.

2.3 Anti-Sweat Heaters. The anti-sweat heater switch is to be on during one test and off during a second test. In the case of an electric freezer with variable anti-sweat heater control, the standard cycle energy use shall be the result of the calculation described in 6.2.3.

2.4 The unit under test and its refrigerating mechanism shall be assembled and set up in accordance with the printed consumer instructions supplied with the unit. Set-up of the freezer shall not deviate from these instructions, unless explicitly required or allowed by this test procedure. Specific required or allowed deviations from such set-up include the following:

(a) Connection of water lines and installation of water filters are required only when conducting the icemaking test described in section 8 of this appendix;

(b) Clearance requirements from surfaces of the unit shall be as described in section 2.6 of this appendix;

(c) The electric power supply shall be as described in HRF–1–2008 (incorporated by reference; see § 430.3) section 5.5.1;

(d) Temperature control settings for testing shall be as described in section 3 of this appendix. Settings for special compartments shall be as described in section 2.5 of this appendix;

(e) The unit does not need to be anchored or otherwise secured to prevent tipping during energy testing;

(f) All the unit's chutes and throats required for the delivery of ice shall be free of packing, covers, or other blockages that may be fitted for shipping or when the icemaker is not in use; and

(g) Ice storage bins shall be emptied of ice except as required for the icemaking test described in section 8 of this appendix.

For cases in which set-up is not clearly defined by this test procedure, manufacturers must submit a petition for a waiver (see section 7 of this appendix).

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2.6 Rear Clearance.

(a) General. The space between the lowest edge of the rear plane of the cabinet and a vertical surface (the test room wall or simulated wall) shall be the minimum distance in accordance with the manufacturer's instructions, unless other provisions of this section apply. The rear plane shall be considered to be the largest flat surface at the rear of the cabinet, excluding features that protrude beyond this surface, such as brackets, the compressor, or rear-wall-mounted condensers.

(b) Maximum clearance. The clearance shall not be greater than 2 inches (51 mm) from the lowest edge of the rear plane to the vertical surface, unless the provisions of subsection (c) of this section apply.

(c) If permanent rear spacers or other components that protrude beyond the rear plane extend further than the 2 inch (51 mm) distance, or if the highest edge of the rear plane is in contact with the vertical surface when the unit is positioned with the lowest edge of the rear plane at or further than the 2 inch (51 mm) distance from the vertical surface, the appliance shall be located with the spacers or other components protruding beyond the rear plane, or the highest edge of the rear plane, in contact with the vertical surface.

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2.8 Freezers with Demand-Response Capability. For freezers that have a communication module for demand-response functions, whether integrated within the cabinet or external to the cabinet and connected by the consumer, the communication module must be installed, energized, and connected to a network, but there shall be no active communication during testing.

2.9 For products that require the freezer compartment to be loaded with packages in accordance with section 5.5.5.3 of HRF–1–2008, the number of packages comprising the 75% load shall be determined by filling the compartment completely with the packages that are to be used for the test, such that the packages fill as much of the usable refrigerated space within the compartment as is physically possible and removing from the compartment a number of packages so that the compartment contains 75% of the packages that were placed in the compartment to completely fill it. For multi-shelf units this method should be applied to each shelf. The remaining packages may be arranged as necessary to provide the required air gap and thermocouple placement. The number of packages comprising the 100% and 75% loading conditions should be recorded in the test data maintained in accordance with 10 CFR 429.71.

3. Test Control Settings

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3.2 * * *

3.2.1 A first test shall be performed with all temperature controls set at their median position midway between their warmest and coldest settings. For mechanical control systems, (a) knob detents shall be mechanically defeated if necessary to attain a median setting, and (b) the warmest and coldest settings shall correspond to the positions in which the indicator is aligned with control symbols indicating the warmest and coldest settings. For electronic control systems, the test shall be performed with all compartment temperature controls set at the average of the coldest and warmest settings—if there is no setting equal to this average, the setting closest to the average shall be used. If there are two such settings equally close to the average, the higher of these temperature control settings shall be used.

