DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket No. EERE–2009–BT–TP–0003]

RIN 1904–AB92

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 (NOPR) to amend the test procedures for refrigerators, refrigerator-freezers, and freezers. The NOPR consists of two parts. First, it proposes amending the current procedure by adding test procedures to account for refrigerator-freezers equipped with variable anti-sweat heater controls, amending the long-time automatic defrost test procedure to capture all energy use associated with the defrost cycle expended during testing, establishing test procedures for refrigerator-freezers equipped with more than two compartments, making minor adjustments to the language to eliminate any potential ambiguity regarding how to conduct tests, and requiring certain information in certification reports to clarify how some products are tested to determine their energy ratings. Second, the notice proposes amended test procedures for refrigerators, refrigerator-freezers, and freezers that would be required for measuring energy consumption once DOE promulgates new energy conservation standards for these products. These new standards are currently under development in a separate rulemaking activity. Pursuant to the Energy Policy and Conservation Act of 1975, as amended, these new standards would apply to newly manufactured products starting on January 1, 2014. While the amended test procedures would be based largely on the test methodology used in the existing test procedures, they also include significant revisions with respect to the measurement of compartment temperatures and compartment volumes that would provide a more comprehensive accounting of energy usage by these products. Finally, the new test procedure for 2014 would incorporate into the energy use metric the energy use associated with icemaking for products with automatic icemakers. This NOPR also discusses the proposed treatment of combination wine storage-freezer products that were the subject of a recent test procedure waiver, the testing of refrigeration products with the anti-sweat heater switch turned off, the treatment of auxiliary features used in refrigeration products, the treatment of electric heaters in the current and proposed test procedures, and the incorporation of icemaking energy use in the test procedure.

DATES: DOE will hold a public meeting on Tuesday, June 22, 2010, from 9 a.m. to 4 p.m., in Washington, DC. DOE must receive requests to speak at the public meeting before 4 p.m., Tuesday, June 8, 2010. DOE must receive a signed original and an electronic copy of statements to be given at the public meeting before 4 p.m., Tuesday, June 15, 2010.

DOE will accept comments, data, and information regarding this NOPR before and after the public meeting, but no later than August 10, 2010. *See* section V, "Public Participation," of this NOPR 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 20585–0121. To attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945. (Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the public meeting should advise DOE as soon as possible by contacting Ms. Edwards to initiate the necessary procedures.)

Any comments submitted must identify the NOPR on Test Procedures for Refrigerators, Refrigerator-Freezers, and Freezers, and provide the docket number EERE–2009–BT–TP–0003 and/or Regulatory Information Number (RIN) 1904–AB92. Comments may be submitted using any of the following methods:

- *Federal eRulemaking Portal: http://www.regulations.gov.* Follow the instructions for submitting comments.
- *E-mail: Refrig-2009–TP–0003@ee.doe.gov.* Include docket number EERE–2009–BT–TP–0003 and/or RIN 1904–AB92 in the subject line of the message.
- *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Please submit one signed paper original.
- *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. Please submit one signed paper original.

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

Docket: For access to the docket to read background documents or comments received, visit the U.S. Department of Energy, Resource Room of the Building Technologies Program, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC 20024, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Please call Ms. Brenda Edwards at the above telephone number for additional information about visiting the Resource Room.

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. Telephone: (202) 287–1317. E-mail: *Lucas.Adin@ee.doe.gov.*

Mr. Michael Kido, U.S. Department of Energy, Office of the General Counsel, GC–72, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 586–8145. E-mail: *Michael.Kido@hq.doe.gov.*

For information on how to submit or review public comments and on how to participate in the public meeting, contact Ms. Brenda Edwards, 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. Telephone: (202) 586–2945. E-mail: *Brenda.Edwards@ee.doe.gov.*

SUPPLEMENTARY INFORMATION:

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), Public Law 110–140 (Dec. 19, 2007)). Part A of title III (42 U.S.C. 6291–6309) establishes the "Energy Conservation Program for Consumer Products Other Than Automobiles," which includes refrigerators, refrigerator-freezers, and freezers, all of which are referred to below as "covered products". (42 U.S.C. 6291(1)–(2) and 6292(a)(1)) "Refrigerators, refrigerator-freezers, and freezers" are referred to below, collectively, as "refrigeration products". 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, pursuant to EPCA, manufacturers of covered products must use (1) as the basis for certifying to the DOE that their products comply with 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 residential 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 on or after July 1, 2001. 62 FR 23102.

EISA 2007 amended EPCA to require DOE to determine by December 31, 2010, whether amending the energy conservation standards in effect for refrigeration products would be justified. (42 U.S.C. 6295(b)(4)) As a result, DOE has initiated a standards rulemaking for these products. On September 18, 2008, DOE announced the availability of a framework document to initiate that rulemaking. (73 FR 54089) On September 29, 2008, DOE held a public workshop to discuss the framework document and issues related to the rulemaking. The framework document identified several test procedure issues, including: (1) Compartment temperature changes; (2) modified volume calculation methods; (3) products that deactivate energy-using features during energy testing; (4) variable anti-sweat heaters; (5) references to the updated Association of Home Appliance Manufacturers (AHAM) HRF–1 test standard, "Energy and Internal Volume of Refrigerating Appliances", published in 2008 (HRF–1–2008); (6) convertible compartments; and (7) harmonization with international test procedures. ("Energy Conservation Standards Rulemaking Framework Document for Residential Refrigerators, Refrigerator-Freezers, and Freezers", RIN 1904–AB79, Docket No. EERE–2008–BT–STD–0012) Separately, DOE raised the issue of how to address various aspects related to the icemaker, including the manner in which to measure icemaking energy usage as well as set-up issues during testing. ("Additional Guidance Regarding Application of Current Procedures for Testing Energy Consumption of Refrigerator-Freezers with Automatic Ice Makers", (December 18, 2009) published at 75 FR 2122 (January 14, 2010)) The test procedure rulemaking announced by today's notice seeks to address these issues and to establish a procedure that will be used for determining compliance with the new energy conservation standards under development.

General Test Procedure Rulemaking Process

Under 42 U.S.C. 6293, EPCA sets forth the criteria and procedures for DOE's adoption and amendment of such test procedures. 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 addition, if DOE determines that a test procedure amendment is warranted, it must publish proposed test procedures and offer the public an opportunity to present oral and written comments. (U.S.C. 6293(b)(2)) Finally, in any rulemaking to amend a test procedure, DOE must determine "to what extent, if any, the proposed test procedure would alter the measured energy efficiency * * * of any covered product as determined under the existing test procedure.” (42 U.S.C. 6293(e)(1)) If DOE determines that the amended test procedure would alter the measured efficiency of a covered product, DOE must amend the applicable energy conservation standard accordingly. (42 U.S.C. 6293(e)(2))

With respect to today's rulemaking, DOE has tentatively determined that at least some of the amendments it is proposing may result in a change in measured efficiency when compared to the current test procedure, although DOE has not quantified the full impact of these anticipated changes. In such situations, EPCA requires a standards rulemaking to address such changes in measured energy efficiency. (42 U.S.C. 6293(e)(2)) However, DOE is presently under an obligation under 42 U.S.C. 6295(b)(4) to conduct an amended standards rulemaking for refrigeration products by December 31, 2010. Consequently, DOE will consider the impacts of the test procedure changes that are affected by this rulemaking in the context of that standards rulemaking. DOE requests comments regarding what impacts, if any, would be associated with the test procedure amendments proposed to be adopted prior to the effective date of the new energy conservation standards. These comments should specifically address the amendments proposed in section III.D.

DOE also considers the activity initiated by today's notice sufficient to satisfy the 7-year review requirement established by Section 302 of EISA 2007 to review its test procedures for all covered products at least once every seven years, including refrigeration products, and either amend the applicable test procedures or publish a determination in the **Federal Register** not to amend it. (42 U.S.C. 6293(b)(1)(A))

Because DOE's existing test procedures for these products were already in place on December 19, 2007, when the 7-year test procedure review provisions of EPCA were enacted (42 U.S.C. 6293(b)(1)(A)), DOE would have had to review these test procedures by December 2014. However, since DOE is already considering changes to the test procedure in anticipation of the 2014 rulemaking required by Congress, DOE is satisfying this requirement in advance of that date. This rulemaking satisfies those review requirements in that it constitutes a review of the current procedures and proposes amendments to those procedures for refrigeration products.

Refrigerators and Refrigerator-Freezers

DOE's test procedures for refrigerators and refrigerator-freezers are found at 10 CFR part 430, subpart B, Appendix A1. 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 system that varies the time intervals between defrosts based on the defrost need). 54 FR 36238. DOE most recently amended these test procedures in a final rule published March 7, 2003, which modified the test period used for products equipped with long-time automatic defrost. 68 FR 10957. The term “long-time automatic defrost” identifies the use of an automatic defrost control in which successive defrosts are separated by more than 14 hours of compressor run time. The test procedures include provisions for determining the annual energy use in kilowatt-hours (kWh) and the annual operating cost for electricity for refrigerators and refrigerator-freezers.

Also, consistent with the regulations set out in 10 CFR part 430, the 1989 and 2003 final rules terminated all the previous refrigerator and refrigerator-freezer test procedure waivers that DOE had previously granted to manufacturers before the issuance of the 2003 rule. Since the issuance of that rule, DOE has granted four waivers and three interim waivers. First, on April 24, 2007, DOE permitted Liebherr Hausgeräte to test a combination wine storage-freezer line of appliances using a standardized temperature of 55 °F for the wine storage compartment, as opposed to the 45 °F prescribed for fresh food compartments of refrigerators and refrigerator-freezers. 72 FR 20333, 20334.

Second, DOE has granted waivers and interim waivers allowing manufacturers to use a modified procedure to test refrigeration products that use ambient condition sensors that adjust anti-sweat heater power consumption. These heaters prevent condensation on the external surfaces of refrigerators and refrigerator-freezers. The new control addressed by the waivers uses sensors that detect ambient conditions to energize the heaters only when needed. The procedure described by these waivers provides a method for manufacturers to determine the energy consumed by a refrigerator using this type of variable control system. The first of these waivers was granted to the General Electric Company (GE) on February 27, 2008. 73 FR 10425. DOE granted a similar waiver to Whirlpool Corporation on May 5, 2009. 74 FR 20695. DOE published a petition for a third waiver from Electrolux Home Products, Inc. (Electrolux) and granted its application for an interim waiver on June 4, 2009. 74 FR 26853. On December 15, 2009, DOE granted a waiver to Electrolux (74 FR 66338) and published a petition for a second waiver to Electrolux seeking to extend the coverage of this waiver to additional basic models. 74 FR 66344. On December 15, 2009, DOE also published a petition from Samsung Electronics America (Samsung) seeking a waiver for variable control of anti-sweat heaters and granted the company an interim waiver. 74 FR 66340.

After granting a waiver, DOE regulations generally direct the agency to initiate a rulemaking that would amend the regulations to eliminate the continued need for the waiver. 10 CFR 430.27(m). Today's notice addresses this requirement. Once this rule becomes effective, any waivers it addresses will terminate.

Freezers

DOE's test procedures for freezers are found at 10 CFR part 430, subpart B, Appendix B1. 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 test procedures were amended on September 20, 1989, to correct the effective date published in the August 31, 1989 rule. See 54 FR 38788. The test procedures include provisions for determining the annual energy use in kWh and annual electrical operating costs for freezers.

DOE has not issued any waivers from the freezer test procedures since the promulgation of the 1989 final rule.

II. Summary of the Proposal

The proposed rule contains two basic parts. First, it would amend the current DOE test procedures for refrigerators, refrigerator-freezers, and freezers, to clarify the manner in which to test for compliance with existing energy conservation standards. As indicated in greater detail below, these proposed amendments, if adopted, would apply strictly to the current procedures in Appendices A1 and B1. These minor amendments would eliminate any potential ambiguity contained in these appendices and clarify regulatory text to ensure that regulated entities fully understand the long-standing views and interpretations that the Department holds with respect to the application and implementation of the test procedures that are in place. The current procedures would also be amended to account for, among other things, the various waivers granted by DOE.

Second, the proposal would establish comprehensive changes to the manner in which the procedures are conducted by creating new Appendices A and B. Elements from the proposed amendments to Appendices A1 and B1 would also be carried over into the new Appendices A and B. The procedures contained in these new appendices would apply only to those products that would be covered by any new standard that DOE promulgates and would be organized separately from the current test procedures found in Appendices A1 and B1. EPCA requires these new standards to take effect by January 1, 2014. While DOE is proposing to retain current Appendices A1 and B1 for this rulemaking to cover products manufactured before the effective date of the new standards, once the new standards become effective, these appendices would be replaced by Appendices A and B, respectively. Consequently, DOE would apply the procedures detailed in the proposed Appendices A and B to potential revisions to the energy conservation standards for refrigerators, refrigerator-freezers, and freezers.

The proposed amendments discussed in this notice would, if adopted, take effect 30 days after issuance of the final rule. However, manufacturers would not need to use Appendices A and B until the compliance date for the 2014 standards, which has been set by Congress through EISA 2007 (*i.e.* January 1, 2014). See EISA 2007, sec. 311(a)(3) (42 U.S.C. 6295(b)(4))

The proposed revisions of Appendices A1 and B1 would achieve four primary goals: (1) Address issues raised in the framework document, by stakeholders during the framework workshop, and in written comments; (2) incorporate test procedures for refrigerator-freezers with variable anti-sweat heater controls that were the subject of test procedure waivers granted to General Electric, Whirlpool, and Electrolux and an interim waiver granted to Samsung, (3) modify the long-time automatic defrost test procedure to ensure that the test procedure measures all energy use associated with the defrost function, and (4) clarify the test procedures for addressing special compartments and those refrigerator-freezers that are equipped with more than two compartments. The revisions also address areas of potential inconsistency in the current procedure, and eliminate an optional test that DOE understands is not used by the industry.

The test procedure revisions in the new Appendices A and B would include (1) new compartment temperatures for refrigerators and refrigerator-freezers, and (2) new methods for measuring compartment volumes for all refrigeration products. These two amendments would improve harmonization with relevant international standards and test repeatability. The compartment temperature changes would significantly impact the energy use measured by the test for refrigerators and refrigerator-freezers. The new volume calculation method being proposed would change the adjusted volume for all refrigeration products. The proposed temperature changes would also affect the calculated adjusted volume, which is equal to the fresh food compartment volume plus a temperature-dependent adjustment factor multiplied by the freezer compartment volume. Since the standards for refrigeration products are expressed as equations that specify maximum energy use as a function of adjusted volume, the proposed modifications would impact the allowable energy use for all of these products. The proposed changes would also change the energy factor, which is equal to adjusted volume divided by daily energy consumption.

This notice also discusses the combination wine storage-freezer products that were the subject of the Liebherr Hausgeräte test procedure waiver. While DOE expects to propose modified product definitions to include coverage of wine storage products in a separate future rulemaking addressing just these products, DOE proposes in this current rulemaking to establish consistency in its treatment of wine coolers and wine storage-freezers.

Lastly, this notice also discusses (1) the measurement of energy use of electric heaters in refrigeration products, (2) the energy use of auxiliary features, and (3) the incorporation of the measurement of icemaking energy use into the test procedure. Incorporating the measurement of icemaking energy use would add the energy used to produce ice in refrigeration products that are equipped with automatic icemakers. This addition would improve the consistency of the measurement with the representative use cycle for such products.

III. Discussion

Table 1 below summarizes the subsections of this section and indicates where the proposed amendments would appear in each appendix. Three of the subsections address proposed changes in sections of 10 CFR 430 other than appendices A1, B1, A, or B, and four of the subsections would not have any proposed test procedure changes associated with them.

TABLE 1—SECTION III SUBSECTIONS

Section	Title	Affected appendices			
		A1	B1	A	B
A	Products Covered by the Proposed Revisions	No proposed change is associated with this section of the NOPR.			
B	Combination Wine Storage-Freezer Units	*			
C	Establishing New Appendices A and B, and Compliance Date for the Amended Test Procedures.	✓	✓	✓	✓

TABLE 1—SECTION III SUBSECTIONS—Continued

Section	Title	Affected appendices			
		A1	B1	A	B
D.1	Procedures for Test Sample Preparation	✓	✓	✓	✓
D.2	Product Clearances to Walls During Testing	✓	✓	✓	✓
D.3	Alternative Compartment Temperature Sensor Locations.	✓	✓	✓	✓
D.4	Median Temperature Settings for Electronic Control Products.	✓	✓	✓	✓
D.5	Test Procedures for Convertible Compartments and Special Compartments.	✓	....	✓	....
D.6	Establishing a Temperature-Averaging Procedure for Auxiliary Compartments.	✓	✓	✓	✓
D.7	Modified Definition for Anti-Sweat Heater	✓	✓	✓	✓
D.8	Testing with the Anti-Sweat Heater Switch Turned Off.	**			
D.9	Incorporation of Test Procedures for Products with Variable Anti-Sweat Heating Control Waivers.	✓	....	✓	....
D.10	Modification of Long-Time and Variable Defrost Test Method to Capture Precooling Energy.	✓	✓	✓	✓
D.11	Establishing Test Procedures for Multiple Defrost Cycle Types.	✓	....	✓	....
D.12	Elimination of Part 3 of the Variable Defrost Test.	✓	✓	✓	✓
D.13.A	A: Simplification of Energy Use Equation for Products with Variable Defrost Control.	✓	✓	✓	✓
D.13.B	B: Energy Testing and Energy Use Equation for Products with Dual Automatic Defrost.	✓	....	✓	....
D.14	Including in Certification Reports Basic Information Clarifying Energy Measurements.	***			
E.1	Incorporating by Reference AHAM Standard HRF–1–2008 for Measuring Energy and Internal Volume of Refrigerating Appliances.	....	....	✓	✓
E.2	Establishing New Compartment Temperatures	....	....	✓	✓
E.3	Establishing New Volume Calculation Method	....	....	✓	✓
E.4	Control Settings for Refrigerators and Refrigerator-Freezers During Testing.	....	....	✓	✓
E.5	Icemakers and Icemaking	....	....	✓	✓
F.1	Electric Heaters	No proposed changes to the regulatory language are associated with these sections of the NOPR.			
F.2	Rounding Off Energy Test Results				
G.1	Test Burden				
G.2	Potential Amendments to Include Standby and Off Mode Energy Consumption.				

* This amendment would appear in 10 CFR 430.2.
** This amendment would appear in 10 CFR 430.23.
*** This amendment would appear in 10 CFR 430.62.

A. Products Covered by the Proposed Revisions

The current regulations define the terms "refrigerators," "refrigerator-freezers," and related terms as follows:

"Refrigerator" means an electric refrigerator.

"Refrigerator-freezer" means an electric refrigerator-freezer.

"Electric refrigerator" means a cabinet designed for the refrigerated storage of food at temperatures above 32 °F and below 39 °F, configured for general refrigerated food storage, and having a source of refrigeration requiring single phase, alternating current electric energy input only. An electric refrigerator may include a compartment for the freezing and storage of food at temperatures below 32 °F, but does not provide a separate low temperature compartment designed for the freezing and storage of food at temperatures below 8 °F.

"Electric refrigerator-freezer" means a cabinet which consists of two or more compartments with at least one of the compartments designed for the refrigerated storage of food at temperatures above 32 °F and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8 °F which may be adjusted by the user to a temperature of 0 °F or below. The source of refrigeration requires single phase, alternating current electric energy input only.

10 CFR 430.2.

This rulemaking proposes to change the definition for electric refrigerator-freezer to limit the fresh food compartment temperature range to a maximum temperature of 39 °F, consistent with the definition for electric refrigerator. This specific proposal is discussed further in section III.B. No change is being proposed to the definition for electric refrigerator but DOE is open to comments on possible improvements to enhance the clarity of this term and may incorporate such changes in the final rule.

DOE notes that its regulations currently define a freezer as "a cabinet designed as a unit for the freezing and storage of food at temperatures of 0 °F or below, and having a source of refrigeration requiring single phase, alternating current electric energy input only." 10 CFR 430.2. No change in this definition is being proposed at this time but, as with the definition for electric refrigerator-freezers, DOE is interested in receiving comments on this issue to help improve the definition's clarity and may decide to modify the definition based on these comments.

B. Combination Wine Storage-Freezer Units

DOE amended its definition of electric refrigerators to exclude wine storage products on November 19, 2001. 66 FR 57845. Specifically, the definition was changed to exclude products that do not maintain internal temperatures below 39 °F. The final rule explained that these products "are configured with special storage racks for wine bottles and in general do not attain as low a storage temperature as a standard refrigerator. These characteristics make them unsuitable for general long-term storage of perishable foods." 66 FR 57846. The final rule also stated that "sales of these products are small and excluding them from coverage would not have any significant impacts." Id.

DOE, however, did not change the definition of electric refrigerator-freezers to exclude products such as the Liebherr line of wine storage-freezer appliances, which contain both freezer and wine storage compartments. DOE believes that the arguments made in favor of excluding wine storage products from the definition of electric refrigerators also apply to combination appliances such as these wine storage-freezer combination appliances—*i.e.,* the wine storage compartment does not attain temperatures which are suitable for long-term storage of perishable foods, and the sales levels of such products are small.