A second test shall be performed with all controls set at either their warmest or their coldest setting (not electrically or mechanically bypassed), whichever is appropriate, to attempt to achieve compartment temperatures measured during the two tests that bound (i.e., one is above and one is below) the standardized temperature. If the compartment temperatures measured during these two tests bound the standardized temperature, then these test results shall be used to determine energy consumption. If the compartment temperature measured with all controls set at their coldest setting is above the standardized temperature, the tested unit fails the test and cannot be rated. If the compartment temperature measured with all controls set at their warmest setting is below the standardized temperature, then the result of this test alone will be used to determine energy consumption. Also see Table 1 of this appendix, which summarizes these requirements.

TABLE 1—TEMPERATURE SETTINGS FOR FREEZERS

First test		Second test		Energy calculation based on—
Settings	Results	Settings	Results	
Mid	Low	Warm	Low	Second Test Only.
			High	First and Second Tests.
	High	Cold	Low	First and Second Tests.
			High	No Energy Use Rating.

* * * * *

4. Test Period

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4.1 Non-automatic Defrost. If the model being tested has no automatic defrost system, the test period shall start after steady-state conditions (see section 2.7 of this appendix) have been achieved and be no less than three hours in duration. During the test period, the compressor motor shall complete two or more whole compressor cycles. (A whole compressor cycle is a complete ‘‘on’’ and a complete ‘‘off’’ period of the motor.) If no ‘‘off’’ cycling occurs, the test period shall be three hours. If incomplete cycling occurs (less than two compressor cycles during a 24-hour period), then a single complete compressor cycle may be used.

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5. Test Measurements

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5.1 Temperature Measurements. Temperature measurements shall be made at the locations prescribed in Figure 5.2 of HRF–1–2008 (incorporated by reference; see § 430.3) and shall be accurate to within ±0.5 °F (0.3 °C).

If the interior arrangements of the unit under test do not conform with those shown in Figure 5.2 of HRF–1–2008, the unit may be tested by relocating the temperature sensors from the locations specified in the figures to avoid interference with non-adjustable hardware or components within the unit, in which case the specific locations used for the temperature sensors shall be noted in the test data records maintained by the manufacturer in accordance with 10 CFR 429.71, and the certification report shall indicate that non-standard sensor locations were used.

If the temperature sensor placement required by this section is impeded by adjustable shelves or other components that could be relocated by the consumer, those components shall be repositioned as necessary to allow for placement of the sensors in the required locations. Any repositioning of components shall adhere as closely as practicable to the set-up instructions specified in section 5.5.2 of HRF–1–2008 while maintaining a minimum 1 inch air space between the sensor thermal mass and adjacent hardware.

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5.1.2 Compartment Temperature. The compartment temperature for each test period shall be an average of the measured temperatures taken in a compartment during the test period as defined in section 4 of this appendix. For long-time automatic defrost models, compartment temperature shall be that measured in the first part of the test period specified in section 4.2.1 of this appendix. For models with variable defrost controls, compartment temperature shall be that measured in the first part of the test period specified in section 4.2.2 of this appendix. For models with automatic defrost that is neither long-time nor variable defrost, the compartment temperature shall be an average of the measured temperatures taken in a compartment during a stable period of compressor operation that;

(a) Includes no defrost cycles or events associated with a defrost cycle, such as precooling or recovery,

(b) Is no less than three hours in duration, and

(c) Includes two or more whole compressor cycles or two or more complete temperature cycles. If neither the compressor nor the temperature cycles, the stable period used for the temperature average shall be three hours in duration.

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5.2.1.3 Variable Defrost Control. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$$ET = (1440 \times K \times EP1/T1) + (EP2 - (EP1 \times T2/T1)) \times K \times (12/CT),$$

Where:

ET, K, and 1440 are defined in section 5.2.1.1;

EP1, EP2, T1, T2, and 12 are defined in section 5.2.1.2;

$$CT = (CT_L \times CT_M)/(F \times (CT_M - CT_L) + CT_L)$$

Where:

CT_L = the shortest compressor run time between defrosts observed for the test—or the shortest compressor run time between defrosts used in the variable defrost control algorithm (greater than or equal to 6 but less than or equal to 12 hours)—whichever is shorter, in hours rounded to the nearest tenth of an hour;

CT_M = maximum compressor run time between defrosts in hours rounded to the nearest tenth of an hour (greater than CT_L but not more than 96 hours);

F = ratio of per day energy consumption in excess of the least energy and the maximum difference in per-day energy consumption and is equal to 0.20.

For variable defrost models with no values for CT_L and CT_M in the algorithm, the default values of 6 and 96 shall be used, respectively. However, the shortest compressor run time between defrosts observed for the test shall be used for CT_L, if it is less than 6.

5.3 Volume Measurements. The unit's total refrigerated volume, VT, shall be measured in accordance with HRF–1–2008 (incorporated by reference; see § 430.3), section 3.30 and sections 4.2 through 4.3. The measured volume shall include all spaces within the insulated volume of each compartment except for the volumes that must be deducted in accordance with section 4.2.2 of HRF–1–2008.

In the case of freezers with automatic icemakers, the volume occupied by the automatic icemaker, including its ice storage bin, is to be included in the volume measurement.

Total refrigerated volume is determined by physical measurement of the test unit. Measurements and calculations used to determine the total refrigerated volume shall be retained as part of the test records underlying the certification of the basic model in accordance with 10 CFR 429.71.

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6. Calculation of Derived Results From Test Measurements

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6.2 Average Per-Cycle Energy Consumption. The average per-cycle energy consumption for a cycle type, E, is expressed in kilowatt-hours per cycle to the nearest one hundredth (0.01) kilowatt-hour, and shall be calculated according to the sections below.

6.2.1 If the compartment temperature is always below 0.0 °F (−17.8 °C), the average per-cycle energy consumption shall be equivalent to:

E = ET1 + IET

Where:

ET is defined in 5.2.1;

The number 1 indicates the test period during which the highest compartment temperature is measured; and

IET, expressed in kilowatt-hours per cycle, equals 0 (zero) for products without an automatic icemaker, and for products with an automatic icemaker shall be equal to 0.23 until the energy conservation standards at 10 CFR 430.32(a) are amended. Beginning on the compliance date of any such amended standards, the icemaking energy shall be calculated as described in section 8.3.6 of this appendix.

6.2.2 If one of the compartment temperatures measured for a test period is greater than 0.0 °F (17.8 °C), the average per-cycle energy consumption shall be equivalent to:

E = ET1 + ((ET2 − ET1) × (0.0 − TF1)/(TF2 − TF1)) + IET

Where:

IET is defined in 6.2.1 and ET is defined in 5.2.1;

TF = freezer compartment temperature determined according to 5.1.3 in degrees F;

The numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate; and

0.0 = standardized compartment temperature in degrees F.

6.2.3 Variable Anti-Sweat Heater Models. The standard cycle energy consumption of an electric freezer with a variable anti-sweat heater control (Estd), expressed in kilowatt-hours per day, shall be calculated equivalent to:

Estd = E + (Correction Factor) where E is determined by 6.2.1, or 6.2.2, whichever is appropriate, with the anti-sweat heater switch in the ''off'' position or, for a product without an anti-sweat heater switch, the anti-sweat heater in its lowest energy use state.

Correction Factor = (Anti-sweat Heater Power × System-loss Factor) × (24 hrs/1 day) × (1 kW/1000 W)

Where:

Anti-sweat Heater Power = 0.034 * (Heater Watts at 5%RH)
+ 0.211 * (Heater Watts at 15%RH)
+ 0.204 * (Heater Watts at 25%RH)
+ 0.166 * (Heater Watts at 35%RH)
+ 0.126 * (Heater Watts at 45%RH)
+ 0.119 * (Heater Watts at 55%RH)
+ 0.069 * (Heater Watts at 65%RH)
+ 0.047 * (Heater Watts at 75%RH)
+ 0.008 * (Heater Watts at 85%RH)
+ 0.015 * (Heater Watts at 95%RH)

Heater Watts at a specific relative humidity = the nominal watts used by all heaters at that specific relative humidity, 72 °F ambient (22.2 °C), and DOE reference freezer (FZ) average temperature of 0 °F (−17.8 °C).