The current test procedure does not address the treatment of wine storage-freezer products. Because of this gap, Liebherr Hausgeräte (Liebherr) petitioned the agency for a test procedure waiver to address this product. (72 FR 20333) DOE granted a test procedure waiver to Liebherr on April 24, 2007 (Liebherr waiver) that permitted the company to test and certify its combination wine storage-freezer line of appliances. (72 FR 20333) The waiver specified that testing shall be conducted following the test procedures for refrigerator-freezers, except that the standard temperature for the wine-storage compartment shall be 55 °F, as opposed to 45 °F as specified in the test procedures for refrigerator-freezers. (72 FR 20334)

Under DOE's regulations, DOE must publish a NOPR to amend the DOE test procedures to eliminate the continued need for the waiver. A final rule must issue "as soon thereafter as practicable." The waiver would then terminate on the effective date of the final rule. 10 CFR 430.27(m). Accordingly, to address this requirement and the treatment of these products, DOE proposes to modify the definition of electric refrigerator-freezers in order to exclude products with wine storage or other compartments that do not attain suitable temperatures for food storage. The proposed modified definition is as follows:

"Electric refrigerator-freezer" means a cabinet which consists of two or more compartments with at least one of the compartments designed for the refrigerated storage of food at temperatures above 32 °F and below 39 °F and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8 °F which may be adjusted by the user to a temperature of 0 °F or below. Additional compartments shall be designed for temperatures in any range up to 39 °F. The source of refrigeration requires single phase, alternating current electric energy input only.

This definition of refrigerator-freezer, if adopted, would exclude the Liebherr product line and other similar products from coverage under the test procedures and energy conservation standards for refrigerator-freezers. DOE is proposing this approach to maintain consistency with treatment of single-compartment wine storage products, which were eliminated from coverage by the definition change for refrigerators discussed above in this section, and to clarify that energy conservation standards have not been established for these products. DOE expects to propose modifications to cover wine storage products in a separate future rulemaking.

DOE notes that beer refrigerators, in contrast to wine coolers, generally are designed to operate with compartment temperature below 39°F. Hence, these products are, and would continue to be treated as, refrigerators and would continue to remain subject to the current test procedures and energy conservation standards of 10 CFR 430.

C. Establishing New Appendices A and B, and Compliance Date for the Amended Test Procedures

As briefly discussed above, the effective date for all of today's proposed amendments would be 30 days after publication of a final rule. However, only the amendments to Appendices A1 and B1 would have an immediate impact on manufacturers.

For purposes of representations, under 42 U.S.C. 6293(c)(2), effective 180 days after amending a test procedure, manufacturers cannot make representations regarding energy use and efficiency unless the product was tested in accordance with the amended test procedure. A manufacturer, distributor, retailer or private labeler may petition DOE to obtain an extension of time for making these representations. (42 U.S.C. 6293(c)(3))

However, manufacturers would need to use proposed Appendices A and B once amended energy conservation standards become effective on January 1, 2014. Likewise, the proposed Appendices A and B would be mandatory for representations regarding energy use or operating cost of these products once the new energy conservation standards take effect. Under EPCA, DOE must determine by no later than December 31, 2010, whether to amend energy conservation standards that would apply to refrigeration products manufactured on or after January 1, 2014. As discussed earlier, because the proposed modified test procedures of Appendices A and B would change the measured energy use of these products, DOE is planning to amend its energy conservation standards for these products. (42 U.S.C. 6293(e)(2)) These amended test procedures would be used in analyzing and developing any amended standards.

D. Amendments To Take Effect Prior to a New Energy Conservation Standard

1. Procedures for Test Sample Preparation

Current DOE test procedures generally address product features and functions available at the time that the test procedures were written. Advances in technology and product design, however, can lead to operating conditions and/or product features and functions that are not addressed in current applicable test procedures. In particular, these existing test procedures may not specifically address these new features or functions that are in addition to (and not involved in) the primary functions of maintaining temperatures suitable for food storage *(i.e.* temperatures up to 39 °F). To the extent that these new features or functions may be directly involved with the primary functions, in DOE's view, the energy use impact of these secondary functions should be included when measuring the overall energy consumption of a covered product under the DOE test procedure.

Because DOE's test procedures provide a measurement of a representative average use cycle, the procedures need to reflect the changes in technology and product design that are present in current products. If installation of a refrigeration product according to its accompanying instructions does not clearly explain how to set up products with new technology or design features, concerns may arise as to whether a given test can be conducted in a fashion that would measure the representative energy use of the product.

HRF–1–1979, parts of which are included in the current DOE test procedure by reference, requires that, "the cabinet with its refrigerating mechanism is to be assembled and set up as nearly as practicable in accordance with the printed instructions supplied with the cabinet." HRF–1–1979, section 7.4.2. Similarly, HRF–1–2008, parts of which are proposed to be included in the new Appendices A and B, has an essentially identical requirement: "The cabinet with its refrigerating mechanism shall be assembled and set up as nearly as practical in accordance with the printed instructions supplied with the cabinet." HRF–1–2008, section 5.5.2. DOE proposes to emphasize this set-up requirement by eliminating the words, "as nearly as practical", and providing specific (permitted and required) deviations from this set-up requirement as warranted. DOE is proposing the use of these specific deviations in order to ensure that the procedure is clear and yields consistent test results. This provision would be inserted directly into section 2 of Appendices A1, B1, A, and B.

Permitted deviations from this requirement would include set-up details that are required for consumer installation but do not affect measured energy use. Examples include:

• Connection of water lines and installation of water filters (not required).

• Anchoring or otherwise securing a product to prevent tipping during energy testing (also not required, but encouraged if necessary to ensure safety during testing).

Required deviations needed to achieve the necessary testing conditions and obtain consistent results would include, but are not limited to, the following:

• Clearance requirements: Establishing a consistent approach for wall-to-cabinet clearances that would limit the clearance ranges when compared to actual field installations.

• The electric power supply: Establishing a tighter tolerance on the voltage of the power supply than would be found during field use.

• Temperature control settings: Establishing standardized compartment temperatures to ensure meaningful comparisons of test results.

All of the permitted and required deviations from the printed instructions included with the manufacturer's product would be listed in section 2 of Appendices A1, B1, A, and B. DOE conducted a review of product installation instructions to determine which instructions would require specific language describing allowed or required deviations during testing. However, there may be other specific installation instructions that would affect energy use or would otherwise not be necessary to conduct the test. DOE seeks comment on whether these proposed deviations are sufficient to ensure that the procedure is clear and produces consistent results.

DOE recognizes that in some cases there may still be questions about how to set up a product for testing. In cases where the proposed modified language does not address the specific type of situation presented by a particular basic model, a test procedure waiver would be the appropriate course of action to allow test procedures to be developed for the specific characteristics of the product. DOE proposes to incorporate language into the test procedure instructing manufacturers to apply for a test procedure waiver in such cases. DOE proposes adding language to the set-up instructions of section 2 to alert manufacturers to this issue.

In addition, DOE proposes to add a new section 7 to the test procedure that explains when a test procedure waiver would be needed:

> To the extent that the procedures contained in this appendix do not provide a means for determining the energy consumption of a refrigerator or refrigerator-freezer, a manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product. Such instances could, for example, include situations where the test set-up for a particular refrigerator or refrigerator-freezer basic model is not clearly defined by the provisions of section 2. For details regarding the criteria and procedures for obtaining a waiver, please refer to 10 CFR 430.27.

DOE proposes to add this language to Appendices A1, B1, A, and B.

In addition to questions about product set-up during testing, the introduction of new technology in refrigeration products may cause the product to operate in a manner inconsistent with a representative average use cycle. An example of such technology in modern refrigerators is the variable anti-sweat heater control described in section III.D.9. This type of control, which responds to ambient humidity, generally will not allow the anti-sweat heaters to operate in a fashion consistent with a representative use cycle when tested in accordance with the required 90 °F ambient temperature. This occurs because the control operates on the basis of relative humidity, which is not required to be controlled and is typically lower in a test chamber at 90 °F than in the temperatures typically found in homes (approximately 70 °F). (*See, e.g.,* Appendix A1, section 2.1). Measuring the energy use of such a product using the current test procedure would not be repeatable because the measurement can be affected by this uncontrolled parameter. Hence, the modifications provided by the current waivers associated with this control (and by the proposed amended test procedure) provide a reasonably designed procedure to obtain energy costs during a representative average use cycle.

In order to address these types of situations, AHAM introduced the following additional language in AHAM standard HRF–1–2007:

> The following principles of interpretation should be applied to AHAM HRF–1, and should apply to and guide any revisions to the test procedure. The intent of the energy test procedure is to simulate typical room conditions (approximately 70 °F) with door openings, by testing at 90 °F 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 standard, shall operate equivalent to the unit in typical room conditions. The energy used by the unit shall be calculated when a calculation is provided by the standard.
>
> 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 standard, shall operate in an equivalent manner during energy testing under this standard, or be accounted for by all calculations as provided for in the standard.
>
> *Examples:*
>
> 1. 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.
>
> 2. The defrost heater should not either function or turn off differently during the

energy test than it would when in typical room conditions.

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

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

(HRF–1–2007, section 1.2)

HRF–1–2008 incorporates this language and ENERGY STAR adopted it as part of its Program Requirements that took effect in April 2008. (*see* "ENERGY STAR Program Eligibility Criteria for Residential Refrigerators and/or Freezers", section 4 (August 3, 2007)).

DOE proposes to use similar language in 10 CFR 430.23(a) to address the testing of refrigerators and refrigerator-freezers, and 10 CFR 430.23(b) to address the testing of freezers. The new text would read as follows:

The energy test procedure is designed to provide a measurement consistent with representative average consumer use of the product, even if the test conditions and/or procedures may not themselves all be representative of average consumer use (*e.g,* 90 °F ambient conditions, no door openings, use of temperature settings unsafe for food preservation, *etc.*). If (1) a product contains energy consuming components that operate differently during the prescribed testing than they would during representative average consumer use and (2) 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), the prescribed procedure may not be used. Examples of products that cannot be tested using the prescribed test procedure include those products that can exhibit operating parameters (*e.g,* duty cycle or input wattage) for any energy using component that are not smoothly varying functions of operating conditions or control inputs—such as when a component is automatically shut off when test conditions or test settings are reached. A manufacturer wishing to test such a product must obtain a waiver in accordance with the relevant provisions of 10 CFR 430.

DOE's proposal reflects the statutory requirement, and the Department's longstanding view, that the overall objective of the test procedure is to measure the product's energy consumption during a representative average use cycle or period of use. 42 U.S.C. 6293(b)(3). Further, the test procedure requires specific conditions during testing that are designed to ensure repeatability while avoiding excessive testing burdens. Although certain test conditions specified in the test procedure may deviate from representative use, such deviations are carefully designed and circumscribed in order to attain an overall calculated measurement of the energy consumption during representative use. Thus, it is—and has always been—DOE's view that products should not be designed such that the energy consumption drops during test condition settings in ways that would bias the overall measurement to make it unrepresentative of average consumer use. While DOE may consider imposing design requirements to prohibit certain control schemes, the agency believes that addressing this issue through the applicable test procedure and related requirements is appropriate at this time. Accordingly, DOE's proposed language both (1) makes explicit in the regulatory text the Department's long held interpretation that the purpose of the test procedure is to measure representative use and (2) proposes a specific mechanism—the waiver process—as a mandatory requirement for all products for which the test procedure would not properly capture the energy consumption during representative use.

DOE seeks comment on this proposed language to address products equipped with controls or other features that modify the operation of energy using components during testing. The language does not identify specific product characteristics that could make the test procedure unsuitable for testing certain products (*e.g,* modification of operation based on ambient temperature) but rather describes such characteristics generally, in order to assure that the language can apply to any potential features that would yield measurements unrepresentative of the product's energy consumption during a representative use cycle. While the proposed language does not delineate what constitutes representative average consumer use, in DOE's view, this use would include a variety of factors, including ranges of ambient temperature and humidity, multiple door openings of a variety of durations, food product loading, and ice production, among others. DOE seeks comment on this issue and invites commenters to submit any data that would help define the representative average use setting for each of these parameters and seeks comment and data on this issue. DOE also seeks comment on whether more specificity is needed to define (1) the types of product characteristics that would make the test procedure unsuitable to use and (2) the concept of representative average use.

2. Product Clearances to Walls During Testing

Wall clearance is a necessary element to refrigerator and refrigerator-freezer energy efficiency testing because the restriction of airflow due to close proximity to the wall can affect the cooling performance of the condenser. The condenser removes heat from the refrigeration system to the ambient air. In this regard, the current procedure references the steps outlined in HRF–1–1979, which provides that "[t]he space between the back [of the cabinet] and the wall shall be in accordance with the manufacturer's instructions or as determined by mechanical stops on the back of the cabinet." (HRF–1–1979, section 7.4.2).

The National Institute of Standards and Technology (NIST) examined the repeatability of energy testing based on the current DOE procedure and observed that the procedure does not provide clear guidance regarding the required clearance between the rear of a test sample cabinet and the wall of the test chamber or another simulated wall during testing. (Yashar, D.A. *Repeatability of Energy Consumption Test Results for Compact Refrigerators,* September 2000. U.S. Department of Commerce, National Institute of Standards and Technology, Gaithersburg, MD. NISTIR.6560, available at *http://www.fire.nist.gov/bfrlpubs/build00/PDF/b00055.pdf*). The alternative instruction provided by the current procedure—*i.e.* "as determined by mechanical stops on the back of the cabinet"—implies that a minimum distance from the wall applies. HRF–1–2008 provides greater specificity by providing that "the space between the back and the test room wall or simulated wall shall be the minimum distance in accordance with the manufacturer's instructions or as determined by mechanical stops on the back of the cabinet." (HRF–1–2008, section 5.5.2).

Refining this requirement is particularly important for products equipped with static condensers, which rely on free convection (*i.e.* heat transfer by air movement induced by the buoyancy effects of temperature differences rather than by fans) to cool the condenser. Static condensers are generally mounted on the back of the refrigerator or refrigerator-freezer. Manufacturers of most full-size refrigerators and refrigerator-freezers have replaced static condensers with forced-convection condensers (fan-cooled condensers), which are generally mounted at the base of the refrigerator near the compressor.

However, many manufacturers of compact refrigerators and freezers still use static condensers. Compact refrigerators are defined as refrigerators and freezers "with total volume less than 7.75 cubic feet * * * and 36 inches * * * or less in height." 10 CFR part 430.2. While the performance of refrigeration products with static condensers tends to be sensitive to rear clearance, the performance of products with forced-convection condensers tends to be less sensitive to this factor. DOE believes that most refrigerators are installed with the back of the refrigerator positioned with at the minimum distance from the wall as specified in the manufacturer's instructions. The limited potential for increasing exterior dimensions is often cited by the industry as a reason why increasing insulation thickness is not a viable design option to improve efficiency for these products. DOE noted this limitation in its technical support document that accompanied the 1997 final rule. *See* 62 FR 23102 (April 28, 1997) (noting that "[s]ince kitchen dimensions and designed spaces for refrigerator-freezers are limited, there are restrictions on increasing the exterior size of the product"). (U.S. Department of Energy-Office of Codes and Standards, Technical Support Document: Energy Efficiency Standards for Consumer Products: Refrigerators, Refrigerator-Freezers, and Freezers, DOE/EE–0064, at 3–6 (July 1995)). If there were any significant space between the rear wall of the cabinet and the kitchen wall, this limitation would not be present. Accordingly, positioning a refrigerator or refrigerator-freezer more than the minimum distance from the wall may not produce repeatable or representative performance results during the representative average use cycle or period.

DOE proposes to include in the test procedures of Appendices A1, B1, A, and B, the following language, which more thoroughly addresses clearance to the cabinet walls:

2.9 The space between the back of the cabinet and the test room wall or simulated wall shall be the minimum distance in accordance with the manufacturer's instructions. If the instructions do not specify a minimum distance, the cabinet shall be located such that the rear of the cabinet touches the test room wall or simulated wall. The test room wall facing the rear of the cabinet or the simulated wall shall be flat within ¼ inch, and vertical to within 1 degree. The cabinet shall be leveled to within 1 degree of true level, and positioned with its rear wall parallel to the test chamber wall or simulated wall immediately behind the cabinet. Any simulated wall shall be solid and shall extend vertically from the floor to above the height of the cabinet and horizontally beyond both sides of the cabinet.

The additional specifications in this proposed language, including touching the rear wall, flatness and vertical orientation of the wall behind the product, use of a solid wall (*i.e.* rather than a perforated wall or screen), size of the simulated wall, and product orientation to be level and parallel with the wall would collectively help ensure the consistent application of simulated walls in energy testing. DOE believes that these additional requirements are consistent with the current test procedures, as well as the clearance requirements found in HRF–1–1979 and HRF–1–2008, but have the added advantage of providing greater assurance that the intended product installation set-up is used for testing. DOE seeks comment on this approach.

3. Alternative Compartment Temperature Sensor Locations

The current test procedures indicate that temperature sensor locations shall be as indicated in HRF–1–1979, Figures 7.1 and 7.2. (see for example Appendix A1, section 5.1). The test procedure indicates what a manufacturer would do in case the cabinet layout is not consistent with these figures:

If the interior arrangements of the cabinet do not conform with those shown in Figure 7.1 and 7.2 of HRF–1–1979, measurements shall be taken at selected locations chosen to represent approximately the entire refrigerated compartment. The locations selected shall be a matter of record.

Appendix A1, section 5.1

In order to provide clearer instructions, and to avoid the potential for significant deviation from the standard temperature sensor locations, DOE proposes to modify this requirement, allowing manufacturer selection of new locations only for small deviations from the standard locations, and otherwise requiring a waiver to allow for the development of a new diagram addressing the new compartment configuration. DOE proposes the following amended text for section 5.1:

If the interior arrangements of the cabinet do not conform with those shown in Figure 7.1 and 7.2 of HRF–1–1979, the product may be tested by relocating the temperature sensors from the locations specified in the Figures by no more than 2 inches to avoid interference with hardware or components within the cabinet, 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 430.62(d). For those products equipped with a cabinet that does not conform with Figures 7.1 or 7.2 and cannot be tested in the manner described above, the manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product.

DOE expects that the processing of several such waivers and subsequent development and incorporation into the test procedures of new figures describing the test sensor location requirements for modified cabinet styles will help to improve energy testing consistency. DOE proposes to make these changes in Appendices A1 and B1, and to include these requirements in Appendices A and B. DOE seeks comment on the frequency of temperature sensor location revisions from the specifications of the figures of HRF–1–1979, and on whether the exception allowing for minor relocation of sensors is sufficient to limit to a reasonable level the potential number of waivers associated with the proposed requirement.

In order to ensure that manufacturers make DOE aware of small changes in temperature sensor locations to avoid interference with internal hardware, DOE further proposes to include a requirement that manufacturers report that such a change has been made as part of the certification reporting requirements. This additional proposal is discussed in more detail in section III.D.14.

4. Median Temperature Settings for Electronic Control Products

The procedure related to temperature control settings is detailed in section 3 of Appendix A1. The procedure specifies how to set thermostatic controls for the freezer and fresh food compartments of refrigerators and refrigerator-freezers to permit testing that yields results that are interpolated based on compartment temperatures to represent the energy use of these products when operated with the compartment temperatures set at the specified standardized temperatures. Interpolation in this context means calculating the energy use associated with a standardized compartment temperature using two tests. In one test, the compartment temperature is lower than the standardized temperature. In the other test, the compartment temperature is higher than the standardized temperature. This approach is used so that the test measurement can be based on the standardized temperature without requiring the numerous trial and error attempts it generally takes to exactly match this temperature during testing.

Most refrigeration products have user-operable temperature controls, for which the procedures of section 3.2 apply. While section 3.2 provides a number of alternative control setting options, the specific provisions of section 3.2.1 are most often applied because the provisions of sections 3.2.2 and 3.2.3 have special conditions that typically do not apply, such as the inability to achieve the standardized temperature in the compartment. Section 3.2.1 currently specifies the adjustment of settings as follows:

A first test shall be performed with all compartment temperature controls set at their median position midway between their warmest and coldest settings. Knob detents shall be mechanically defeated if necessary to attain a median setting. 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 which bound (*i.e.,* one is above and one is below) the standardized temperature for the type of product being tested. (10 CFR part 430, subpart B, Appendix A1, section 3.2.1)

DOE is aware of some issues associated with this procedure. First, the section describes the defeating of mechanical detents of controls that do not allow controls to be set in the median position. Many current products have electronic controls, which generally have setpoints indicating specific control temperatures. For these controls, an average of the coldest and warmest temperature settings is generally used as the median. However, in some cases there is no temperature setting exactly equal to this average, and the controls cannot be mechanically defeated as described in the procedure. To address this situation, DOE proposes to modify the test procedure language to specify that products equipped with such electronic controls be tested using one of the following three options: (1) Use of a setting equal to the average of the coldest and warmest settings, (2) use of the setting that is closest to this average, or (3) if there are two settings whose difference with the average is the same, use of the higher of these two such settings. This modification is being proposed for Appendices A1 and B1, and they would be retained for Appendices A and B.

Additional issues and proposed amendments addressing them for Appendices A and B are discussed in section III.E.4.