System-loss Factor = 1.3

* * * * *

8. Icemaking Test

This section would apply to manufacturers seeking to demonstrate compliance with any new or amended energy conservation standard that DOE may issue in a final rule for refrigerators, refrigerator-freezers, and freezers after September 15, 2014. Absent the issuance of a test procedure waiver by the Department of Energy permitting the earlier use of this section, this section is not required unless and until such final rule is issued.

8.1 Special Test Conditions.

8.1.1 Multiple Icemakers. If one of the automatic icemakers in a product with multiple icemakers serves a through-the-door ice dispenser, initiate icemaking only for this icemaker when conducting the icemaking part of the test of section 8.3.

8.1.2 Anti-sweat Heater. The anti-sweat heater switch shall be off for the icemaking test. In the case of a freezer equipped with variable anti-sweat heater control but without an anti-sweat heater switch, the test shall be conducted in an ambient humidity condition that will prevent the anti-sweat heater from being energized.

8.1.3 Connection of water lines and installation of water filters are required. Inlet water temperature shall be 90 +/− 2 °F. The water supply system shall be designed to assure that inlet water temperature stays within this specified range at all times during the test. Inlet water pressure shall be 60 +/− 15 psig.

8.1.4 Data collection frequency for temperatures, power, and energy shall be no less than once per minute.

8.1.5 Icemaker Cycle Indication. The end of one icemaker cycle and the start of the following icemaker cycle is defined to occur when the mold heater (to release ice pieces) is turned off. When measuring energy use for an icemaker (a) without a mold heater or (b) for which review of test data does not allow easy determination of the times that a mold heater was turned off, the end of one icemaker cycle and the start of the following icemaker cycle is defined to occur when one of the methods described in this section indicates the initiation of water flow into the icemaker mold. One of the following measurement approaches shall be used to indicate the start and end of icemaker cycles using measurements at a data acquisition time interval no greater than the data acquisition time interval used for the test's energy and temperature measurements. The test data record maintained in accordance with 10 CFR 429.71 shall indicate which of these three methods is used.

8.1.5.1 Mold Temperature. Measure icemaker mold temperature during the test with a temperature sensor adhered to the bottom of the icemaker mold. Ensure that the temperature sensor is installed so that the icemaker operation, including operations such as twisting of the icemaker mold and ice dropping into the ice bin, will not be impeded by the temperature sensor and its connecting wire(s), and that neither the temperature sensor nor its connecting wire(s) will be dislodged or damaged by icemaker operation.

8.1.5.2 Water Supply Temperature. Measure the temperature of the water at a location in the water supply line where the measured temperature changes (within the 90 ±2F supply temperature range) when water is supplied to the icemaker, thus reliably indicating the start of an icemaking cycle. If the temperature changes measurably when the icemaker water supply valve opens, this change may be used to provide an indication of when a new icemaker cycle has started.

8.1.5.3 Solenoid Valve Activation. Measure power input, voltage, or current supplied to the icemaker water supply solenoid valve to indicate when the valve is energized. Make this measurement at a frequency sufficient to identify individual valve activation events, or use an event counter to track valve activation events. Alternatively, measure energy use of the valve with a precision sufficient to indicate individual activation events.

8.2 Baseline Test. Render the icemaker inoperative as described in HRF–1–2008 (incorporated by reference; see § 430.3), section 5.5.2(c), and empty the ice storage bin before beginning the baseline test.

8.2.1 Baseline Test Temperature Control Settings. Baseline test compartment temperatures shall be as defined in section 5.1.3 of this appendix and measured during the same test period used to determine baseline test average power, as described in section 8.2.3. Temperature controls shall be adjusted to their warmest settings for which baseline test compartment temperatures are no more than 1 °F (0.6 °C) warmer than their standardized temperatures, as defined in section 3.2 of this appendix. For mechanical temperature controls, only settings corresponding to positions in which the indicator is aligned with a control symbol shall be used. Temperature controls shall be readjusted and stabilization shall be repeated, if necessary to meet this requirement. Temperature controls shall not be adjusted between the icemaking baseline test and subsequent parts of the icemaking test except as described in section 8.3.2.2.

8.2.2 Stabilization. After setting the temperature controls as described in section 8.2.1, wait until steady-state conditions have been confirmed, as described in section 2.7 of this appendix.