5. Test Procedures for Convertible Compartments and Special Compartments

Manufacturers recently introduced refrigerator-freezers with compartments that consumers can convert from fresh food to freezer use and vice versa. Under the current DOE test procedure, which references section 7.4.2 of HRF–1–1979, "compartments which are convertible from refrigerator to freezer are operated in the highest energy usage position." (This section of HRF–1–1979 is referenced in Appendix A1, section 2.2.) DOE believes that the highest energy use position would most likely be the freezer mode since additional energy is required to maintain the colder temperatures required for freezer use when compared to fresh food compartment use. However, DOE recognizes that the requirement does not clarify whether such a compartment is to be controlled as a freezer compartment, or whether the controls are to be set in the absolute highest energy position.

To ascertain how manufacturers might be treating these compartments during testing, DOE examined data reported to the ENERGY STAR program, which are available at *http://www.energystar.gov/index.cfm?fuseaction=refrig.display_products_excel.* Based on DOE's analysis of these data, the entries suggest that some manufacturers may have rated their own products based on the operation of these convertible compartments as fresh food compartments. DOE came to this conclusion after noticing that the calculated adjusted volume matches the reported adjusted volumes when the convertible compartment is treated as a fresh food compartment. Accordingly, to ensure manufacturer clarity, DOE proposes including the following language in section 2 of Appendices A1 and A: "Compartments that are convertible (*e.g,,* from fresh food to freezer) shall be operated in [their] highest energy use position."

A related situation applies to special compartments that are not convertible from fresh food to freezer. The procedure for such compartments is also described in HRF–1–1979:

Other temperature controllable compartments (such as crispers convertible to meat keepers and temperature adjustable meat keepers) are considered special compartments and are tested with controls set to provide the coldest temperature. (HRF–1–1979 section 7.4.2)

To simplify the requirements of this provision, DOE proposes to add similar language as discussed above into section 2 of Appendices A and A1: "Other temperature controllable compartments (such as crispers convertible to meat keepers), with the exception of butter conditioners, shall also be tested with controls set in the highest energy use position." DOE believes that this language would retain the purpose contained in the original provisions (*i.e.* to maximize energy usage during energy efficiency testing) while simplifying the language of the procedure.

DOE seeks comment on this proposed change to its procedure.

6. Establishing a Temperature-Averaging Procedure for Auxiliary Compartments

The current DOE test procedure defines a refrigerator-freezer as "a cabinet which consists of two or more compartments with at least one of the compartments designed for the refrigerated storage of food at temperatures above 32 °F and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8 °F." 10 CFR 430.2. Hence, a refrigerator-freezer includes at least one fresh food compartment and at least one freezer compartment. The definition does not specify the characteristics of any additional compartments.

Some refrigeration products have an additional freezer compartment or an additional fresh food compartment, or both, and some have enclosed compartments within the primary compartments that have separate temperature controls and may represent a substantial fraction of the primary compartment volume. DOE notes that, with respect to the latter group of products, it is not yet proposing a value of this fraction (*i.e.* such as 25% or 35%). However, this concept is necessary in order to distinguish such auxiliary compartments from the "special compartments" discussed in section III.D.5. For the purposes of this discussion, auxiliary compartments are additional compartments in a refrigerator or refrigerator-freezer that are large enough that treatment as special compartments is not appropriate (generally, 2 cubic feet or greater).[1]

As discussed earlier in Section III.D.5, products with additional convertible compartments are examples of refrigerator-freezers equipped with more than two compartments. In such cases, the convertible compartment could be considered an auxiliary compartment.

While the special compartments discussed in section III.D.5 would be tested with their controls set to the highest energy use position under the proposed test procedure modification, the compartments addressed in this section are relatively large (*i.e.* 2 cubic feet or larger) and represent instances in which employing the highest energy use position would be inappropriate. The requirements for setting such a compartment at the absolute highest energy use position are inappropriate

[1] Auxiliary compartments could be entirely separate from the main two compartments of a typical refrigerator-freezer (the freezer compartment and the fresh food compartment), or they could be substantial-volume, separately-controllable compartments located within main compartments. In the latter case, they are referred to as "sub-compartments" for the purposes of this discussion.

because (1) such a compartment would likely be used for general food storage rather than for a limited special purpose and (2) the energy use impact during testing when the controls are set for the absolute highest energy use position would be very significant and would not necessarily be consistent with consumer use.

Both HRF–1–1979 and HRF–1–2008 include definitions and special test procedures for special compartments. However, neither the current test procedure (*i.e.* setting them to their coldest temperature) nor the proposed one (*i.e.* setting them in the highest energy use position) would necessarily be consistent with the required representative average use cycles for compartments representing a substantial fraction of the product's total refrigerated volume. DOE is not aware of many products currently being sold in the U.S. market that have auxiliary compartments. This section discusses issues associated with testing refrigerator-freezers with all such auxiliary compartments.

DOE notes that a large drawer without separate temperature control that is located within a compartment would not be considered a sub-compartment for the purpose of this discussion. Such a drawer would be part of the compartment in which it is housed. In contrast, for the purposes of this discussion, a larger compartment with a separate door *without* separate temperature control would be considered an auxiliary compartment, since it is not part of any other compartment. Further, if one or more drawers or doors that open to the exterior serve a space inside a refrigeration product that is a single compartment, the status as a single compartment is not affected by the presence of the additional drawer(s) or door(s).

While there is no size limit for classification as a special compartment under the current DOE test procedure, and DOE is not currently proposing such a limit, DOE seeks comment on whether such a size limit should be imposed, and what the size limit should be.

As discussed in section III.D.5, the DOE test procedures require that a convertible auxiliary compartment must be tested in the "highest energy usage position." However, the current test procedures do not state whether the temperature for the compartment must be set at a level to ensure energy use is at its absolute maximum, or whether the temperature must be the standardized test temperature for the higher energy use compartment type (5 °F for a freezer compartment and 45 °F for a fresh food compartment for the current DOE test procedures). DOE proposes that a convertible auxiliary compartment with separate exterior doors be tested as a freezer compartment or fresh food compartment, depending on which of these represents the highest energy usage position. For these compartments, and for nonconvertible auxiliary compartments with separate exterior doors whose operating temperature range specifies their status as freezer or fresh food compartments, DOE proposes that these energy measurements be determined based on the compartment's standardized temperature.

In contrast, DOE proposes that sub-compartments (*i.e.,* auxiliary compartments located entirely within main compartments) be tested with their settings in the absolute highest energy use position. Although the discussion of this section is intended to address large sub-compartments, the common sub-compartments with separate temperature controls found in U.S. refrigerator-freezer products usually occupy a relatively small portion of the fresh food compartment. Examples include ice compartments, meat drawers, deli drawers, and butter conditioning compartments. Hence, DOE believes that the proposed procedures for special compartments described in section III.D.5 (*i.e.* that the consumer-adjustable setting be in its highest energy-use position) are appropriate for these compartments.

In contrast, auxiliary compartments that have their own external doors often have large volumes, which are comparable to the volumes of other compartments associated with the products. An example of such a product is the Samsung RM257ACRS, which has an 11.8 cubic foot fresh food compartment, a 7.0 cubic foot freezer compartment, and two convertible compartments of volumes 3.5 and 2.3 cubic feet.

Given that auxiliary compartments with external doors would be tested as either freezer or fresh food compartments, requirements must be established for (1) temperature settings during testing, (2) measurement of auxiliary compartment temperature, and (3) incorporation of the auxiliary compartment temperature in the calculation of energy consumption. To address these issues, DOE proposes the following changes:

(1) Temperature settings, generally—Consistent with current temperature setting requirements, the temperature settings for auxiliary compartments with external doors that have individual temperature control capability would be the same median, cold, or warm setting required for all compartments when performing testing as described in section III.D.4.

(2) Auxiliary compartment temperature measurements—Measurement of compartment temperature during testing is done using temperature sensors. The placement of temperature sensors (typically thermocouples) is specified in HRF–1–1979 in section 7.4.3.2 and Figure 7.1 for fresh food compartments and in section 7.4.3.3 and Figure 7.2 for freezer compartments. The DOE test procedures incorporate by reference these sections of HRF–1–1979. They provide further instructions on determination of compartment temperature, stating that the "measured temperature of a compartment is to be the average of all sensor temperature readings taken in that compartment at a particular time." (10 CFR part 430, subpart B, Appendix A1, section 5.1.1), and the "compartment temperature for each test period shall be an average of the measured temperatures taken in a compartment during a complete cycle or several complete cycles of the compressor motor (one compressor cycle is one complete motor 'on' and one complete motor 'off' period)." Id. at section 5.1.2. The same procedures for measuring the compartment temperature during testing would be used for auxiliary compartments with external doors.

(3) Incorporation of auxiliary compartment temperature measurements in the test procedure calculations—Calculation of freezer temperature for a product with more than one freezer compartment (including one or more auxiliary freezer compartments with external doors) would be a weighted average of the compartment temperatures measured within each freezer compartment. The weighting factors for this average would be the calculated compartment volumes. Likewise, calculation of fresh food temperature for a product with more than one fresh food compartment (including one or more auxiliary fresh food compartments with external doors) would be a volume-weighted average of the measured compartment temperatures. These freezer and fresh food temperatures would be used both in the determination of the appropriate temperature settings for subsequent testing, and in the energy use calculation. The calculation of daily energy consumption, described for refrigerators or refrigerator-freezers in section 6.2.2 of Appendix A1, uses the freezer or fresh food compartment temperature in the equation. This

approach would be adopted for auxiliary compartments using the volume-weighted average temperatures.

DOE proposes these amendments to address auxiliary compartments with external doors in Appendices A1 and A. DOE proposes similar amendments to address auxiliary compartments of freezers in Appendices B1 and B. DOE further proposes a definition for "separate auxiliary compartments" to refer to these auxiliary compartments with external doors that would be treated in the test procedures as described in this section. This definition would read as follows:

"Separate auxiliary compartment" means a freezer compartment or a fresh food compartment of a refrigerator or refrigerator-freezer having more than two compartments that is not the first freezer compartment or the first fresh food compartment. Access to a separate auxiliary compartment is through a separate exterior door or doors rather than through the door or doors of another compartment. Separate auxiliary compartments may be convertible (*e.g.,* from fresh food to freezer).

DOE seeks comment on this proposed approach.

7. Modified Definition for Anti-Sweat Heater

The DOE test procedure for refrigerators and refrigerator-freezers defines an "anti-sweat heater" as "a device incorporated into the design of a refrigerator or refrigerator-freezer to prevent the accumulation of moisture on exterior surfaces of the cabinet under conditions of high ambient humidity." 10 CFR part 430, subpart B, appendix A1, section 1.3. (This accumulated moisture is commonly referred to as "sweat", and the process of accumulation of such moisture is called "sweating".) Similarly, the DOE test procedure for freezers defines an "anti-sweat heater" as "a device incorporated into the design of a freezer to prevent the accumulation of moisture on exterior surfaces of the cabinet under conditions of high ambient humidity." 10 CFR part 430, subpart B, Appendix B1, section 1.2. Some refrigerator-freezers also use anti-sweat heaters to prevent moisture accumulation on internal surfaces of the cabinet. In particular, manufacturers of French door refrigerator-freezers with through the door (TTD) ice service have used anti-sweat heaters to prevent accumulation of moisture inside the fresh food compartment near the air duct that carries refrigerated air to the ice compartment.

In DOE's view, to obtain consistency and an accurate measurement of all energy consuming components, the anti-sweat heater regulations should apply to any anti-sweat heater regardless of the heater location. To ensure that this result occurs, DOE proposes to modify the definitions of anti-sweat heater for both the refrigerator and refrigerator-freezer test procedures and for the freezer test procedures to apply to both interior and exterior surfaces. DOE proposes to make these changes in Appendices A1 and B1, and to include these modified definitions in Appendices A and B.

This proposed modification does not change the test procedure. Rather, it clarifies that interior heaters used to prevent sweating are to be treated as anti-sweat heaters for purposes of calculating energy usage under the procedure.

DOE seeks comment on this proposed clarification.

Additionally, in DOE's view, the current and proposed definitions of an anti-sweat heater encompass devices that prevent moisture accumulation. However, DOE is considering modifying the anti-sweat heater definition to indicate that a heater that prevents the accumulation of moisture, irrespective of whether that heater is designated as an anti-sweat heater, should be defined as an anti-sweat heater. DOE is interested in whether additional specificity is required to bring further clarity to this concept, and seeks public comment.

8. Testing With the Anti-Sweat Heater Switch Turned Off

The energy conservation standards for refrigeration products are based on annual energy use calculated for these products. The annual energy use is calculated based on a "standard cycle," which is defined as "the cycle type in which the anti-sweat heater control, when provided, is set in the highest energy consuming position." This term is applied throughout the regulatory provisions governing refrigeration products. *See, e.g,* 10 CFR 430.23(a)(5) and (b)(5) (applying the term "standard cycle"), 10 CFR part 430, subpart B, Appendix A1, section 1.7 (defining "standard cycle" for refrigerators and refrigerator-freezers), and 10 CFR part 430, subpart B, Appendix B1, section 1.5 (defining "standard cycle" for freezers).

In contrast, the annual operating cost, which serves as the basis for the figures reported on the Federal Trade Commission's EnergyGuide label, can be calculated based on the average of energy consumption test results using the standard cycle and a cycle with the anti-sweat heater switch positioned as it is when shipped from the factory. See 10 CFR 430.23(a)(2) and (b)(2). DOE understands that most manufacturers test refrigeration products equipped with anti-sweat heater switches in this fashion, and use the same results for reporting both energy use and annual operating cost.

DOE added the energy use calculation requirements to the test procedure on February 7, 1989. 54 FR 6062. At the time of the final rule's publication, the annual operating cost calculation had already been established in the test procedure. The final rule, however, did not discuss the different treatment between the calculation for energy use and the calculation of annual operating cost.

It is unclear to DOE whether a need exists for the distinction between the annual operating cost and the energy use calculations. Accordingly, DOE is proposing to modify the calculation for annual energy use to ensure consistency with the annual operating cost calculation. These changes would be implemented by making changes to 10 CFR 430.23(a) and 10 CFR 430.23(b).

This test procedure modification would not affect the way manufacturers test products to establish their ratings or alter the measured energy use of these products.

9. Incorporation of Test Procedures for Products With Variable Anti-Sweat Heating Control Waivers

On February 27, 2008, DOE published a decision and order granting GE with a waiver from the DOE test procedure ("GE waiver") to allow the company to use a modified test procedure for a line of appliances that use ambient condition sensors to adjust the wattage of anti-sweat heaters. 73 FR 10425. These sensors use the detected humidity levels to adjust anti-sweat heater operation to prevent condensation. DOE granted a similar waiver to Whirlpool Corporation on May 5, 2009. 74 FR 20695. DOE published a petition for a third such waiver from Electrolux Home Products, Inc. (Electrolux) and granted the application for an interim waiver on June 4, 2009. 74 FR 26853. This waiver was granted on December 15, 2009. 74 FR 66338. Electrolux also submitted a petition to extend the initial waiver to additional products—DOE published this petition and granted the associated application for an interim waiver on December 15, 2009. 74 FR 66344. Samsung also petitioned DOE for a waiver for this type of control for anti-sweat heaters. The Samsung petition was published and the associated application for interim waiver granted on December 15, 2009. 74 FR 66340.

Because ambient humidity of the test chamber is not specified in the DOE test procedures, the current test procedure is unable to accurately determine the annual energy use contribution of anti-sweat heaters. The test procedure allowed under the GE waiver involves (1) conducting energy testing with the anti-sweat heater switch in the "off" position, and (2) adding a correction factor to account for the additional energy use associated with the anti-sweat heater for a standard cycle (*i.e.,* a cycle with the anti-sweat heater switch in the "on" position). 73 FR 10427. While the test procedure allowed under the GE waiver assumes that the anti-sweat heater operates on a switch that can turn off the heater, this feature would not necessarily be present on all products equipped with variable anti-sweat heater control systems.

The test procedure allowed under the GE waiver specifies calculation of the correction factor as follows:

Correction Factor = (Anti-sweat Heater Power × System-loss Factor) × (24 hrs/1 day) × (1 kW/1000 W)

Where: Anti-sweat Heater Power
= A1 * (Heater Watts at 5%RH)
+ A2 * (Heater Watts at 15%RH)
+ A3 * (Heater Watts at 25%RH)
+ A4 * (Heater Watts at 35%RH)
+ A5 * (Heater Watts at 45%RH)
+ A6 * (Heater Watts at 55%RH)
+ A7 * (Heater Watts at 65%RH)
+ A8 * (Heater Watts at 75%RH)
+ A9 * (Heater Watts at 85%RH)
+ A10 * (Heater Watts at 95%RH)

Where A1–A10 are from the following table:
A1 = 0.034
A2 = 0.211
A3 = 0.204
A4 = 0.166
A5 = 0.126
A6 = 0.119
A7 = 0.069
A8 = 0.047
A9 = 0.008
A10 = 0.015

73 FR 10427

The System-Loss Factor noted in the above calculation accounts for additional energy use (a) of the refrigeration system to overcome the increased cabinet load imposed by the anti-sweat heater, and (b) of the controls associated with the anti-sweat heater. 73 FR 10427. The GE waiver specifies a System-Loss Factor of 1.3, based on experience-related data developed by GE. Factors A1 through A10 represent the national average frequency of occurrence for various ambient relative humidity ranges that a refrigerator is likely to experience in a typical consumer household. GE determined these factors based on 30 years of weather data for 50 major population centers within the United States. 73 FR 10427. The GE waiver defines the Heater Watts parameter of Equation 1 as "the nominal watts used by all heaters at that specific relative humidity, 72 °F ambient, and DOE reference temperatures of fresh food (FF) average temperature of 45 °F and freezer (FZ) average temperature of 5 °F." 73 FR 10427.

However, the alternate test procedure permitted under the GE waiver does not state how the Heater Watts parameter is determined during an energy test conducted under the waiver. It also does not disclose the associated number of heater-watts for each product equipped with variable anti-sweat control features. Hence, it would be impossible to independently verify published energy consumption measured under the GE, Whirlpool, Electrolux, or Samsung waivers. To address these deficiencies, DOE is proposing to incorporate a modified version of the GE waiver procedure into Appendices A and A1.

Proposed Amendment

DOE proposes amending its test procedures to require measurements of variable anti-sweat heater energy contribution under various specific ambient air conditions to permit laboratory verification of the resulting energy consumption estimates. DOE also proposes using the relative humidity factors A1 through A10 established in the GE waiver. The proposed changes would be implemented by modifications in various sections of Appendix A1, which would also be implemented in Appendix A. These humidity factors represent the national average frequency of the relative humidity levels for refrigeration product ambient conditions. While field test data corroborating the methodology for determining typical consumer household humidity levels were not provided as part of the waiver petition, DOE is unaware of more accurate or comprehensive information to better represent field conditions.

Although the GE waiver includes a calculation involving ten relative humidities, testing to determine performance of variable anti-sweat heater control systems would not require ten separate measurements. The proposed approach is based on the fact that the rate of heat energy input supplied by the electric anti-sweat heaters required to prevent condensation at a fixed ambient temperature and compartment temperature should vary linearly with dew point temperature (*i.e.,* the temperature of a given mixture of dry air and water vapor at 100% relative humidity). This means that the wattage increment associated with the heater control system needs to be determined for only two humidity conditions. DOE defines this type of anti-sweat heater control as "ideal".

Based on DOE's analysis, at a fixed ambient air dry-bulb temperature such as the 72 °F ambient specified in the GE waiver, ideal anti-sweat heater power varies linearly as a function of dew point temperature, increasing from zero power at some dew point temperature lower than the ambient dry bulb temperature (*i.e.,* at low relative humidity) to a maximum requirement at a dew point temperature equal to the ambient dry bulb temperature (*i.e.,* at 100% relative humidity). DOE conducted this analysis for a surface that (1) loses heat to the refrigerator interior at a rate proportional to the difference in temperature between the surface and the interior, (2) gains heat from the ambient air at a rate proportional to the difference in temperature between the ambient air and the surface, and (3) gains a controlled amount of heat from the anti-sweat heater to maintain the surface at a fixed small temperature difference (such as 1 °F) above the dew-point temperature of the ambient air.

One can establish correlations for the ideal heater wattage once the heat-flow characteristics from the heated surfaces to the refrigerator interior and the ambient air are understood. The linear nature of these correlations with respect to ambient dew point suggests that tests conducted at a limited number of ambient humidity conditions could provide sufficient information about the operating characteristics of a variable anti-sweat heating system. Based on DOE's analysis, for operation in a normal ambient near 72 °F, the freezer compartment of a typical refrigerator-freezer should require no anti-sweat heating at relative humidities below roughly 50 percent and the fresh food compartment of a typical refrigerator-freezer should require no anti-sweat heating at relative humidities below roughly 65 percent. However, the actual relative humidity at which no anti-sweat heat is needed would vary among products and even at different surfaces of the same product, depending on design details.

DOE proposes to amend the DOE test procedures to determine the incremental energy contribution of the variable anti-sweat heater in the manner described below.

a. DOE proposes specifying that tests be conducted in a chamber with both temperature and humidity control to verify the behavior of the variable anti-sweat heater control. Three tests would be conducted, as described below.

i. *Ambient Conditions:* The tests would be conducted in a chamber controlled to 72 ± 1 °F dry bulb temperature, at three different relative humidities, 95 ± 2 percent, 65 ± 2 percent, and 25 ± 10 percent. DOE proposes wide tolerances in the relative humidity for the 25 percent relative humidity test because it is expected that the anti-sweat heater would be turned off throughout this range of conditions, thus obviating the need for tight control. The 25 percent relative humidity test would determine energy use of the refrigerator-freezer with the anti-sweat heaters turned off in the 72 °F dry bulb condition specified for these tests. The difference in energy use measured during this test and energy use measured during the tests conducted at 65 percent and 95 percent relative humidities would be the energy use contribution of the anti-sweat heaters at the higher humidities.

ii. *Cabinet Temperatures:* Appendix A1, as amended, would specify cabinet temperatures of 5 ± 2 °F in the freezer compartment and 38 ± 2 °F in the fresh food compartment for the variable anti-sweat heater tests. Appendix A would specify cabinet temperatures of 0 °F ± 2 °F in the freezer compartment and 39 °F ± 2 °F in the fresh food compartment, consistent with the new compartment temperatures prescribed in HRF–1–2008. These modified cabinet temperatures would be more consistent with the modified standardized cabinet temperatures used for all of the testing conducted under Appendix A.

iii. *Test Period:* Each test would be similar to an energy test for a refrigerator without automatic defrost (as described in section 4.1.1 of 10 CFR part 430 subpart B Appendix A1), including compressor cycling but no defrost cycles.

iv. *Stabilization:* The test would require waiting to achieve steady state conditions as the test starts. However, for each test that is conducted immediately following another test in which the ambient dry bulb temperature is maintained between tests, the standard stabilization period may be waived, and the test can proceed two hours after the required ambient humidity conditions have been established.

b. The energy use in kilowatt-hours per day for the 25-percent relative humidity test would be subtracted from the energy use per day for the 95-percent and 65-percent relative humidity tests to determine energy use contributions of the anti-sweat heaters at 95-percent and 65-percent relative humidities.

c. DOE proposes calculating the anti-sweat heater energy contributions for the same ten relative humidities specified in the GE waiver based on the measured energy use contributions of the variable anti-sweat heaters at 95-percent and 65-percent relative humidity, assuming that the anti-sweat heater energy contribution varies linearly with dew point, but with a minimum energy contribution of zero kilowatt-hours (*i.e.,* the anti-sweat heater cannot have negative energy use, which would represent electric energy generation). The correction factor would be calculated using the ten RH factors (A1 through A10), but without using the system adjustment factor (1.3 in the GE waiver) and without converting from watts to kilowatt-hours.

d. The correction factor would be added to the energy use measured for a normal energy test as conducted in 90 °F ambient temperature.

e. For a product with an anti-sweat heater switch, DOE proposes to require that all tests be conducted with the switch in the on position, in order to ensure proper measurement of the energy use associated with the ambient sensing functions of the variable anti-sweat heating control, and to reduce the possibility of circumvention associated with the switch—*i.e.* using this switch to control heaters or components other than the anti-sweat heater. In order to ensure that the anti-sweat heater itself is not energized during the normal energy test conducted in 90 °F ambient conditions, this energy test would be conducted in a chamber with sufficiently low humidity to prevent activation of the heater. DOE proposes adding the following language to Appendix A1, section 2.1: "If the product being tested has variable anti-sweat heater control, the ambient relative humidity shall be no more than 35%."

f. DOE proposes eliminating the averaging of tests with the anti-sweat heater switch on and off for products with variable anti-sweat heater control. The GE waiver specifies that the correction factor for the energy use associated with the variable anti-sweat heaters would be applied to the standard cycle. 73 FR 10427. Under the current test procedure, the standard cycle is a cycle with the anti-sweat heater switch turned on. (10 CFR part 430, subpart B, appendix A1, section 1.7). The calculation of annual operating cost for a product with an anti-sweat heater switch is based on an average of a test with (1) the switch set in its position just prior to shipping from the factory (typically off) and (2) a test of the standard cycle. 10 CFR 430.23(a)(2).

However, this approach of averaging of the standard cycle and the cycle for a test with the anti-sweat heater switch turned off is inappropriate for products with variable anti-sweat heater control because the position of the switch would impact the operation of the anti-sweat heaters only during times when ambient conditions are sufficiently humid to trigger the operation of the anti-sweat heater. For this reason, it is unlikely that the switch would be moved to the off position during times when it could save energy. Hence, it is unlikely that the anti-sweat heater switch could generate any significant energy savings in addition to the savings provided by the variable control. Accordingly, DOE proposes to eliminate the averaging of tests with the anti-sweat heater switch turned on and with the switch turned off for products equipped with variable anti-sweat heating.

The above proposed modifications to the test procedure to address variable anti-sweat heater control would be made in both Appendices A1 and A. DOE is proposing at this time to implement the variable anti-sweat heater test only for refrigerators and refrigerator-freezers because of the limited use of electric anti-sweat heaters in freezers. DOE seeks comments as to whether a similar requirement in Appendices B1 and B should also apply to freezers.

DOE seeks comments regarding the proposed test procedures for measurement of energy use of products with variable anti-sweat heater control.

10. Modification of Long-Time and Variable Defrost Test Method To Capture Precooling Energy

DOE is proposing to modify the test method for products with long-time or variable defrost to capture precooling energy. Precooling involves cooling the compartment(s) of a refrigerator-freezer to temperatures significantly lower than the user-selected temperature settings prior to an automatic defrost cycle. Before DOE established test procedures for long-time defrost (defrost control in which compressor run time between defrosts exceeds 14 hours) and variable defrost (defrost control in which the time interval between defrosts is adjusted based on the need, *i.e.* on the amount of moisture collecting on the evaporator as frost), the DOE test procedures had captured energy use associated with defrost by specifying that duration of an energy test be "from one point during a defrost period to the same point during the next defrost period." 10 CFR part 430, subpart B, Appendix A1, section 4.1.2. In 1982, DOE amended the test procedures to include the alternative procedure for long-time defrost (section 4.1.2.1 of Appendix A1) to accommodate long periods of time between defrosts (*i.e.* significantly greater than 24 hours of test time) without making the energy test period unduly burdensome. 47 FR 34517 (August 10, 1982).

The current long-time defrost test consists of two parts. The first part measures the steady cycling energy use of the refrigerator-freezer with no contribution from the defrost cycle. The second part measures all of the energy use contribution associated with the defrost cycle. The equation for total energy use for a 24-hour period combines these two energy use contributions and weights the measurement of the second part of the test based on the reciprocal of compressor run time between defrosts. 10 CFR part 430, subpart B, Appendix A1, section 5.2.1.2.

The variable defrost test, introduced in 1989, accommodates even longer times between defrosts compared to the time periods in the long-time defrost test. (*See* 54 FR 36238 discussing calculated values of CT (hours of compressor run time between defrosts to be used in the equation for energy consumption) with values ranging from 28.96 to 45 hours, as compared to approximately 14 hours for long-time defrost). The current DOE test procedures provide an optional step (Part 3) to measure the mean time between defrosts based on "typical" ambient and door-opening conditions. This optional step would be used in cases where a manufacturer chooses to measure the mean time between defrosts rather than using the default value prescribed by the test procedure. 10 CFR part 430, subpart B, Appendix A1.

When DOE first introduced the test method for long-time defrost in 1982, few refrigerator-freezers, if any, employed electronic controls. Instead, refrigerator-freezers controlled defrost using mechanical defrost controllers. Because of their simpler nature, mechanical defrost controllers are incapable of performing any of the more complex control functions handled by models equipped with electronic controls.

On August 3, 2001, DOE granted an interim test procedure waiver to Electrolux Home Products (Electrolux) for products that use a sophisticated control algorithm. 66 FR 40689. The associated test procedure modification was incorporated into the DOE test procedure on March 7, 2003. 68 FR 10957. The modified procedure allows a delay between the end of the last compressor on-cycle and the start of the defrost cycle. This delay saves energy by allowing the evaporator to warm naturally after the compressor turns off. 66 FR 40690. The modified test method only applies to products using long-time or variable defrost. If such a control strategy were applied to a product not equipped with long-time or variable defrost, the product would be tested in accordance with Appendix A1, section 4.1.2, which specifies a test period "from one point during a defrost period to the same point during the next defrost period." Such a test would measure the reduction in energy use from the natural warming of the evaporator, making this modified procedure unnecessary.

Precooling before defrost also requires a more sophisticated control system than a defrost timer. A precooling control system initiates an extra long compressor run (*i.e.* a compressor on-cycle that continues for at least 10% of the length of a typical compressor on-cycle after the compartment temperature has dropped down to the temperature at which the compressor typically turns off during steady state cycling operation between defrosts) before the defrost cycle to reduce the temperature of the cabinet or one of its compartments significantly more than would occur during a normal compressor cycle. Precooling before defrost may prevent unacceptable increases in freezer compartment temperature during the defrost cycle. Precooling will also reduce the recovery time after a defrost cycle, which could reduce the measured energy use of the recovery portion of the defrost cycle. However, the long time automatic defrost test procedure does not consider the energy use of compressor operation to provide precooling, since the second part of the test starts after compressor operation has stopped but prior to the initiation of a defrost cycle. The measured energy use of a refrigerator-freezer or freezer using precooling before the defrost cycle may underrepresent the product's actual energy consumption.

DOE intends for its test procedures to capture all of the energy use associated with defrost and to provide results that accurately represent the energy use of the product by consumers. In light of this intent and the recognized limitations present in the current procedure, DOE proposes modifying the test method for long-time defrost in a manner consistent with what Fisher Paykel suggested in its comment to the Electrolux petition for waiver mentioned above. 68 FR 10958. Fisher Paykel proposed amending the third sentence of section 4.1.2.1 of the test procedure to read as follows: "The second part would start at the last compressor off [-cycle] that is part of steady-state operation (or at a point still within stable operation if there are no temperature swings) before a defrost is initiated * * *." 68 FR 10958. Currently, section 4.1.2.1 calls for the second part of the test to start either when the defrost heater is energized or at the end of the last compressor on-cycle prior to defrost. If this last compressor on-cycle is an extended run for precooling, its energy use impact will be captured neither in the first part nor the second part of the test. Amending the test procedure as described would enable the test to capture such an increase in compressor run time needed to accomplish precooling before the defrost cycle occurs.

The language suggested by Fisher-Paykel addressing the "no temperature swings" scenario apparently referred to systems with variable-speed compressors that modulate capacity over a wide range such that the compressor operates at a low speed but does not turn off during steady-state operation between defrosts. DOE is aware that such products have been commercialized. However, DOE believes that the instructions suggested by Fisher Paykel for this type of operation are not sufficiently clear to ensure consistent application of the test procedure because such stable operation has not been defined. DOE proposes to clarify that the second part of the test would start when the compartment temperatures are within their measured ranges during steady state operation or within 0.5 °F of their average temperature during steady state operation if this range is 1 °F or less when testing products that do not experience compressor off cycles during steady-state operation between defrosts. Language addressing the end of the second part of the test for products for which there is no compressor off-cycle between defrosts is not needed, because this possibility is already addressed by the maximum time for the test of 4 hours after the defrost heater is first energized.

Accordingly, DOE proposes modifying the description of the long time automatic defrost test procedure found in section 4.1.2.1 as follows for Appendices A1, A, B1, and B:

4.1.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the two-part test described in this section may be used. The first part is the same as the test for a unit having no defrost provisions (section 4.1.1). The second part starts when the compressor turns off at the end of a period of steady-state cycling operation just before initiation of the defrost control sequence. If the compressor does not cycle during steady-state operation between defrosts, the second part starts at a time when the compartment temperatures are within their ranges measured during steady state operation, or within 0.5 °F of the average during steady state operation for a compartment with a temperature range during steady state operation no greater than 1 °F. This control sequence may include additional compressor operation prior to energizing the defrost heater. The second part terminates when the compressor turns on the second time after the defrost control sequence or 4 hours after the defrost heater is energized, whichever occurs first. See Figure 1.

In conjunction with these changes, DOE proposes modifying the current illustration in Appendix A1, which shows how to measure long-time defrost and would be modified to reflect the proposed language discussed above. DOE also proposes adding a second illustration showing the appropriate measurement technique when there is precooling. These amendments are proposed for both Appendices A1 and A.

DOE anticipates that these proposed modifications could affect the energy use measurement for those products that employ precooling. However, these products represent a minority of the products available on the market. Adjustment of energy use standards to address the small increase in the measurement for these products would be a relaxation of energy use standards for all other products. If an adjustment were made to accommodate the minority of products with precooling, the energy use of a given product class would be increased. This would represent an increase in allowable energy use for the majority of products of the class for which the new test would make no change in measured energy use.

DOE is aware that sophisticated control systems could be used to reduce the energy use measured in the second part of the test through the use of partial temperature recovery after the defrost, followed later by a full recovery. This control scheme cuts short the first on-cycle of the compressor after the defrost heater has been energized, before cabinet temperatures recover fully. The second part of the test then stops when the compressor starts operating a second time. The second compressor on-cycle is allowed to run long enough for full cabinet temperature recovery, but this additional energy use is not captured in the test. A number of options could be considered to address this issue including, but not limited to, the following: (1) Requiring the recovery to continue until the average freezer temperature is within a specified temperature difference of the average lowest temperature attained during steady-state cycling operation, (2) requiring that the test continue for a specified extended time period after completion of defrost, and (3) requiring that the average temperature of the compartment during the second part of the test be incorporated into the freezer temperature calculation. DOE requests comments on whether consideration should be given to further modification of the test to avoid partial recovery and, if so, what type of changes would be appropriate.

11. Establishing Test Procedures for Multiple Defrost Cycle Types

DOE is aware of products that use more than one control sequence for defrost cycles. Examples include products with refrigeration systems equipped with a single compressor and two evaporators, in which the evaporators have different defrost frequencies. Each defrost cycle type may have a different control sequence. For example, one defrost cycle type may involve defrosting the freezer evaporator while another may involve defrosting the fresh food evaporator. Alternatively, one defrost cycle type may involve defrosting both evaporators, while another may involve defrosting the fresh food evaporator, which may require more frequent defrost cycles. The current test procedures do not address products that employ these types of defrost cycles. DOE proposes to remedy this omission by defining the term "defrost cycle type" as follows.

"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 sequence of control for defrost such as the number of defrost heaters energized. Each such variation establishes a separate distinct defrost cycle type.

In cases where these systems use automatic defrost control with less than fourteen hours of compressor run time between defrosts for all defrost cycle types, and in which compressor run hours for distinct defrost cycle types are multiples of each other (*e.g.,* the freezer defrost occurs every 12 hours of compressor run time and the fresh food defrost occurs every 6 hours of compressor run time), the automatic defrost test procedure of 10 CFR 430, subpart B, Appendix A1, section 4.1.2 applies. This procedure includes a single test period, which lasts "from one point during a defrost period to the same point during the next defrost period." (10 CFR part 430, subpart B, appendix A1 section 4.1.2). As currently written, the defrost period can be interpreted as being associated with the defrost cycle type with the longest compressor run time between defrosts, which would enable the test procedure to measure all energy use, including the defrost energy use of the product. DOE proposes to amend the language in the current procedure to ensure that the defrost period used during testing is the period associated with the defrost cycle type with the longest time between defrosts.

In particular, DOE proposes to establish a procedure that addresses the energy contribution of each of the defrost cycle types. Appendix A1 currently provides a procedure for long time defrost that allows separate measurement of the energy use associated with the defrost cycle in a second part of the test. 10 CFR part 430, subpart B, Appendix A1, section 4.1.2.1. DOE proposes that this second part of the test be applied separately to each of the defrost cycle types and that the energy use contribution associated with each of these defrost cycle types be included in the energy use calculation. The calculation would be adjusted as appropriate according to the applicable frequency of the cycle types.

DOE proposes to incorporate these changes into Appendix A1 and the new Appendix A. The changes are not considered to be applicable to freezers, making similar changes to Appendices B and B1 unnecessary.

DOE seeks comments on this approach and its related assumptions and analyses.

12. Elimination of Part 3 of the Variable Defrost Test

As described in section III.D.10, language addressing variable defrost was introduced in the test procedures in August 1989. 54 FR 36238. This test procedure amendment established a three-part test for products equipped with variable defrost. Part 1 measures the steady-state energy use between defrosts. Part 2 measures the energy use associated with each defrost cycle. Part 3, which is optional, provides a measurement of the time interval between defrosts. 10 CFR part 430, subpart B, appendix A1, sections 4.1.2.1 and 4.1.2.2 (describing Parts 1 and 2 of the variable defrost test).

Part 3 reads as follows:

4.1.2.3 Variable defrost control optional test. After steady-state conditions with no door openings are achieved in accordance with section 3.3 above, the test is continued using the above daily door-opening sequence until stabilized operation is achieved. Stabilization is defined as a minimum of three consecutive defrost cycles with times between defrosts that will allow the calculation of a Mean Time Between Defrosts (MTBD1) that satisfies the statistical relationship of 90 percent confidence. The test is repeated on at least one more unit of the model and until the Mean Time Between Defrosts for the multiple unit tests (MTBD2) satisfies the statistical relationship. If the time between defrosts is greater than 96 hours (compressor "on" time) and this defrost period can be repeated on a second unit, the test may be terminated at 96 hours (CT) and the absolute time value used for MTBD for each unit.

10 CRF part 430, subpart B, appendix A1, section 4.1.2.3.

The time required to conduct this part of the test ranges from 1 to 2 weeks, which can double since a second unit must also be tested.[2] DOE had previously estimated that the energy use captured during this part of the test to comprise between 1.5 to 7 percent of a tested unit's total energy consumption. *See* 47 FR 34522 and 54 FR 36238. DOE's testing of refrigeration products to support the energy conservation standard rulemaking involved testing one product using the third part of the test, as described above. Using the optional Part 3, the test yielded a CT value of 20.9 hours, while using the default CT calculation (using the default value 0.2 for F, as specified in Appendix A1 section 5.2.1.3) resulted in a value of 24.0 hours. The energy use calculated using the CT determined by the test differs from the energy use determined using the default value of CT by less than 0.4%.[3] In this case, use of the default results in a lower energy use, but achieving a reduction of 0.4% in the measured energy use would generally not be sufficient to justify running the Part 3 test. Because of the high test burden and the small amount of energy use involved, a manufacturer may decide not to use this optional step. DOE is unaware of any manufacturer that has used the test to rate a refrigeration product.

Manufacturers that choose not to conduct the optional third part of the test instead use a prescribed equation to determine the appropriate time interval between defrosts for use when calculating energy consumption. The equation is described as follows:

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

CT_L = least or shortest time between defrosts in tenths of an hour (greater than or equal to six but less than or equal to 12 hours)

CT_M = maximum time between defrost cycles in tenths of an hour (greater than CT_L but not more than 96 hours)

10 CFR part 430, subpart B, appendix A1, section 5.2.1.3

In the equation for CT, the value F is the ratio of per day energy consumption in excess of the least energy and the maximum difference in per day energy consumption, and is set equal to 0.2 if the optional part of the test is not conducted to determine CT directly. (Appendix A1, section 5.2.1.3). For example, if using the maximum time between defrosts and the minimum time between defrosts in the equation for defrost contribution to energy use gives results of 0.1 and 0.2 kilowatt-hours per day, a value of CT would be selected so that the defrost energy use contribution is set equal to $0.1 + 0.2 \times (0.2 - 0.1)$, equal to 0.12 kilowatt-hours per day.

Since the alternative energy calculation method can be used, the optional step is not necessary. As mentioned above, DOE is unaware of any manufacturers that use this optional part, which indicates that the industry generally considers the equation for CT described above to be an adequate representation of the performance of variable defrost systems. For this reason, and to simplify the test procedure, DOE proposes to eliminate this optional test. This amendment would be made in both Appendices A1 and B1.

13. Corrections and Other Test Procedure Language Changes

This section discusses two other proposed amendments to the current test procedure.

A: Simplification of Energy Use Equation for Products With Variable Defrost Control

Section 5.2.1.3 of Appendix A1 provides the equation for ET, energy use in kilowatt-hours per day, for refrigerators and refrigerator-freezers with variable defrost:

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

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

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

CT_L = least or shortest time between defrosts in tenths of an hour (greater than or equal to six but less than or equal to 12 hours)

CT_M = maximum time between defrost cycles in tenths of an hour (greater than CTL 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

$F = (1/CT - 1/CT_M)/(1/CT_L - 1/CT_M) = (ET - ET_L)/(ET_M - ET_L)$ or 0.20 in lieu of testing to find CT.

ET_L = least electrical energy used (kilowatt hours)

ET_M = maximum electrical energy used (kilowatt hours)

For variable defrost models with no values for CT_L and CT_M in the algorithm the default values of 12 and 84 shall be used, respectively.

10 CFR part 430, subpart B, Appendix A1, section 5.2.1.3.

Should DOE adopt the changes to the variable defrost control test as discussed in Section III.D.12 above,—*i.e.,* eliminating it—much of the language describing the factor F (*i.e.,* the ratio of daily energy consumption in excess of the difference between the maximum and minimum ("least") daily energy consumption) explained above in section III.D.12) would no longer be necessary and would be dropped. For cases in which the optional Part 3 is not conducted, CT is calculated based on the default value of F, and either the manufacturer-specified or the default values of CT_M and CT_L. If, on the other hand, DOE retains the optional step, the agency believes that the clarifying equations for F, ET_L (least electrical energy used (kilowatt hours)), and ET_M (maximum electrical energy used (kilowatt hours)) are not needed, as described below. For cases in which the optional step is conducted to measure the value of CT (*i.e.,* hours of compressor run time between defrosts to be used in the equation for energy consumption), this value is used directly in the equation for ET. The value of F does not need to be calculated for any of these situations.