8.2.3 Baseline Test Average Power. The test period shall be as described in section 4.1 of this appendix and shall not include any defrost cycles or events associated with a defrost cycle, such as precooling or recovery. The stabilization period and the baseline test period may overlap, provided the baseline test period ends no earlier than the stabilization period. The baseline test average power, expressed in Watts (W), shall be calculated as:

$$PI1 = \frac{EPI1 \times 1{,}000}{\left(\frac{TI1}{60}\right)}$$

Where:

EPI1 = Energy use measured for the baseline test period (Icemaking Test Period 1), expressed in kilowatt-hours;
TI1 = Length of time in minutes of the baseline test period;
1,000 = conversion factor to adjust kilowatt-hours to watt-hours; and
60 = conversion factor to adjust minutes to hours.

8.3 Icemaking Test

8.3.1 Initiation and Duration of Icemaking Operation

8.3.1.1 For units that can complete 24 hours of icemaking or can fill their ice storage bin without encountering a defrost or the precooling preceding the defrost, or for units for which the defrost can be disabled or bypassed by the tester, verify that the ice storage bin is empty and initiate icemaking during a compressor on cycle. Continue the icemaking operation until either:

(a) The ice storage bin becomes full and stops the icemaker, or

(b) An icemaker harvest occurs at least 24 hours after the initial icemaker harvest.

8.3.1.2 For units that cannot complete 24 hours of icemaking without encountering a defrost or the precooling preceding the defrost, verify that the ice storage bin is empty and initiate icemaking shortly after the start of the compressor after a defrost. Continue the icemaking operation until either:

(a) The ice storage bin becomes full and stops the icemaker, or

(b) The next defrost cycle occurs.

8.3.2 Compartment Temperature.

8.3.2.1 Compartment Temperature Measurement. For products with cycling compressors during icemaking, the compartment temperature shall be as measured for Icemaking Test Period 3, which is defined in section 8.3.5.2 and comprises a whole number of compressor cycles. For products with non-cycling compressors during icemaking, compartment temperatures shall be as measured for Icemaking Test Period 2 (defined in section 8.3.4.1) and comprises a whole number of icemaking cycles.

8.3.2.2 Temperature Control Settings. If the compartment temperature is warmer during the icemaking test than it was during the baseline test without making temperature control setting adjustments, the compartment temperature control shall be adjusted to its warmest setting for which compartment temperature is no more than 1 °F warmer than its temperature measured for the baseline test. For mechanical temperature controls, only settings corresponding to positions in which the indicator is aligned with a control symbol shall be used. For products with controls that automatically reduce compartment temperature settings or automatically increase compressor duty cycle or compressor speed to enhance cooling for icemaking, this enhanced cooling feature shall not be disabled during icemaking, and temperature control settings shall not be adjusted.

8.3.3 Ice Mass per Icemaker Cycle

8.3.3.1 Total Ice Mass. After completion of icemaking, determine the total mass of ice produced, M_{ICE}, expressed in pounds, by weighing the ice storage bin when it contains the ice made during the test and subtracting the weight of the empty ice storage bin.

8.3.3.2 Total Number of Icemaker Cycles. Count the total number of icemaker cycles (*i.e.*, number of harvests), TN_{CYC}, that have occurred between initiation of icemaking and ice weight measurement based on examination of the recorded power input data or the measurements described in section 8.1.5.

8.3.3.3 The Ice Mass per Icemaker Cycle, expressed in pounds, shall be calculated as:

$M_{ICE\_CYC} = M_{ICE}/TN_{CYC}$

Where:

M_{ICE} is defined in section 8.3.2.1; and
TN_{CYC} is defined in section 8.3.2.2.

8.3.4 Energy Use per Ice Mass for Non-Cycling Compressor During Icemaking. This section describes the calculation of energy use per mass of ice produced if the compressor does not cycle during the icemaking test. Icemaking Test Period 2 can be used to measure both energy use per icemaker cycle and icemaking test average power.