Regarding specific issues that DOE is proposing to amend, DOE notes that the values of CT, CT_M, and CT_L should be in units of hours to the nearest tenth of an hour rather than in units of tenths of an hour. Section 5.2.1.2 indicates clearly that CT is in units of hours: "CT = Defrost timer run time in hours required to cause it to go through a complete cycle, to the nearest tenth hour per cycle" (Appendix A1 section 5.2.1.2). DOE proposes to modify Appendix A1 to remove the clarifying equations for F, ET_M, and ET_L, to eliminate reference to the optional third part of the test, and to correct the units in the definitions for CT_M (maximum time between defrosts in hours of compressor run time) and CT_L (lowest

[2] As an example, DOE contracted with a test facility to conduct such a test in October 2008. This test was started on October 10 at 4 p.m. and continued until October 21 at 8 p.m., a total duration of more than 11 days.

[3] The energy use contribution of defrost is inversely proportional to the value of CT, which represents hours of compressor run time between defrosts.

time between defrosts in hours of compressor run time). If the optional part of the test is retained, DOE would propose all of these changes except elimination of the reference to the optional step. DOE is also proposing that parallel changes be made in Appendices B1, A, and B. (In Appendix B1, the change would be made in the current section 5.2.1.3.)

B: Energy Testing and Energy Use Equation for Products With Dual Automatic Defrost

Section 4.1.2.4 of Appendix A1 describes the manner in which to test products equipped with a dual automatic defrost cycle. The section provides:

4.1.2.4 Dual compressor systems with automatic defrost. If the model being tested has separate compressor systems for the refrigerator and freezer sections, each with its own automatic defrost system, then the two part method in 4.1.2.1 shall be used. The second part of the method will be conducted separately for each automatic defrost system. The auxiliary components (fan motors, anti-sweat heaters, etc.) will be identified for each system and the energy consumption measured during each test.

10 CFR part 430, subpart B, Appendix A1, section 4.1.2.4.

The energy use of each compressor system must be measured separately in order to properly measure the energy use associated with each defrost system. Section 4.1.2.4 does not describe all of the key components—*e.g.,* the compressor and the defrost heater are not mentioned—that must have their energy use separately measured. DOE proposes to modify the text 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 to clarify the required procedure.

Additionally, DOE is proposing to modify the current energy use equation for products equipped with dual automatic defrost cycles. Currently, the energy use equation for products with dual automatic defrost in section 5.2.1.5 of Appendix A1 reads as follows:

$$ET = (1440 \times EP1/T1) + (EP2_F - (EP_F \times T2/T1)) \times 12/CT_F + (EP2_R - (EP_R \times T3/T1)) \times 12/CT_R$$

Where 1440, EP1, T1, EP2, 12, and CT are defined in 5.2.1.2

EP_F = energy expended in kilowatt-hours during the second part of the test for the freezer system by the freezer system.

$EP2_F$ = total energy expended during the second part of the test for the freezer system.

EP_R = energy expended in kilowatt-hours during the second part of the test for the refrigerator system by the refrigerator system.

$EP2_R$ = total energy expended during the second part of the test for the refrigerator system.

T2 and T3 = length of time in minutes of the second test part for the freezer and refrigerator systems respectively.

CT_F = compressor "on" time between freezer defrosts (tenths of an hour).

CT_R = compressor "on" time between refrigerator defrosts (tenths of an hour).

10 CFR part 430, subpart B, Appendix A1, section 5.2.1.5.

DOE proposes correcting several errors in the above definitions. The value EP_F, defined as the energy use of the freezer system during the second part of the test for the freezer system, should instead be defined as the energy use of the freezer system during the *first* part of the test. Similarly, EP_R should be the energy use of the refrigerator system during the first part of the test rather than the second part of the test.

Also, the value $EP2_F$ should be the energy use of the freezer system for the second part of the test for the freezer system, rather than the total energy use for the second part of the test for the freezer system. The total energy would include the fresh food system energy. Calculating defrost contributions for each system requires that the measurements be conducted only for that particular system. Subtracting the total energy use for steady state operation (adjusted for the time period of the defrost part of the test) from the total energy use for the freezer defrost, the fresh food part of these measurements will not necessarily cancel out, because they will not necessarily include a whole number of compressor cycles. The situation created by the current equation's definitions can result in the measurement being erroneously adjusted based on the random nature of when the fresh food compressor cycles on and off, rather than calculated based just on the operation of the freezer system.

Similarly, $EP2_R$ should be the energy use of the refrigerator system during the second part of the test for the refrigerator system. The values CT_F and CT_R should also be denoted in hours to the nearest tenths of an hour.

DOE proposes to amend the test procedure of Appendix A1 to correct these errors. The corrected text would also appear in Appendix A.

14. Including in Certification Reports Basic Information Clarifying Energy Measurements

This section discusses a proposal to include information in certification reports that would clarify how products with advanced controls features (*e.g.,* variable defrost control or variable anti-sweat heater control) or with modifications from standard temperature sensor locations are tested. Section III.D.10 discusses test procedures for products with long-time or variable defrost, section III.D.9 discusses test procedures for products with variable anti-sweat heater control, and section III.D.3 discusses alternative temperature sensor locations. Measurement of energy use of such products cannot be conducted properly without knowledge of specific information regarding these control systems or without knowledge that the temperature sensor locations have been modified from their standard locations. This information impacts how such a product is tested and how its energy use is calculated. In order to allow verification of the energy use ratings for such products by parties other than their manufacturers, DOE proposes that this information be included in certification reports.

The calculation of energy use for products with variable defrost control involves either use of control parameters CT_L and CT_M or a test to determine the appropriate compressor run time between defrosts. (see for example Appendix A1, section 5.2.1.3). Section III.D.12 above proposes elimination of the approach using the test, because DOE believes that this approach is rarely if ever used in rating products. In order to properly measure the defrost portion of the energy use for a product, a test technician must know (1) whether the product has variable defrost control, and (2) the values CT_L and CT_M. DOE proposes that these three sets of data be provided in certification reports for refrigeration products.

The proposed procedure for calculation of energy use for products with variable anti-sweat heater control is described in section III.D.9 above. Proper energy use measurement for such a product according to the proposed procedure requires the disclosure of whether a particular product has this type of control. Hence, DOE proposes that this information be provided in certification reports.

The inclusion of details regarding the relocation of temperature sensor locations in test reports to be maintained by manufacturers is discussed in section III.D.3 above. However, knowledge that such modification has been made to conduct a test would not generally be available unless DOE requested the test records. Hence, DOE proposes that notification be provided in the certification report for a product if such an adjustment has been made.

These modifications would be introduced into the regulations by modifying 10 CFR 430.62(a)(4)(xii), which requires the reporting of information specific to refrigeration products that must be provided in certification reports. Reporting of the presence of variable defrost or variable anti-sweat heater control would be required for all such products, while reporting of the variable defrost parameters CT_L and CT_M would be required only for products equipped with this type of control. If specific values of these parameters are not used in the control algorithm, the default defrost parameters specified for example in Appendix A1 section 5.2.1.3 would be reported. In the case of products with multiple defrost cycle types (see section III.D.11 above), the defrost cycle parameters for all of the defrost cycle types would be provided.

DOE requests comment on whether this proposal would be sufficient to allow accurate testing, and, if this information is not sufficient, what additional or alternative information should be provided.

E. Amendments To Take Effect Simultaneously With a New Energy Conservation Standard

In addition to the proposed changes discussed above, DOE is considering additional changes to the test procedure that would become effective in conjunction with a final rule amending the energy conservation standards for these products. These proposed changes are discussed below.

1. Incorporating by Reference AHAM Standard HRF–1–2008 for Measuring Energy and Internal Volume of Refrigerating Appliances

The current DOE test procedures for refrigerators and refrigerator-freezers reference sections of AHAM Standard HRF–1–1979. The referenced sections specify the test facility, test sample set-up, measurement procedure, and volume calculation requirements that manufacturers must follow when testing their products. The most recent version of this industry procedure, HRF–1–2008, incorporates many changes, including the specification of new requirements for compartment temperatures and new methods of volume calculation, discussed further in sections III.E.2 and III.E.3 of this notice.

Adopting the provisions in HRF–1–2008 for new compartment temperatures and new volume calculation methods into the DOE test procedures for refrigeration products would alter the measured energy efficiency of these products. These new compartment temperatures are lower for refrigerator-freezers and refrigerators with freezer compartments larger than 0.5 cubic ft. in size. This proposed change would create a greater temperature difference between the exterior and interior of the cabinet during the test, which in turn would increase thermal loads placed on the tested unit. In addition, the refrigeration systems of refrigerator-freezers would operate with a greater temperature lift (*i.e.,* the rise in temperature between the refrigeration system's evaporator, where heat is absorbed, and the system's condenser, where heat is transferred to the ambient air), which would reduce its coefficient of performance (COP, refrigeration provided divided by power input). Both factors would increase the measured energy use for these products, the first by increasing the amount of heat that must be removed by the refrigeration system, and the second by reducing the refrigeration system's effectiveness in removing heat.

The proposed changes in the volume calculation method would change the calculated refrigerated volume and the adjusted volume because both factors depend on the volume measurements.

2. Establishing New Compartment Temperatures

Working Group 12 of Technical Committee 59 of the IEC is developing IEC 62552, a new international test procedure for refrigeration products. DOE understands that one of the chief goals of this effort is to harmonize the energy test procedure for countries that comprise key markets for these products. Among the procedures addressed in IEC 62552 is the treatment of compartment temperatures for refrigeration products.

In developing HRF–1–2008, AHAM incorporated some of the provisions being considered for IEC 62552. Among these provisions, AHAM changed the compartment temperatures for refrigerator and refrigerator-freezer testing. These temperature changes include (1) lowering the standard test temperatures from 5°F to 0°F for the freezer compartment of a refrigerator-freezer and from 45°F to 39°F for the fresh food compartment, (2) raising the standard test temperature from 38°F to 39°F for an all-refrigerator, and (3) lowering the standard test temperature from 45°F to 39°F for the fresh food compartment of a refrigerator having a freezer compartment. (HRF–1–2008, section 5.6.2). AHAM believes the new temperatures more closely represent compartment temperatures typically experienced during normal use of these products. (See AHAM (Framework Comments), No. 11 at p. 2. *See* also Godwin, S.L. *et al.,* "A Comprehensive Evaluation of Temperatures within Home Refrigerators", Food Protection Trends, Vol. 27, No. 3, pp. 168–73, International Association for Food Protection, 2007 (assessing the actual temperatures at which cold foods are stored in homes and noting the need to maintain refrigeration temperatures at 40°F or lower) and Kosa, K. *et al.,* "Consumer Home Refrigeration Practices: Findings from a Consumer Survey", presented at the ADA Food & Nutrition Conference & Expo, Honolulu, Hawaii, (September, 2006) (noting the need to maintain refrigeration temperatures at 40°F or lower and the significant number of surveyed households that did not follow this practice).)

These compartment temperature changes also led AHAM to change the volume adjustment factors, which depend on compartment temperatures. AHAM changed the volume adjustment factor for (1) freezer compartments of refrigerator-freezers from 1.63 to 1.76, (2) freezers from 1.73 to 1.76, and (3) freezer compartments of refrigerators from 1.44 to 1.47. (Compare HRF–1–1979, section 10.4 with HRF–1–2008, section 6.3).

Volume adjustment factors are used in the calculation of adjusted volumes, which are the basis of the energy conservation standard equations for refrigeration products. Adjusted volume is defined for refrigerators and refrigerator-freezers as "the sum of (i) the fresh food compartment volume as defined in HRF–1–1979 in cubic feet, and (ii) the product of an adjustment factor and the net freezer compartment volume as defined in HRF–1–1979, in cubic feet." 10 CFR part 430, subpart B, Appendix A1, section 1.2.

DOE proposes to adopt the new compartment temperatures of HRF–1–2008 and their associated volume adjustment factors in the DOE test procedures. It is doing so to improve the ability of the required procedure to produce measurements that are more representative of field energy use and to help facilitate the international harmonization of appliance test procedures. Reducing the energy test compartment temperatures for refrigerators (excluding all-refrigerators) and refrigerator-freezers will result in higher energy test numbers because of the higher thermal load associated with the increased temperature difference between ambient conditions and the compartments. Chapter 7 of the preliminary Technical Support

Document for the ongoing rulemaking on Energy Conservation Standards for Refrigerators, Refrigerator-Freezers, and Freezers addressed field energy use for refrigeration products. This analysis was developed using the U.S. DOE's Energy Information Agency's Residential Energy Consumption Survey (RECS) of 2005. For all product classes for which data were available in the RECS database, the field energy use was determined to be greater than the energy use associated with an energy test using the new compartment temperatures that are under consideration in today's proposal. Part of this energy use increase is associated with icemaking, which is not covered by the current energy test procedure. However, DOE's initial analysis shows that the higher energy use measured using the new compartment temperatures provides a more accurate representation of energy use during typical consumer use of refrigeration products. This observation reinforces the position that energy tests conducted using the new compartment temperatures are more representative of field energy use than the temperatures used in the current test procedures.

Under today's proposal, these new compartment temperatures and their associated volume adjustment factors would be incorporated into the proposed Appendices A and B to coincide with the compliance date for any new standards that manufacturers would need to meet in 2014.

3. Establishing New Volume Calculation Method

In HRF–1–2008, AHAM simplified the volume calculation method. (See HRF–1–2008, preface). Specifically, the revised calculation involves far fewer instructions regarding the inclusion or exclusion of various components and regions of the compartments, and provides far fewer diagrams illustrating these varied instructions. AHAM provided DOE with data illustrating the impact that the new volume calculation method would have for certain representative product classes. These data show that calculated compartment volumes change in the range of 1 to 3 percent. ("Impact of HRF–1 Test Procedure Change on Reported Adjusted Volume and Reported Energy Consumption Values", RIN 1904–AB79, Docket No. EERE–2008–BT–STD–0012 (data provided by AHAM for the Rulemaking for Energy Conservation Standards for Refrigerators, Refrigerator-Freezers, and Freezers)).

DOE proposes to amend the DOE test procedures to adopt the volume calculation procedure used in HRF–1–2008. The new volume calculation method is simpler and leaves less room for subjective interpretation by test technicians in developing a volume estimate when compared to the current method. Adoption of the simplified method is expected to improve the accuracy of volume reporting. Further, since the energy conservation standard is based on the adjusted volume determined from volume measurements, this improved accuracy is also expected to improve compliance with the energy standard.

Questions have surfaced during DOE review of AHAM HRF–1–2008 in regard to requirements for the treatment of icemakers and related hardware for the purposes of volume calculations. HRF–1–2008 does explicitly mention whether automatic icemakers or ice storage bins should be considered part of the internal volume. The key clause of this standard, which specifies components whose volumes are to be included in the volume measurement, reads, "(w)hen the volume is determined, internal fittings such as shelves, removable partitions, containers and interior light housings shall be considered as not being in place." (HRF–1–2008, section 4.2.2).

In contrast, HRF–1–1979 specifically addresses the volume of the icemaker and the ice storage bin:

Volumes to be included. The total refrigerated volume is to include volume occupied by special features, such as baskets, crispers, meat pans, chiller trays, icemakers (including storage bins for automatic icemakers) and water coolers. (HRF–1–1979, section 4.2.1.1(a))

Volumes to be deducted. The total refrigerated volume is not to include volume occupied by fixed projections, such as control knobs, shelf hangers, shelf and pan rails, and thermostat escutcheons, which collectively, exceed a volume of more than 0.05 cubic foot (1.4 liters) per compartment. (Id., section 4.2.1.2(e))

DOE does not intend to change the test procedure for volume calculation to require excluding the volume of the icemaker and the ice storage bin in the volume calculation. Hence, DOE proposes to include the following clarifying language to this effect in section 5.3 of Appendix A:

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

DOE proposes a similar amendment to Appendix B, recognizing that freezers may also incorporate automatic icemakers.

As with the proposed incorporation of new compartment temperatures, DOE plans to incorporate the proposed volume calculation changes as part of the procedures that manufacturers would apply when certifying compliance to any standards that apply in 2014. These changes (*i.e.,* temperature and volume measurements) would have a significant impact on the overall standards for refrigeration products and necessitate, in DOE's view, that sufficient time be provided to manufacturers to adjust to these changes. In light of this belief, DOE believes it appropriate to require that manufacturers use these new calculations within the initiation of any required standards for 2014. These amendments would appear in the new Appendices A and B.

4. Control Settings for Refrigerators and Refrigerator-Freezers During Testing

Section III.D.4 above introduces one issue associated with the current test procedure requirements for temperature control settings. Additional issues and proposed amendments to resolve these issues are discussed in this section.

The use of two tests conducted at different temperature control settings is described above in section III.D.4. Appendix A1, section 3.2.1 requires the adjustment of settings in the second test so that the compartment temperatures measured during the two tests bound the standardized temperature for the product under test. The standardized temperatures for the products covered by Appendix A1 are defined in section 3.2: All-refrigerator, 38 °F (3.3 °C) for the fresh food compartment temperature; Refrigerator, 15 °F (−9.4 °C) for the freezer compartment temperature; Refrigerator-freezer, 5 °F (−15 °C) for the freezer compartment temperature. For refrigerators and refrigerator-freezers, the current procedure requires that the settings adjustment for the second test be based only on the freezer temperature measured during the first test, even though the product's energy use would also be impacted by the temperature of the fresh food compartment during the test. Hence, ensuring consistency of the test measurement with the representative use cycle of these products should also require consideration of bounding of the standardized temperature of the fresh food compartment.

DOE understands that manufacturers conduct tests of refrigerator-freezers and of refrigerators that are not all-refrigerators with consideration of the fresh food compartment temperature. The controls are set to their warmest position(s) for the second test only if during the first test all compartment temperatures are lower than their standardized temperatures. Otherwise, the controls are all set to their coldest position for the second test required under the procedure. The fresh food compartment's standardized temperature under the practice followed by the manufacturers is 45 °F, which is consistent with the temperature used for the energy use calculation (interpolation) based on fresh food compartment temperature of Appendix A1, section 6.2.2.2. DOE understands that manufacturers have adopted this approach to ensure that the energy use calculation provides an interpolation to a setpoint condition for which the temperatures of all compartments are either equal to or lower than the standardized temperatures for the compartments. This practice is most clearly described in the Canadian Standards Association Standard C300–08, "Energy performance and capacity of household refrigerators, refrigerator-freezers, freezers, and wine chillers" (CSA C300–08), section 6.1.3.2.2, which states:

> If the first test produces average compartment temperatures that fall into quadrants B, C, or D of Figure A.1, the second test shall be performed with all controls at their coldest setting(s). If the first test produces average compartment temperatures that fall into quadrant A of Figure A.1, the second test shall be performed with all controls at their warmest setting(s).

CSA C300–08, section 6.1.3.2.2.

In Figure A.1 of C300–08 at least one of the compartment temperatures is above its standardized temperature for quadrants B, C, or D, but only for quadrant A are both compartment temperatures lower than their standardized temperatures.

DOE proposes to modify the energy test procedure to make it consistent with the procedure manufacturers already use to adjust settings. Specifically, by requiring that the second test be conducted with all controls at their warmest settings only if both compartment temperatures during the first test were lower than the standardized temperatures, DOE will help ensure that the required procedure is more rigorous than what is currently in place in its test procedure. It would also create a procedure that is consistent with current industry practices. DOE proposes also to modify the specification of standardized compartment temperatures by adding a standardized compartment temperature for the fresh food compartment of refrigerators and refrigerator-freezers. The standardized fresh food temperature would be specified as 39 °F in Appendix A.

Conducting a Third Test

DOE also notes that the current DOE test procedure specifies that as many as three tests may need to be conducted for calculating energy use. In particular, it specifies when the first two tests are sufficient for calculating energy use and when a third test is required. The current test procedure provides:

> If the compartment temperatures measured during these two tests bound the appropriate 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, a third test shall be performed with all controls set at their warmest setting and the result of this test shall be used with the result of the test performed with all controls set at their coldest setting to determine energy consumption. If the compartment temperature measured with all controls set at their warmest setting is below the standardized temperature; and the fresh food compartment temperature is below 45 °F (7.22 °C) in the case of a refrigerator or a refrigerator-freezer, excluding an all-refrigerator, then the result of this test alone will be used to determine energy consumption.

(10 CFR 430, subpart B, Appendix A1, section 3.2.1).

Test Results Not Addressed in the Current Test Procedure

Table 2 below illustrates the logic behind the temperature setting requirements for refrigerator and refrigerator-freezer testing. This logic is based on the current test procedure and incorporates the clarification regarding the treatment of fresh food and freezer compartment temperatures for the first test, as described above. The tests for Cases 2, 5, and 6 in Table 2 are not clearly addressed in the current test procedure—specifically, while the freezer compartment temperature is lower than the setpoint for both tests, the fresh food compartment temperature is higher than 45 °F for at least one of the tests. The current procedure does not explicitly state which set of results are to be used when calculating energy consumption in these cases.

TABLE 2—TEMPERATURE SETTING CHART FOR REFRIGERATORS AND REFRIGERATOR-FREEZERS

First test		Second test		Third test settings	Energy calculation based on	Case No.
Settings	Results	Settings	Results			
Fzr Mid FF Mid	Fzr Low FF Low	Fzr Warm FF Warm	Fzr Low FF Low.	None	Second Test Only	1
			Fzr Low FF High.	None	Not Clear: Propose use of First and Second Test	2
			Fzr High FF Low.	None	First and Second Test	3
			Fzr High FF High.	None	First and Second Test	4
	Fzr Low FF High	Fzr Cold FF Cold	Fzr Low FF High.	None	Not Clear: Propose requiring a Third test with Warm/Warm settings and use of the Second and Third Tests.	5
			Fzr Low FF Low.	None	Not Clear: Propose use of First and Second Test	6
	Fzr High FF Low	Fzr Cold FF Cold	Fzr High FF Low	Fzr Warm FF Warm.	Second and Third Tests	7
			Fzr Low FF Low.	None	First and Second Tests	8
	Fzr High FF High	Fzr Cold FF Cold	Fzr Low FF Low.	None	First and Second Tests	9
			Fzr Low FF High.	None	First and Second Tests	10

TABLE 2—TEMPERATURE SETTING CHART FOR REFRIGERATORS AND REFRIGERATOR-FREEZERS—Continued

First test		Second test		Third test settings	Energy calculation based on	Case No.
Settings	Results	Settings	Results			
			Fzr High ...... FF Low	Fzr Warm .... FF Warm.	Second and Third Tests	11
			Fzr High ...... FF High	Fzr Warm .... FF Warm.	Second and Third Tests	12

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

DOE proposes that for cases 2 and 6 that the results of the first and second tests be used for the energy consumption calculation, since this calculation will ensure that all compartment temperatures do not exceed their standardized temperatures at the calculated condition.

Warm Compartments

Similarly, cases 5, 7, 10, 11, and 12 all involve at least one compartment that is warmer than its standardized temperature when all controls are at their coldest setting. These cases represent substandard product performance, but the test procedure allows for the rating of products under some of these scenarios. When one of the warmer compartments is the freezer compartment (as in cases 7, 11, and 12), the current test procedure calls for conducting a third test with all controls set at their warmest setting and using the second and third tests to determine energy use. For case 10, the results for the freezer compartment comply with the requirements of the current test procedure (using the results from the first and second tests to calculate energy use), even though the fresh food compartment temperature is higher than the standardized temperature when the unit is tested at the compartment's coldest setting. As mentioned above, the current test procedure provides no guidance for case 5, where the freezer compartment temperature is below the standardized temperature but the fresh food compartment temperature at its coldest setting is higher than the standardized temperature.

These amendments are proposed for new Appendix A.

Alternative Approach for High Compartment Temperatures

While DOE proposes that a third test be required for case 5, and that the results of the second and third tests be used to calculate energy consumption, the agency is considering an alternative to address the nonstandard performance of all of these test cases in a manner described below. While the current proposal does not incorporate this alternative, DOE seeks comment on whether it should be implemented to discourage designs for which any of the standardized compartment temperatures are not achieved.

The alternative would be to modify the test procedure to prevent the rating of products if any measured compartment temperature exceeds its standardized temperature when all controls are at their coldest settings. If a tested unit's fresh food compartment exceeds its standardized temperature, the product would not meet the refrigerator definition, which specifies the use of "temperatures above 32 °F and below 39 °F". (10 CFR 430.2). Under the proposed definition for a refrigerator-freezer (see section III.B), the product would also fail to meet that product definition. Similarly, if the freezer compartment temperature of a refrigerator-freezer exceeded its standardized temperature, the product would not comply with the current requirement that the freezer compartment "may be adjusted by the user to a temperature of 0 °F or below." (10 CFR 430.2). The maximum temperature for the freezer compartment of a refrigerator is 32 °F, substantially higher than the 15 °F standardized temperature (10 CFR 430.2). Hence, a modification to the test procedure preventing a rating would not directly be supported by the product definition for the case of a refrigerator whose freezer compartment is warmer than the 15°F standardized temperature.

Precedent for disallowing the rating of a product for which a compartment is above its standardized temperature when the product is tested with temperature controls at their coldest settings is found in CSA C300–08:

5.2.7.3 Noncompliance and Product Description

For the standard and alternative testing sequences, the conditions of noncompliance with prescribed thermal performance shall be as follows:

(a) if, with all compartment controls at their coldest settings, the freezer temperature remains above the standard operating temperature specified in Clause 5.2.6.2, the product description shall be revised in accordance with the measured temperature; and

(b) energy consumption shall then be declared in accordance with the revised product description.

CSA C300–08 Section 5.2.7.3

DOE seeks comment on a possible general test procedure requirement that would provide that any product that exhibits such substandard performance would be ineligible of being rated as a product associated with the standardized temperature that was not achieved. DOE further seeks comment on whether such a provision should be considered for current Appendices A1 and B1 as well as proposed new Appendices A and B. Note that the reduction of some of the standardized temperatures upon transition to Appendices A and B would increase the level of performance required for these products.

Alternative Test Methods Involving Just Warm and/or Cold Settings

The DOE test procedure allows two alternative approaches: (1) Using just a test with controls at their warm settings and (2) conducting two tests with controls at their cold settings for one test and at their warm settings for the second test. (*see* Appendix A1 sections 3.2.2 and 3.2.3). For the second of these approaches, the compartment temperature is higher than the standardized temperature at the coldest setting. Depending on the results of these tests, they can be used to determine energy consumption. Except for the fact that a test with median temperature setting has not been conducted as the first test, these cases are equivalent to the cases listed in Table 2. In these cases (cases 1, 6, 7, 11, and 12), the results of the first test are not used in the energy consumption calculation.

General

DOE proposes to add a modified version of Table 2 to the test procedure. The proposed changes would clarify the energy consumption calculation by dictating both the (1) temperature settings of subsequent tests and (2) test results that would be used when calculating energy consumption. These changes would apply to Appendices A.

DOE also proposes that the equivalent of the logic chart represented by Table 2 be included in the test procedures to describe the temperature settings and tests to use for the energy use calculation for all-refrigerators and freezers. An example of such a chart is shown in Table 3 below. This change would be made in Appendices A and B.

TABLE 3—TEMPERATURE SETTING CHART FOR ALL—REFRIGERATORS AND FREEZERS

First test		Second test		Third test settings	Energy calculation based on:
Settings	Results	Settings	Results		
Mid	Low	Warm	Low	None	Second Test Only.
			High	None	First and Second Tests.
	High	Cold	Low	None	First and Second Tests.
			High	Warm	Second and Third Tests.

DOE seeks comment on these proposed amendments, on whether the circumstances listed in Table 2 and Table 3 adequately address all test result possibilities for their respective products, whether the proposed approaches for the currently unclear cases 2, 5, and 6 as indicated in Table 2 are appropriate, and whether the alternative approach disallowing a rating in the case of warm compartment temperatures should be adopted. DOE also seeks comment as to whether its understanding regarding manufacturer practices with respect to setting adjustments during testing are accurate and, if not, what those practices are and how best to address them within the context of DOE's proposed amendments. Finally, DOE requests comment on whether any of these amendments should be directly applied to Appendices A1 and B1 so that they would take effect prior to the effective date of new energy conservation standards; such comments should indicate whether implementing these changes would make any impact on measured energy use.

5. Icemakers and Icemaking

Nearly all refrigerator-freezers currently sold either have an automatic icemaker or are "icemaker-ready", meaning that they have the necessary water tubing, valve(s), and icemaker mounting hardware already installed to allow quick conversion to icemaking operation if an automatic icemaker is installed at any time after product shipment. Production of ice increases the energy use of a refrigerator-freezer in two ways: (1) Additional refrigeration is required to cool and freeze the incoming water, and (2) some icemaker components (*e.g,* the mold heater, the gear motor) also consume energy.

The current test procedure for refrigerators and refrigerator-freezers does not measure the energy use associated with ice production (HRF–1–1979, section 7.4.2). (This is a separate issue from energy used by heaters as part of the icemaking system, which is addressed in section III.F.1.) Limited information has been publicly available regarding ice production energy use, which depends on the product's efficiency in producing ice and the rate of ice production. Publicly available information on this issue includes the following:

- Measurements of the impact of ice making on energy use in tests which were otherwise consistent with the DOE energy test procedure for four refrigerator-freezers meeting 1993 energy standards show energy use increase of 72 to 121 kWh/year. (Alan Meier and Mark Martinez. 1996. *Energy Use of Icemaking in Domestic Refrigerators.* ASHRAE Transactions: Symposia. AT–96–19–2)
- Similar measurements with a single refrigerator showed energy use increase of 130 to 150 kWh/year. (Haider, Imam; He Feng; and Reinhard Radermacher. *Experimental Results of a Household Automatic Icemaker in a Refrigerator/Freezer.* ASHRAE Transactions: Symposia. SA–96–7–3)
- Energy impact at full production of ice was estimated at 250 kWh per year, average ice production is suggested to be 500 grams (g) per day (roughly one-quarter of full production), and the overall impact is estimated to be about 10% of the rated refrigerator energy use. This is based on testing of refrigerators that likely were compliant with the 1993 energy standards, considering the 1995 date of the report referenced in the article. (Alan Meier, *Energy Use of Ice Making in Domestic Refrigerators, http://eetd.lbl.gov/EA/1995_Ann_Rpt/Buildings/energy.use.of.ice.html*)

DOE conducted testing to determine icemaking energy use. The average energy consumption and ice production rates were measured for extended periods of refrigerator-freezer operation involving multiple icemaking cycles during the steady-state operation of the products between defrost cycles for three refrigerator-freezers. Two of these products were bottom-mount refrigerator-freezers with TTD ice service. The other was a side-mount refrigerator-freezer with TTD ice service. The results of the tests are summarized in Table 1 below. The results show a fairly consistent energy use per pound of ice in the range 175 to 200 Watt-hours.

TABLE 4—REFRIGERATOR ICEMAKING TEST RESULTS

Refrigerator type	Bottom-mount	Bottom-mount	Side-mount
Refrigerated Volume (cubic ft.)	26	25	26
Rated Annual Energy Consumption (kWh)	540	547	728
Test Average Wattage			
With Icemaking	85.1	130.0	98.2
Without Icemaking	75.6	104.5	60.9
Differential	10	25	37
Ice Production Rate (lb/day)	1.35	3.44	4.6
Production Efficiency (Watt-hours/lb)	178	174	193

Assuming a daily ice production rate of 1 pound per day (consistent with the 1995 Meier report), the energy use increase associated with icemaking is in the range of 64 to 73 kWh represents 10% to 15% of the rated energy use of the tested products. While the energy use in kWh is consistent with the 1995 Meier report (one-quarter of 250 kWh, or 63 kWh), the percentage of rated annual energy use is higher. DOE believes this discrepancy is due to the lower annual energy consumption of current products. DOE concludes from these data that icemaking energy use can be a significant portion of overall energy use of refrigerator-freezers.

DOE notes that AHAM has been developing a test procedure for measuring icemaking energy use. Preliminary work on this effort was presented to DOE on November 19, 2009. The handout for this presentation, "AHAM Update to DOE on Status of Ice Maker Energy Test Procedure", November 19, 2009, has been incorporated into the docket for this rulemaking (RIN 1904–AB92, Docket No. EERE–2009–BT–TP–0003). While AHAM has not completed its icemaking test procedure, the presentation provides measurements of icemaking energy use determined using a preliminary test method. The average of these measurements is 128 Watt-hours per pound. The preliminary AHAM procedure specified a daily production rate of 1.8 pounds of ice—thus, the average daily energy use associated with icemaking of these preliminary measurements is 0.23 kWh and the average annual energy use is 84 kWh.

In light of the amount of overall energy use that icemaking appears to require, DOE is considering incorporating a test procedure for measuring icemaking energy use in the energy test for refrigerators, refrigerator-freezers, and freezers. However, as described in the AHAM presentation handout, and as noted in several comments associated with the refrigeration product energy conservation standard rulemaking (*see* for example comments provided by AHAM, No. 34 at p. 2, RIN 1904–AB79, Docket No. EERE–2008–BT–STD–0012), development of an icemaking test procedure is complex and consensus has not been reached that a satisfactory procedure has been developed. Consequently, rather than incorporate a measurement of icemaking energy use into the procedure at this time, DOE proposes to introduce the inclusion of a fixed placeholder value for icemaking energy use into the calculation for the energy use of refrigeration products with automatic icemakers. This approach would satisfy the need for improved accuracy in reporting the representative energy use of products, since the reported energy use would no longer be omitting icemaking energy consumption.

DOE proposes use of the average daily icemaking energy use value reported by AHAM, 0.23 kWh per daily cycle. While there are questions about the suitability of the test method used to determine this value, the data reported by AHAM represents the most thorough and complete test series addressing this issue that is available for consideration. DOE welcomes comment on this approach. Further, DOE will consider updated information, such as revised data based on a more thoroughly developed test.

DOE proposes incorporation of icemaking energy use for products that have automatic icemakers. This includes products either with or without TTD ice service, and could include freezers and refrigerators as well as refrigerator-freezers. While the icemaking energy use of products having automatic icemakers could vary significantly, accurate data that would allow the development of fixed icemaking energy use values that are a function of product class or other product characteristics is not available.

DOE proposes incorporation of the icemaking energy use into the energy use calculation by integrating the icemaking energy use value, designated IET and measured in kWh per cycle, into the equations for energy use per cycle, which would be included in the proposed Appendices A and B in section 6.2. For example, the energy use per cycle for refrigerators or refrigerator-freezers in which the compartment temperatures are lower than the standardized temperatures during the test with control settings in their warmest positions would be determined as follows:

6.2.2.1 If the fresh food compartment temperature is at or below 39 °F (3.9 °C) in both tests and the freezer compartment temperature is at or below 15 °F (−9.4 °C) in both tests of a refrigerator or at or below 0 °F (−17.8 °C) in both tests of a refrigerator-freezer, the 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 0.23 for a product with an automatic icemaker and otherwise equals 0 (zero); and number 1 indicates the test period during which the highest freezer compartment temperature was measured.

These amendments would be incorporated in the proposed new Appendices A and B.

DOE may consider modifying the test procedure requirements associated with icemaking energy use to incorporate testing to determine the icemaking energy use of particular products. If a suitable test procedure for this purpose can be developed in time for incorporation in the final rule for this rulemaking, DOE will consider adopting such an amendment. However, such a step will involve issuance of a supplementary NOPR (SNOPR) prior to the final rule. Stakeholders are invited to provide comments including recommendations for the test procedure if DOE were to propose an SNOPR. DOE expects to consider the following factors in developing a proposal for test measurement of icemaking energy use:

(1) Applicability of the test procedure for all types of automatic ice makers;

(2) Submitted test data demonstrating accuracy and repeatability of the procedure;

(3) Proposal of an ice production rate in pounds per day (or per year) so that daily or annual icemaking energy use can be calculated and data supporting the production rate; and

(4) The degree of consensus among industry representatives that the test is viable and that burden is not excessive.

One issue that has come to DOE's attention during consideration of a test for icemaking energy use is the possible impact on energy use measurements of the presence of ice in the ice bin. (*See,* for example, comment 9 from the July 14, 2009 HRF–1 Task Force meeting, included in information provided by AHAM, No. 34 at p. 2, RIN 1904–AB79, Docket No. EERE–2008–BT–STD–0012). The current test procedure does not clarify whether ice may be in the bin during the energy test. Appendix A1 section 2.2 references sections 7.2 through section 7.4.3.3 of HRF–1–1979. (Appendix A1 section 2.2). Section 7.4.2 of HRF–1–1979 states, "[i]ce bins of automatic ice makers are to be full of frozen food packages;" (HRF–1–1979 section 7.4.2). However, Appendix A1 section 2.3 states, "For automatic defrost refrigerator-freezers, the freezer compartments shall not be loaded with any frozen food packages." (Appendix A1 section 2.3). The test procedures are currently silent regarding the presence of ice in the ice bin during the test. DOE requests comment on whether a requirement regarding presence of ice in the bin should be incorporated into the test procedure. Such a requirement would be implemented by inclusion of appropriate language into the set-up requirements in sections 2 of Appendices A1, B1, A, and B.

F. Other Issues Under Consideration

1. Electric Heaters

Refrigeration products use electric heaters for a variety of functions. This section identifies some of those functions, discusses established approaches to heater operation during energy testing, and highlights sections of this notice that address modifications to the current test requirements for heaters.

Anti-Sweat Heaters

The DOE test procedures have always incorporated provisions addressing the operation of anti-sweat heaters. These components are defined in both Appendices A1 and B1 (*See* 10 CFR part 430, subpart B, appendix A1, section 1.3 and 10 CFR part 430, subpart B, appendix B1, section 1.2) as devices designed to prevent moisture accumulation on a product's exterior surfaces under conditions of high ambient humidity. For products that have an anti-sweat heater switch that controls operation of anti-sweat heaters, both Appendices A1 and B1 require tests to be conducted with the anti-sweat heater switch in both the on and off positions. (See 10 CFR part 430, subpart B, appendix A1, section 2.2 and 10 CFR part 430, subpart B, appendix B1, section 2.2). The "standard cycle" is defined as a 24-hour cycle of operation of a refrigeration product with the anti-sweat heater switch on. (10 CFR part 430 subpart B appendix A1 section 1.7, 10 CFR part 430, subpart B, appendix B1, section 1.5). Calculation of annual operating cost for refrigerators, refrigerator-freezers, and freezers involves averaging the energy use of a standard cycle and a cycle with the anti-sweat heater switch in its position just prior to shipping from the factory. (10 CFR 430.23(a)(2) and 430.23(b)(2)).

Section III.D.7 of this NOPR discusses a proposed modification to the definition of what constitutes an anti-sweat heater under DOE's regulations. Section III.D.8 addresses a proposed change that would address anti-sweat heater switch positions during testing. Finally, section III.D.9 discusses incorporating procedures for variable anti-sweat heating controls that were most recently addressed by waivers. Any electric heater that falls under the current definition of anti-sweat heater must be tested according to the current test procedures as defined in the current Appendices A1 and B1. Likewise, any electric heater that falls under the proposed definition would be required to be tested according to the proposed test procedures of Appendices A1 and B1 prior to the date that new energy conservation standards take effect. Manufacturers would use proposed Appendices A and B, which incorporate the proposed changes to Appendices A1 and B1, on and after the date that the new standards take effect.

Defrost Heaters

Defrost heaters, including both heaters used to remove frost from evaporators and heaters used to prevent defrost water from refreezing in the drip pan or discharge tubing are addressed by the DOE test procedures. Automatic defrost is defined in Appendices A1 and B1. (*See* 10 CFR part 430, subpart B, appendix A1, section 1.8 and 10 CFR part 430, subpart B, appendix B1, section 1.7). Additional definitions are provided for long-time automatic defrost and variable defrost control. (10 CFR part 430 subpart B appendix A1 section 1, 10 CFR part 430 subpart B appendix B1 section 1). The test procedures were modified on August 31, 1989 to respond to the development of adaptive defrost technology. 54 FR 36238. Section 4 of both Appendices A1 and B1 address the test time period for automatic defrost and its variations (*See* 10 CFR part 430, subpart B, appendix A1, section 4 and 10 CFR part 430, subpart B, appendix B1, section 4). The methods for measuring daily energy use that incorporate the energy use of defrost heaters for different automatic defrost systems are specified in section 5 of both Appendices A1 and B1. (10 CFR part 430, subpart B, appendix A1, section 5 and 10 CFR part 430, subpart B, appendix B1, section 5).

Section III.D.10 of this NOPR discusses DOE's proposed modification of the long time defrost test procedure to address the energy usage of modern defrost control approaches, which are not comprehensively captured by the current procedure. Section III.D.13.B discusses a proposed correction to the procedure for measuring defrost energy use of dual compressor systems with dual defrost. All energy use associated with defrost, including both the energy input for the heater(s) and all of the energy use of the refrigeration system(s) required to remove the defrost heat or to provide precooling to minimize the impact of cabinet warmup during defrost should be captured by the energy test.

Heaters for Temperature Control

Heaters that adjust the temperatures of refrigerated compartments are addressed indirectly through control setting requirements. The current test procedures require compartment temperature settings consistent with the standardized temperatures for these compartments. While compartment temperature control is primarily achieved by compressor cycling and the adjustment of dampers controlling the air flow to different compartments, some products may use electric heaters to enhance temperature control precision. The control setting requirements, among other things, specify the procedures for setting the temperature control of main compartments. (*See* 10 CFR part 430, subpart B, appendix A1, section 3 and 10 CFR part 430, subpart B, appendix B1, section 3). They also include specific procedures for special compartments as defined in HRF–1–1979, section 7.4.2. Section III.D.5 discusses proposed modifications to procedures for special compartments to make the procedures for these compartments consistent with procedures for convertible compartments.

However, in instances where a refrigerator-freezer has more than two compartments, or where manufacturers have incorporated sub-compartments with separate temperature controls, or both, the instructions in the current test procedure for adjusting temperature control settings and for weighted averaging of energy measurements based on measured compartment temperatures are less clear. Section III.D.6 discusses issues associated with these situations and the agency's proposed approaches for addressing both of these circumstances.

Because the purpose of these test procedures is to provide a measurement of energy use (including those of temperature control heaters) that is representative of typical consumer use, DOE recognizes the need to explicitly address the setting of compartment temperatures for more advanced products equipped with more complicated configurations. Refinement of the procedures for setting the temperatures of compartments during testing in the manner proposed in today's notice will improve the consistency of test measurements with representative use cycles of products in the field.