8.3.4.1 Icemaking Test Period 2. The test period shall include a whole number of icemaker cycles (defined in section 8.1.5). The following stability requirement shall apply for the chosen test period: the average temperature of the freezer compartment for each complete icemaker cycle included in the test period shall be within 3 °F (1.7 °C) of its temperature average for the full test period. The number of icemaker cycles within the test period is designated N_{CYC}, which can be less than or equal to TN_{CYC}.

8.3.4.2 Icemaking Test Average Power. The test period shall be as described in section 8.3.4.1. The icemaking test average power, expressed in Watts (W), shall be calculated as:

$$PI2 = \frac{EPI2 \times 1{,}000}{\left(\frac{TI2}{60}\right)}$$

Where:

EPI2 = Energy use measured for the icemaking test period (Icemaking Test Period 2), expressed in kilowatt-hours;
TI2 = Length of time in minutes of the icemaking test period;
1,000 = conversion factor to adjust kilowatt-hours to watt-hours; and
60 = conversion factor to adjust minutes to hours.

8.3.4.3 Energy Use per Ice Mass. The energy use per mass of ice produced, EIM, expressed in kilowatt-hours per pound, shall be calculated as:

$$EIM = \frac{(PI2 - PI1) \times \left(\frac{TI2}{60}\right)}{1{,}000 \times M_{ICE_{CYC}} \times N_{CYC}}$$

Where:

PI2 and TI2 are defined in section 8.3.4.2;
PI1 is defined in section 8.2.3;
M_{ICE_CYC} is defined in section 8.3.3.4;
N_{CYC} is defined in section 8.3.4.1;
1,000 = conversion factor to adjust watt-hours to kilowatt-hours; and
60 = conversion factor to adjust minutes to hours.

8.3.5 Energy Use per Ice Mass for Cycling Compressor During Icemaking. This section describes the calculation of energy use per mass of ice produced if the compressor cycles during the icemaking test. Icemaking Test Period 2 shall be used to measure energy use per icemaker cycle and Icemaking Test Period 3 shall be used to measure icemaking test average power.

8.3.5.1 Icemaking Test Period 2. The icemaking test period for measuring energy use per icemaker cycle shall be as described in section 8.3.4.1, except that the stability requirement shall be evaluated for Icemaking Test Period 3 rather than for Icemaking Test Period 2 as follows: the average temperature of the freezer compartment for each compressor cycle within Test Period 3 must be within 3 °F (1.7 °C) of the average temperature of the freezer compartment during Icemaking Test Period 3.

8.3.5.2 Icemaking Test Period 3. The test period for measuring icemaking average power shall be the longest period that can be selected from the test data that includes a whole number of compressor cycles starting after the start of Icemaking Test Period 2 and ending before the end of Icemaking Test Period 2.

8.3.5.3 Icemaking Test Average Power. The test period for measuring average power shall be as described in section 8.3.5.2. The icemaking test average power, expressed in Watts (W), shall be calculated as:

$$PI3 = \frac{EPI3 \times 1{,}000}{\left(\frac{TI3}{60}\right)}$$

Where:

EPI3 = Energy use measured for Icemaking Test Period 3, expressed in kilowatt-hours;
TI3 = Length of time in minutes of Icemaking Test Period 3;
1,000 = conversion factor to adjust kilowatt-hours to watt-hours; and
60 = conversion factor to adjust minutes to hours.

8.3.5.4 Energy Use per Ice Mass. The energy use per mass of ice produced, EIM, expressed in kilowatt-hours per pound, shall be calculated as:

$$EIM = \frac{(PI3 - PI1) \times (EPI2)}{PI3 \times M_{ICE_{CYC}} \times N_{CYC}}$$

Where:

PI3 is defined in section 8.3.5.3;
PI1 is defined in section 8.2.3;

EPI2 = Energy use, expressed in kilowatt-hours, measured during Icemaking Test Period 2, defined in section 8.3.4.1;

M_{ICE_CYC} is defined in section 8.3.3.4; and

N_{CYC} is defined in section 8.3.4.1;

8.3.6 The icemaking energy use per cycle, IET, expressed in kilowatt-hours per cycle, shall be calculated as:

$$IET = 1.8 \times EIM$$

Where:

EIM = Energy use per ice mass, defined in section 8.3.4.3 or 8.3.5.4; and

1.8 = Daily ice production in pounds.

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