Icemaker Heaters

Manufacturers also use electric heaters in automatic icemakers. For example, many icemakers use mold heaters (or "harvest heaters") to free the ice from the icemaker mold. Some refrigerator-freezers also have heaters integrated with the icemaker fill tubes to ensure that water does not freeze in the tube transferring water to the icemaker. This topic has been recently addressed in a document issued on the refrigerator rulemaking Web site ("Additional Guidance Regarding Application of Current Procedures for Testing Energy Consumption of Refrigerator-Freezers with Automatic Ice Makers", December 2009, *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/rf_test_procedure_addl_guidance.pdf*). These views would continue to apply to the newly proposed Appendices A and B.

However, energy used by these heaters during ice production may not be sufficiently captured using the current energy test. Consideration of test procedures for measurement of icemaking energy use is discussed in section III.E.5 of this notice.

Exterior Heaters for Evaporation of Defrost Water

Heaters may be used on the exterior of refrigeration products to evaporate defrost melt water collected in the defrost water pan. The current test procedures provide no specific requirements for these heaters.

These heaters may not operate in the high-ambient closed-door operational conditions found during typical energy testing, since, for example, under such test conditions, no significant amount of defrost water would collect in a defrost water pan. The key sources of such water in normal operating conditions are (1) water vapor that enters with the air during door-openings, and (2) moisture from food products. Since energy testing is conducted with the doors closed and with no food products in the refrigerator, these key sources of moisture are absent and the pans generally remain dry. Hence, the energy test cannot provide measurements consistent with the representative use cycles for products with these components. DOE requests comments on the prevalence of the use of such heaters and their likely energy use. DOE may consider a test procedure amendment requesting manufacturers to petition for a waiver for products having these heaters to modify the test procedure to incorporate a measurement addressing their energy use.

Other Heaters

There may be additional uses for electric resistance heaters in refrigeration products that are not mentioned in this section. DOE requests comment regarding what such uses might be, how they contribute to energy use in normal operating conditions and during testing in accordance with the current DOE energy test, and whether the current procedure with or without the proposed amendments discussed in this notice requires additional modifications to more accurately reflect their energy usage.

2. Rounding Off Energy Test Results

The current energy test procedure for refrigeration products references HRF–1–1979, which specifies the level of precision to apply when measuring electric energy consumption (0.01 kWh) and the accuracy of that measurement (within ±0.5%). (HRF–1–1979 section 7.3.2). HRF–1–2008 specifies an increased level of precision (0.001 kWh) for digital watt-hour meters, but retains the same requirement of ±0.5% accuracy for energy measurements (HRF–1–2008, section 5.4.2).

The energy use of refrigeration products covers a broad range. However, a minimally compliant 20-cubic foot refrigerator-freezer with automatic defrost and a top-mounted freezer would have an energy use of roughly 500 kWh. Applying the above requirements, the required accuracy of this measurement is, at best, ±2.5 kWh (500 kWh × 0.5%).

The DOE regulations currently do not specify the level of precision that refrigeration product manufacturers must follow when reporting the energy use of their products—see, for example, 10 CFR 430.23(a)(5). The above example suggests that a precision level exceeding 1 kilowatt-hour may not be warranted but DOE is interested in receiving comment on this issue. Based on comments received, DOE may consider adopting a more precise level of reported energy usage (*e.g.,* to the tenths or hundredths level) or a level that would require reporting to the nearest kilowatt-hour. Such a requirement would be implemented in 10 CFR 430.23(a)(5), for refrigerators and refrigerator-freezers, and in 10 CFR 430.23(b)(5), for freezers.

DOE recognizes that, if energy use is reported to the nearest kilowatt-hour, the specification of maximum allowable energy use must also be rounded to the nearest kilowatt-hour, to prevent a reporting error. For example, if the energy standard was 500.7 kWh for a product whose energy use measurement was 500.6 kWh, rounding the measurement to 501 kWh might appear to show energy use higher than the maximum allowable under the standard. DOE will consider proposing that the maximum allowable energy use under the energy conservation standard be rounded to the nearest kilowatt-hour or some other fraction as part of the energy conservation standard rulemaking.

DOE requests comment on the achievable accuracy in measurement of refrigeration product energy use, the appropriate level of precision for reporting of energy use and on the need to provide a similar rounding for maximum allowable energy use under the energy conservation standard.

G. Compliance With Other EPCA Requirements

In addition, DOE examined its other obligations under EPCA in developing this particular rulemaking notice. These requirements are addressed in greater detail below.

1. Test Burden

Section 323(b)(3) of EPCA requires that "any test procedures prescribed or amended under this section shall be reasonably designed to produce test results which measure energy efficiency, energy use * * * or estimated annual operating cost of a covered product during a representative average use cycle or period of use * * * and shall not be unduly burdensome to conduct." (42 U.S.C. 6293(b)(3)) For the reasons that follow, DOE has tentatively concluded that the proposed amendments to DOE test procedures would satisfy this requirement.

The proposed amendments generally incorporate minor adjustments to test sample set-up procedures, the treatment of certain product features such as convertible compartments, compartment temperatures, and volume calculation methods. Most of these proposed amendments would require no changes in the current requirements for equipment and instrumentation for testing or the time required for testing. With respect to the proposed test method for variable anti-sweat heaters, this proposal would specify testing in a humidity-controlled test chamber and require conducting three tests to measure energy use for steady-state cycling operation of a refrigerator-freezer. As a result, this change would require manufacturers of products equipped with variable anti-sweat heater controls to conduct additional testing. DOE estimates that the additional testing is expected to represent roughly a doubling of test time for these products, from roughly 5 days to roughly 10 days, which is consistent with the additional test burden associated with an anti-sweat heater switch, the approach used by some manufacturers to reduce the energy impact of anti-sweat heaters prior to granting of the variable anti-sweat heater control waivers.

Among the options that DOE considered in preparation of today's notice include: (1) Allowing the test procedure to be conducted exactly as described in the waivers or interim waivers granted to GE, Whirlpool, Electrolux, and Samsung, and (2) harmonizing ambient temperature of the test with the 90 °F generally used for energy testing. After reviewing these options, DOE believes that the additional testing required for variable anti-sweat heaters is the least burdensome approach to determine the energy use of variable anti-sweat heaters while helping to ensure that these components are sufficiently addressed in the agency's test procedure.

At least two reasons support this view. First, manufacturers of refrigerator-freezers generally have test chambers with humidity control that would be appropriate for testing products with variable anti-sweat heaters since manufacturers would need such test chambers in the first instance to verify the effectiveness of anti-sweat and defrost devices in their products. While the additional testing that would be required may double the test time for products with variable anti-sweat heater control, it is unclear that any less-burdensome approaches could reliably verify that the control systems work as described.

Second, relatively few products would require the variable anti-sweat test, which would mean that the overall cost on the industry would be low. (An example of such a product would be a refrigerator-freezer equipped with French doors, for which anti-sweat heating for the seal between the French doors cannot be provided with customary hot-liquid refrigerant heating.) Accordingly, DOE does not anticipate that manufacturers would need to outlay significant capital expenditures for new testing facilities or equipment to comply with the proposed variable anti-sweat test method and has tentatively concluded that the proposed test procedure amendments would not be unduly burdensome to conduct.

As an option to reduce the test burden associated with the variable anti-sweat control test procedure, DOE may consider allowing certification of products having such a feature based on the anti-sweat heater energy use contribution measured for a product with the same variable anti-sweat heating system design. Such an approach would require energy test measurements made in support of certification to be made as currently required for all products. However, the value of the "Correction Factor" representing the energy use contribution of the anti-sweat heaters could be based on measurements conducted for a product with the same variable anti-sweat heating system design. The same system design would include use of the same heater wattages in the same locations of the product, and control using the same algorithms. DOE seeks comment on whether such an approach would be acceptable, and whether the characterization of "same variable anti-sweat heater system design" is appropriate. Further, DOE seeks information justifying this suggested approach for reducing the test burden associated with the proposed variable anti-sweat heater control test procedure, including data demonstrating that it would provide an accurate and repeatable representation of energy use. DOE also seeks information regarding any alternative approach that could be considered to address this test burden issue, with supporting information and data to support such an alternative.

2. Potential Amendments To Include Standby and Off Mode Energy Consumption

EPCA directs DOE to amend test procedures "to include standby mode and off mode energy consumption * * * with such energy consumption integrated into the overall energy efficiency, energy consumption, or other energy descriptor for each covered product, unless the Secretary determines that—(i) the current test procedures for a covered 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 included in the measurements. The refrigeration product could include any auxiliary features which draw power in a standby or off mode. HRF–1–1979 and HRF–1–2008 provide instructions that certain auxiliary features should be set 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 procedures (and as proposed) address these modes.

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 proposed 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.gc.doe.gov*).

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

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 searched the SBA Web site (*http://dsbs.sba.gov/dsbs/search/dsp_dsbs.cfm*) to identify manufacturers within this NAICS code that produce refrigerators, refrigerator-freezers, and/or freezers. Most of the manufacturers supplying these products are large multinational corporations with more than 1,000 employees. There are several small businesses involved in the sale of refrigeration products that are listed on the SBA Web site under the NAICS code for this industry. However, DOE believes that only U-Line Corporation of Milwaukee, Wisconsin is a small business that manufactures these products. U-Line primarily manufactures compact refrigerators and related compact products such as wine coolers and icemakers (these icemakers are distinguished from the automatic icemakers installed in many residential refrigeration products in that they are complete icemaking appliances using either typical residential icemaking technology or the clear icemaking technology used extensively in commercial icemakers—they are distinguished from refrigerators in that their sole purpose is production and storage of ice).

DOE has tentatively concluded that the proposed rule would not have a significant impact on small manufacturers under the provisions of the Regulatory Flexibility Act. The proposed rule would amend DOE's energy test procedures for refrigeration products. The amendments do not require use of test facilities or test equipment that differ significantly from the test facilities or test equipment that manufacturers currently use to evaluate the energy efficiency of these products. Further, the amended test procedures would not be significantly more difficult or time-consuming to conduct than current DOE energy test procedures except for the amendments addressing testing of products with variable anti-sweat heating controls. The products that currently have such control, refrigerator-freezers with bottom-mounted freezers and French doors serving the fresh food compartment, are all manufactured by large manufacturers. U-Line, the only small business manufacturer that has been identified, does not manufacture these products.

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

C. Review Under the Paperwork Reduction Act of 1995

This proposed rulemaking will impose no new information collection or record-keeping requirements. Accordingly, OMB clearance is not required under the Paperwork Reduction Act. (44 U.S.C. 3501 *et seq.*)

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 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. The proposed amendments would also be used to develop and implement future energy conservation standards for refrigeration products. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this rule amends an existing rule without changing its environmental effect, and, therefore, is covered by the Categorical Exclusion in 10 CFR part 1021, subpart D, paragraph A5. The exclusion applies because this rule would establish revisions to existing test procedures that would not affect the amount, quality, or distribution of energy usage, and, therefore, would 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 (August 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 would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of 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 proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish 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*). 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 proposed significant energy action. A "significant energy action" is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule and that (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use if the proposal 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 proposed 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 standards, AHAM Standards HRF–1–1979 and HRF–1–2008. DOE has evaluated these two versions of this standard and is unable to conclude whether it fully complies with the requirements of section 32(b) of the FEAA (*i.e.,* whether it was developed in a manner that fully provides for public participation, comment, and review.) DOE will consult with the Attorney General and the Chairman of the FTC about the impact on competition of using the methods contained in this standard, before prescribing 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 NOPR. To attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945. As explained in the **ADDRESSES** section, foreign nationals visiting DOE Headquarters are subject to advance security screening procedures.

B. Procedure for Submitting Requests To Speak

Any person who has an interest in today's notice, or who is a representative of a group or class of persons that has an interest in these issues, may request an opportunity to make an oral presentation at the public meeting. Such persons may hand-deliver requests to speak to the address shown in the **ADDRESSES** section at the beginning of this notice between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Requests may also be sent by mail or e-mail to Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121, or *Brenda.Edwards@ee.doe.gov.* Persons who wish to speak should include in their request a computer diskette or CD in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format that briefly describes the nature of their interest in this rulemaking and the topics they wish to discuss. Such persons should also provide a daytime telephone number where they can be reached.

DOE requests persons scheduled to make an oral presentation to submit an advance copy of their statements at least one week before the public meeting. DOE may permit persons who cannot supply an advance copy of their statement to participate, if those persons have made advance alternative arrangements with the Building Technologies Program. Requests to give an oral presentation should ask for such alternative arrangements.

C. Conduct of Public Meeting

DOE will designate an agency 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 5 U.S.C. 553 and 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 presentations by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a prepared general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will permit other participants to comment briefly on any general statements. At the end of all prepared statements on each specific topic, DOE will permit participants to clarify their statements briefly and to comment on statements made by others.

Participants should be prepared to answer DOE's and other participants' questions. DOE representatives may also ask participants about 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.

DOE will make the entire record of this proposed rulemaking, including the transcript from the public meeting, available for inspection at the U.S. Department of Energy, 6th Floor, 950 L'Enfant Plaza, SW., Washington, DC 20024, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Copies of the transcript are available for purchase 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 at the beginning of this notice. Comments, data, and information submitted to DOE's e-mail address for this rulemaking should be provided in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format. Stakeholders should avoid the use of special characters or any form of encryption, and wherever possible, comments should include the electronic signature of the author. Comments, data, and information submitted to DOE via mail or hand delivery/courier should include one signed original paper copy. No telefacsimiles (faxes) will be accepted.

Pursuant 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 two copies: one copy of the document that includes all of the information believed to be confidential, and one copy of the document with that information deleted. DOE will determine the confidential status of the information and treat it accordingly.

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

DOE is particularly interested in receiving comments and views of interested parties on the following issues:

1. *Electric Refrigerator Definition:*

DOE requests comment on whether any clarifications are needed regarding the definition for electric refrigerators.

2. *Measured Energy Impacts of Amendments Proposed To Take Effect Prior to the Effective Date of the New Energy Conservation Standards:*

DOE invites comment on whether any of the amendments proposed to take effect prior to the effective date of the new energy conservations standards (scheduled per EPCA to be January 1, 2014), have a significant impact on measured energy use. DOE requests information quantifying these impacts, if any.

3. *Incorporating by Reference AHAM Standard HRF–1–2008:*

DOE invites comment on the approach proposed for incorporating provisions of AHAM Standard HRF–1–2008, including (a) maintaining the reference to AHAM Standard HRF–1–1979 in Appendices A1 and B1, which will continue to be in effect until the new energy conservation standards become mandatory; (b) incorporating directly into Appendices A1 and B1 language from AHAM Standard HRF–1–2008 to clarify test procedures; and (c) changing all references to HRF–1–2008 for Appendices A and B, which will take effect simultaneously with the new energy conservation standards.

4. *Test Sample Preparation:*

DOE invites comments on the proposed clarifications of test procedures for preparing test samples. DOE has proposed allowed and required deviations from set-up according to installation instructions and invites comments on whether additional such deviations should be incorporated into the test procedure.

5. *Test Procedure Waivers for Products for Which Test Measurements Are not Representative:*

DOE seeks comment on the proposed language requiring petition for waivers to address products equipped with controls or other features that modify the operation of energy using components during the energy test. DOE seeks comment on whether more specific definition could or should be provided to define either the product characteristics that would make the test procedure unsuitable for use or to define representative average use.

6. *Temperature Sensor Locations:*

DOE seeks comment regarding frequency of testing using temperature sensor locations not specifically shown in Figures 7.1 and 7.2 of HRF–1–1979. DOE also seeks comment on whether the proposed exception to proposed requirements for waivers associated with non-standard sensor location arrangements are reasonable for limiting the frequency of such waivers.

7. *Convertible Temperature Compartments and Special Compartments:*

DOE invites comment on the proposed clarifications of test procedures for treatment of convertible-temperature and the proposed amendments to the test procedures for special compartments. DOE also requests comment on whether a size limit should be established for classification of a special compartment, and what a reasonable size limit might be.

8. *Auxiliary Compartments:*

DOE invites comment on the proposed approach to modification of the test procedures to address auxiliary compartments with external doors.

9. *Anti-Sweat Heater Definition:*

DOE invites comment on the proposal to allow the anti-sweat heater definition to include condensation of moisture on all rather than just exterior cabinet surfaces. DOE also seeks comment regarding whether additional clarity beyond the proposed amendments is required.

10. *Elimination of the Optional Third Part of the Test for Refrigerator-Freezers With Variable Defrost:*

DOE invites comment on the proposed elimination of the optional third part of the test for testing refrigerator-freezers with variable defrost. In particular, DOE requests information indicating that the third part of the procedure has been used in recent years for rating a product, and whether it provides a more accurate indication of the frequency of defrosts for such products than the default equation for this parameter.

11. *Test Method for Variable Anti-Sweat Heating Energy Contribution:*

DOE invites comment on the proposal to incorporate into the test procedures a determination of the energy use associated with variable anti-sweat heater controls involving test measurements. DOE also invites comment on whether the variable anti-sweat heater test procedure should also be incorporated into Appendices B and B1 for freezers. Finally, DOE invites comment on the suggested approach for reduction of test burden associated with the proposed test; DOE requests information and data providing justification for adopting this approach.

12. *New Compartment Temperatures:*

DOE invites comment on the establishment of new compartment temperatures for testing of refrigerators and refrigerator-freezers and the new volume adjustment factors for testing refrigeration products.

13. *New Volume Calculation Method:*

DOE invites comment on the establishment of a new volume calculation method. DOE also invites comment on the proposed clarification of the HRF–1–2008 volume calculation method addressing treatment of automatic icemakers and ice storage bins in the volume calculation method. Finally, DOE requests comment on whether this clarification should be applied also to freezers.

14. *Defrost Precooling Energy:*

DOE invites comment on the proposals to include precooling energy in the procedures for testing products with long-time or variable defrost controls. DOE also invites comment regarding whether additional test procedure amendments are appropriate in order to address possible use of partial recovery to reduce energy use of this part of the test.

15. *Multiple Defrost Cycle Types:*

DOE requests comments on the proposed amendments addressing test procedures for products with long-time or variable defrost that incorporate multiple types of defrost cycles.

16. *Wall Clearance:*

DOE invites comment on the proposed procedures regarding clearance between the rear of a tested cabinet and the test chamber or simulated wall.

17. *Combination Wine Storage-Freezer Products:*

DOE invites comment on its proposal to modify the definition of refrigerator-freezer to exclude products which combine a freezer and a wine storage compartment.

18. *Icemaking:*

DOE requests comments on the proposed approach for integrating icemaking energy use into the energy use metrics for refrigeration products. DOE requests recommendations for development of a test method for determination of icemaking energy use, including data to show the viability of recommended approaches. DOE requests comments on whether refrigerators with freezer compartments could include icemakers. Finally, DOE requests any updated data supporting determination of a representative daily ice production factor.

19. *Presence of Ice in the Ice Bin During Testing:*

DOE seeks comment on whether a requirement should be adopted in the test procedure specifying whether ice may be in the ice bin during energy testing.

20. *Temperature Settings:*

DOE requests comment on proposed modifications to the test procedures to clarify requirements for temperature settings, including whether DOE's understanding regarding the approach used by manufacturers is correct, and comment on whether these requirements should be incorporated into Appendices A1 and B1 as well as Appendices A and B. DOE also request comment on whether rating of products should be disallowed in case of tests in which compartment temperatures are higher than their standardized temperatures with temperature controls in their coldest position, and whether such an amendment should be introduced immediately in Appendices A1 and B1, or whether they should be considered only for Appendices A and B.

21. *Electric Heaters:*

DOE requests comment regarding electric heaters: what types exist that are not already discussed in section III.F.1; how do they contribute to energy use in typical consumer use and during the energy test; and whether modifications are needed (and if so what types) to more accurately reflect their energy use impact?

22. *Energy Use Measurement Round-Off:*

DOE requests comment on the achievable accuracy in measurement of refrigeration product energy use and the guidance under consideration to specify reporting of energy use to the nearest kilowatt-hour and on the need to provide a similar rounding for maximum allowable energy use under the energy conservation standard.

23. *Certification Report Amendments:*

DOE requests comments on the proposed additions to certification reports that will clarify the approach used to test the product.

VI. Approval of the Office of the Secretary

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

List of Subjects in 10 CFR part 430

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

Issued in Washington, DC, on April 1, 2010.

Cathy Zoi,

Assistant Secretary, Energy Efficiency and Renewable Energy.

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

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

2. Section 430.2 is amended by revising the definition for "electric refrigerator-freezer" to read as follows:

§ 430.2 Definitions.

* * * * *

Electric refrigerator-freezer means a cabinet which consists of two or more compartments with at least one of the compartments designed for the refrigerated storage of food at temperatures above 32 °F and below 39 °F and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8 °F which may be adjusted by the user to a temperature of 0 °F or below. Additional compartments shall be designed for temperature in any range up to 39 °F. The source of refrigeration requires single phase, alternating current electric energy input only.

* * * * *

3. Section 430.3 is amended by redesignating paragraph (g)(1) as (g)(2) and adding new paragraphs (g)(1) and (g)(3), to read as follows:

§ 430.3 Materials incorporated by reference.

(g) * * *

(1) ANSI/AHAM HRF–1–1979, ("HRF–1–1979"), *American National Standard, Household Refrigerators, Combination Refrigerator-Freezers and Household Freezers,* approved May 17, 1979, IBR approved for Appendices A1 and B1 to Subpart B.

* * * * *

(3) AHAM Standard HRF–1–2008, ("HRF–1–2008"), *Association of Home Appliance Manufacturers, Energy, Performance and Capacity of Household Refrigerators, Refrigerator-Freezers and Freezers,* approved September 13, 2008, as modified by Errata published November 17, 2009, IBR approved for Appendices A and B to Subpart B.

* * * * *

3. Section 430.23 is amended by revising paragraphs (a) and (b) to read as follows:

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

(a) *Refrigerators and refrigerator-freezers.* (1) The estimated annual operating cost for electric refrigerators and electric refrigerator-freezers with variable anti-sweat heater control or without an anti-sweat heater switch shall be the product of the following three factors:

(i) The representative average-use cycle of 365 cycles per year;

(ii) The average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 (6.3.6 for externally vented units) of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.2 (6.3.6 for externally vented units) of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A); and

(iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The estimated annual operating cost for electric refrigerators and electric refrigerator-freezers with an anti-sweat heater switch and without variable anti-sweat heater control shall be the product of the following three factors:

(i) The representative average-use cycle of 365 cycles per year;

(ii) Half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just before shipping, each in kilowatt-hours per cycle, determined according to 6.2 (6.3.6 for externally vented units) of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.2 (6.3.6 for externally vented units) of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A); and

(iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(3) The estimated annual operating cost for any other specified cycle type for electric refrigerators and electric refrigerator-freezers shall be the product of the following three factors: (i) The representative average-use cycle of 365 cycles per year;

(ii) The average per-cycle energy consumption for the specified cycle type, determined according to 6.2 (6.3.6 for externally vented units) of Appendix A1 to this subpart before Appendix A becomes mandatory and 6.2 (6.3.6 for externally vented units) of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A); and

(iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(4) The energy factor for electric refrigerators and electric refrigerator-freezers, expressed in cubic feet per kilowatt-hour per cycle, shall be:

(i) For electric refrigerators and electric refrigerator-freezers with variable anti-sweat heater control or without an anti-sweat heater switch, the quotient of:

(A) The adjusted total volume in cubic feet, determined according to 6.1 of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.1 of Appendix A of this subpart after Appendix A becomes mandatory (*see* the note at the beginning of Appendix A), divided by—

(B) The average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 (6.3.6 for externally vented units) of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.2 (6.3.6 for externally vented units) of Appendix A of this subpart after Appendix A becomes mandatory (*see* the note at the beginning of Appendix A), the resulting quotient then being rounded off to the second decimal place; and

(ii) For electric refrigerators and electric refrigerator-freezers having an anti-sweat heater switch and without variable anti-sweat heater control, the quotient of—

(A) The adjusted total volume in cubic feet, determined according to 6.1 of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.1 of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A), divided by—

(B) Half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just before shipping, each in kilowatt-hours per cycle, determined according to 6.2 (6.3.6 for externally vented units) of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.2 (6.3.6 for externally vented units) of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A), the resulting quotient then being rounded off to the second decimal place.

(5) The annual energy use of electric refrigerators and electric refrigerator-

freezers, expressed in kilowatt-hours per year, shall be:

(i) For electric refrigerators and electric refrigerator-freezers with variable anti-sweat heater control or without an anti-sweat heater switch, the representative average use cycle of 365 cycles per year multiplied by the average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 (6.3.6 for externally vented units) of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.2 (6.3.6 for externally vented units) of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A), and

(ii) For electric refrigerators and electric refrigerator-freezers having an anti-sweat heater switch and without variable anti-sweat heater control, the representative average use cycle of 365 cycles per year times half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just before shipping, each in kilowatt-hours per cycle, determined according to 6.2 (6.3.6 for externally vented units) of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.2 (6.3.6 for externally vented units) of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A).

(6) Other useful measures of energy consumption for electric refrigerators and electric refrigerator-freezers shall be those measures of energy consumption for electric refrigerators and electric refrigerator-freezers that the Secretary determines are likely to assist consumers in making purchasing decisions which are derived from the application of Appendix A1 of this subpart before Appendix A becomes mandatory Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A).

(7) The estimated regional annual operating cost for externally vented electric refrigerators and externally vented electric refrigerator-freezers with variable anti-sweat heater control or without an anti-sweat heater switch shall be the product of the following three factors: (i) The representative average-use cycle of 365 cycles per year,

(ii) The regional average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.3.7 of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.3.7 of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A); and

(iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(8) The estimated regional annual operating cost for externally vented electric refrigerators and externally vented electric refrigerator-freezers with an anti-sweat heater switch and without variable anti-sweat heater control shall be the product of the following three factors:

(i) The representative average-use cycle of 365 cycles per year;

(ii) Half the sum of the average per-cycle energy consumption for the standard cycle and the regional average per-cycle energy consumption for a test cycle with the anti-sweat heater switch in the position set at the factory just before shipping, each in kilowatt-hours per cycle, determined according to 6.3.7 of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.3.7 of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A); and

(iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(9) The estimated regional annual operating cost for any other specified cycle for externally vented electric refrigerators and externally vented electric refrigerator-freezers shall be the product of the following three factors:

(i) The representative average-use cycle of 365 cycles per year;

(ii) The regional average per-cycle energy consumption for the specified cycle, in kilowatt-hours per cycle, determined according to 6.3.7 of Appendix A1 of this subpart before Appendix A becomes mandatory and 6.3.7 of Appendix A of this subpart after Appendix A becomes mandatory (see the note at the beginning of Appendix A); and

(iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(10) The energy test procedure is designed to provide a measurement consistent with representative average consumer use of the product, even if the test conditions and/or procedures may not themselves all be representative of average consumer use (*e.g,* 90 °F ambient conditions, no door openings, use of temperature settings unsafe for food preservation, etc.). If a product contains energy consuming components that operate differently during the prescribed testing than they would during representative average consumer use and 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), the prescribed procedure may not be used. Examples of products that cannot be tested using the prescribed test procedure include those products that can exhibit operating parameters (*e.g,* duty cycle or input wattage) for any energy using component that are not smoothly varying functions of operating conditions or control inputs—such as when a component is automatically shut off when test conditions or test settings are reached. A manufacturer wishing to test such a product must obtain a waiver in accordance with the relevant provisions of 10 CFR 430.

(b) *Freezers.* (1) The estimated annual operating cost for freezers without an anti-sweat heater switch shall be the product of the following three factors:

(i) The representative average-use cycle of 365 cycles per year;

(ii) The average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 of Appendix B1 of this subpart before Appendix B becomes mandatory and 6.2 of Appendix B of this subpart after Appendix B becomes mandatory (*see* the note at the beginning of Appendix B); and

(iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2) The estimated annual operating cost for freezers with an anti-sweat heater switch shall be the product of the following three factors:

(i) The representative average-use cycle of 365 cycles per year;

(ii) Half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just before shipping, each in kilowatt-hours per cycle, determined according to 6.2 of Appendix B1 of this subpart before Appendix B becomes mandatory and 6.2 of Appendix B of this subpart after

Appendix B becomes mandatory (see the note at the beginning of Appendix B); and

(iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(3) The estimated annual operating cost for any other specified cycle type for freezers shall be the product of the following three factors:

(i) The representative average-use cycle of 365 cycles per year;

(ii) The average per-cycle energy consumption for the specified cycle type, determined according to 6.2 of Appendix B1 of this subpart before Appendix B becomes mandatory and 6.2 of Appendix B of this subpart after Appendix B becomes mandatory (see the note at the beginning of Appendix B); and

(iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(4) The energy factor for freezers, expressed in cubic feet per kilowatt-hour per cycle, shall be:

(i) For freezers not having an anti-sweat heater switch, the quotient of—

(A) The adjusted net refrigerated volume in cubic feet, determined according to 6.1 of Appendix B1 of this subpart before Appendix B becomes mandatory and 6.1 of Appendix B of this subpart after Appendix B becomes mandatory (see the note at the beginning of Appendix B), divided by—

(B) The average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to or 6.2 of Appendix B1 of this subpart before Appendix B becomes mandatory and 6.2 of Appendix B of this subpart after Appendix B becomes mandatory (see the note at the beginning of Appendix B), the resulting quotient then being rounded off to the second decimal place; and

(ii) For freezers having an anti-sweat heater switch, the quotient of—

(A) The adjusted net refrigerated volume in cubic feet, determined according to 6.1 of Appendix B1 of this subpart before Appendix B becomes mandatory and 6.1 of Appendix B of this subpart after Appendix B becomes mandatory (see the note at the beginning of Appendix B), divided by—

(B) Half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just before shipping, each in kilowatt-hours per cycle, determined according to 6.2 of Appendix B1 of this subpart before Appendix B becomes mandatory and 6.2 of Appendix B of this subpart after Appendix B becomes mandatory (see the note at the beginning of Appendix B), the resulting quotient then being rounded off to the second decimal place.

(5) The annual energy use of all freezers, expressed in kilowatt-hours per year, shall be:

(i) For freezers not having an anti-sweat heater switch, the representative average use cycle of 365 cycles per year multiplied by the average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 of Appendix B1 of this subpart before Appendix B becomes mandatory and 6.2 of Appendix B of this subpart after Appendix B becomes mandatory (see the note at the beginning of Appendix B), and

(ii) For freezers having an anti-sweat heater switch, the representative average use cycle of 365 cycles per year times half the sum of the average per-cycle energy consumption for the standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just before shipping, each in kilowatt-hours per cycle, determined according to 6.2 of Appendix B1 of this subpart before Appendix B becomes mandatory and 6.2 of Appendix B of this subpart after Appendix B becomes mandatory (see the note at the beginning of Appendix B).

(6) Other useful measures of energy consumption for freezers shall be those measures the Secretary determines are likely to assist consumers in making purchasing decisions and are derived from the application of Appendix B1 of this subpart before Appendix B becomes mandatory Appendix B of this subpart after Appendix B becomes mandatory (see the note at the beginning of Appendix B).

(7) The energy test procedure is designed to provide a measurement consistent with representative average consumer use of the product, even if the test conditions and/or procedures may not themselves all be representative of average consumer use (*e.g,* 90 °F ambient conditions, no door openings, *etc.*). If a product contains energy consuming components that operate differently during the prescribed testing than they would during representative average consumer use and 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), the prescribed procedure may not be used. Examples of products that cannot be tested using the prescribed test procedure include those products that can exhibit operating parameters (*e.g,* duty cycle or input wattage) for any energy using component that are not smoothly varying functions of operating conditions or control inputs—such as when a component is automatically shut off when test conditions or test settings are reached. A manufacturer wishing to test such a product must obtain a waiver in accordance with the relevant provisions of 10 CFR 430.

* * * * *

4. Add a new Appendix A to subpart B of part 430 to 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

The provisions of Appendix A shall apply to all products manufactured on or after the effective date of any amended standards promulgated by DOE pursuant to Section 325(b)(4) of the Energy Policy and Conservation Act of 1975, as amended by the Energy Independence and Security Act of 2007 (to be codified at 42 U.S.C. 6295(b)(4)).

1. Definitions

Section 3, *Definitions,* of HRF–1–2008 (incorporated by reference; see § 430.3) is applicable to this test procedure.

1.1 "Adjusted total volume" means the sum of:

(i) The fresh food compartment volume as defined in HRF–1–2008 (incorporated by reference; see § 430.3) in cubic feet, and

(ii) The product of an adjustment factor and the net freezer compartment volume as defined in HRF–1–2008 in cubic feet.

1.2 "All-refrigerator" means an electric refrigerator that does not include a compartment for the freezing and long time storage of food at temperatures below 32 °F (0.0 °C). It may include a compartment of 0.50 cubic feet capacity (14.2 liters) or less for the freezing and storage of ice.

1.3 "Anti-sweat heater" means a device incorporated into the design of a refrigerator or refrigerator-freezer to prevent the accumulation of moisture on the exterior or interior surfaces of the cabinet.

1.4 "Anti-sweat heater switch" means a user-controllable switch or user interface which modifies the activation or control of anti-sweat heaters.

1.5 "Automatic defrost" means a system in which the defrost cycle is automatically initiated and terminated, with resumption of normal refrigeration at the conclusion of the defrost operation. The system automatically prevents the permanent formation of frost on all refrigerated surfaces. Nominal refrigerated food temperatures are maintained during the operation of the automatic defrost system.

1.6 "Automatic icemaker" means a device, that can be supplied with water without user intervention, either from a pressurized water supply system or by transfer from a water reservoir located inside the cabinet, that automatically produces, harvests, and stores ice in a storage bin, with means to automatically interrupt the harvesting operation when the ice storage bin is filled to a pre-determined level.

1.7 "Cycle" means the period of 24 hours for which the energy use of an electric refrigerator or electric refrigerator-freezer is calculated as though the consumer activated compartment temperature controls were set so that the standardized temperatures (see section 3.2) were maintained.

1.8 "Cycle type" means the set of test conditions having the calculated effect of operating an electric refrigerator or electric refrigerator-freezer for a period of 24 hours, with the consumer activated controls other than those that control compartment temperatures set to establish various operating characteristics.

1.9 "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 sequence of control for defrost such as the number of defrost heaters energized. Each such variation establishes a separate distinct defrost cycle type.

1.10 "Externally vented refrigerator or refrigerator-freezer" means an electric refrigerator or electric refrigerator-freezer that has an enclosed condenser or an enclosed condenser/compressor compartment and a set of air ducts for transferring the exterior air from outside the building envelope into, through, and out of the refrigerator or refrigerator-freezer cabinet; is capable of mixing exterior air with the room air before discharging into, through, and out of the condenser or condenser/compressor compartment; includes thermostatically controlled dampers or controls that enable the mixing of the exterior and room air at low outdoor temperatures, and the exclusion of exterior air when the outdoor air temperature is above 80 °F or the room air temperature; and may have a thermostatically actuated exterior air fan.

1.11 "HRF–1–2008" means the Association of Home Appliance Manufacturers standard *Energy, Performance and Capacity of Household Refrigerators, Refrigerator-Freezers and Freezers* that was approved September 13, 2008. Only sections of HRF–1–2008 (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 HRF–1–2008.

1.12 "Long-time automatic defrost" means an automatic defrost system whose successive defrost cycles are separated by 14 hours or more of compressor operating time.

1.13 "Separate auxiliary compartment" means a freezer compartment or a fresh food compartment of a refrigerator or refrigerator-freezer having more than two compartments that is not the first freezer compartment or the first fresh food compartment. Access to a separate auxiliary compartment is through a separate exterior door or doors rather than through the door or doors of another compartment. Separate auxiliary compartments may be convertible (*e.g.,* from fresh food to freezer).

1.14 "Stabilization period" means the total period of time during which steady-state conditions are being attained or evaluated.

1.15 "Standard cycle" means the cycle type in which the anti-sweat heater control, when provided, is set in the highest energy-consuming position.

1.16 "Variable anti-sweat heater control" means an anti-sweat heater control that varies the average power input of the anti-sweat heater(s) based on operating condition variable(s) and/or ambient condition variable(s).

1.17 "Variable defrost control" means a long-time automatic defrost system (except the 14-hour defrost qualification does not apply) in which successive defrost cycles are determined by an operating condition variable or variables other than compressor operating time. This includes any electrical or mechanical device performing this function. Demand defrost is a type of variable defrost control.

2. Test Conditions

2.1 Ambient Temperature and Humidity. The ambient temperature shall be 90.0 ± 1 °F (32.2 ± 0.6 °C) during the stabilization period and the test period. If the product being tested has variable anti-sweat heater control, the ambient relative humidity shall be no more than 35%. For the variable anti-sweat heater test described in section 4.1.3, the ambient temperature shall be 72 ± 1 °F (22.2 ± 0.6 °C) dry bulb. The relative humidities for the three portions of the test shall be 25 ± 10%, 65 ± 2%, and 95 ± 2%.

2.2 Operational Conditions. The electric refrigerator or electric refrigerator-freezer shall be installed and its operating conditions maintained in accordance with HRF–1–2008, (incorporated by reference; see § 430.3), section 5.3 through section 5.5.5.5 (excluding section 5.5.5.4), except that 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 of 1 foot (30.5 cm) above the unit under test. Defrost controls are to be operative. Other exceptions and clarifications to the cited sections of HRF–1–2008 are noted in sections 2.3 through 2.7, and 5.1 of this test procedure.

2.3 Anti-Sweat Heaters.

(a) User-Controllable Anti-Sweat Heaters. The anti-sweat heater switch is to be on during one test and off during a second test.

(b) Variable Anti-Sweat Heaters. In the case of an electric refrigerator-freezer equipped with variable anti-sweat heater control, the test shall be conducted with the anti-sweat heater controls activated to allow the anti-sweat heater to be energized but operating in their minimum energy state corresponding to operation in low humidity conditions, as a result of testing conducted using an ambient relative humidity level as specified in section 2.1. If the product has an anti-sweat heater switch, it shall be switched on. The variable anti-sweat heater test (described in section 4.1.3) shall be conducted to determine the energy consumption of the anti-sweat heater in higher humidity conditions. The standard cycle energy consumption shall be determined using the equation described in section 6.2.3.

2.4 Conditions for Automatic Defrost Refrigerator-Freezers. For automatic defrost refrigerator-freezers, the freezer compartments shall not be loaded with any frozen food packages during testing. Cylindrical metallic masses of dimensions 1.12 ± 0.25 inches (2.9 ± 0.6 cm) in diameter and height shall be attached in good thermal contact with each temperature sensor within the refrigerated compartments. All temperature measuring sensor masses shall be supported by low-thermal-conductivity supports in such a manner to ensure that there will be at least 1 inch (2.5 cm) of air space separating the thermal mass from contact with any interior surface or hardware inside the cabinet. In case of interference with hardware at the sensor locations specified in section 5.1, the sensors shall be placed at the nearest adjacent location such that there will be a 1-inch air space separating the sensor mass from the hardware.

2.5 Conditions for All-Refrigerators. There shall be no load in the freezer compartment during the test.

2.6 The cabinet and its refrigerating mechanism shall be assembled and set up in accordance with the printed consumer instructions supplied with the cabinet. Set-up of the refrigerator or refrigerator-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 not required;

(b) Clearance requirements from surfaces of the product shall be as described in section 2.8 below;

(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 below. Settings for convertible compartments and other temperature-controllable or special compartments shall be as described in section 2.7 below; and

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

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).

2.7 Compartments that are convertible (*e.g.,* from fresh food to freezer) shall be operated in the highest energy use position. For the special case of convertible separate auxiliary compartments, this means that the compartment shall be treated as a freezer compartment or a fresh food compartment, depending on which of these represents higher energy use. Other compartments with separate temperature control (such as crispers convertible to meat keepers), with the exception of butter conditioners, shall also be tested with controls set in the highest energy use position.

2.8 The space between the back of the cabinet and the test room wall or simulated wall shall be the minimum distance in accordance with the manufacturer's instructions. If the instructions do not specify a minimum distance, the cabinet shall be located such that the rear of the cabinet touches the test room wall or simulated wall. The test room wall facing the rear of the cabinet or the simulated wall shall be flat within ¼ inch, and vertical to within 1 degree. The cabinet shall be leveled to within 1 degree of true level, and positioned with its rear wall parallel to the test chamber wall or simulated wall immediately behind the cabinet. Any simulated wall shall be solid and shall extend vertically from the floor to above the height of the cabinet and horizontally beyond both sides of the cabinet.

2.9 Steady-State Condition. Steady-state conditions exist if the temperature measurements in all measured compartments taken at 4-minute intervals or less during a stabilization period are not changing at a rate greater than 0.042 °F (0.023 °C) per hour as determined by the applicable condition of A or B, described below.

A. The average of the measurements during a 2-hour period if no cycling occurs or during a number of complete repetitive compressor cycles occurring through a period of no less than 2 hours is compared to the average over an equivalent time period with 3 hours elapsing between the two measurement periods.

B. If A above cannot be used, the average of the measurements during a number of complete repetitive compressor cycles occurring through a period of no less than 2 hours and including the last complete cycle before a defrost period (or if no cycling occurs, the average of the measurements during the last 2 hours before a defrost period) are compared to the same averaging period before the following defrost period.

2.10 Exterior Air for Externally Vented Refrigerator or Refrigerator-Freezer. An exterior air source shall be provided with adjustable temperature and pressure capabilities. The exterior air temperature shall be adjustable from 30 ± 1 °F (1.7 ± 0.6 °C) to 90 ± 1 °F (32.2 ± 0.6 °C).

2.10.1 Air Duct. The exterior air shall pass from the exterior air source to the test unit through an insulated air duct.

2.10.2 Air Temperature Measurement. The air temperature entering the condenser or condenser/compressor compartment shall be maintained to ± 3 °F (1.7 °C) during the stabilization and test periods and shall be measured at the inlet point of the condenser or condenser/compressor compartment ("condenser inlet"). Temperature measurements shall be taken from at least three temperature sensors or one sensor per 4 square inches of the air duct cross-sectional area, whichever is greater, and shall be averaged. For a unit that has a condenser air fan, a minimum of three temperature sensors at the condenser fan discharge shall be required. Temperature sensors shall be arranged to be at the centers of equally divided cross-sectional areas. The exterior air temperature, at its source, shall be measured and maintained to ± 1 °F (0.6 °C) during the test period. The temperature measuring devices shall have an error no greater than ± 0.5 °F (± 0.3 °C). Measurements of the air temperature during the test period shall be taken at regular intervals not to exceed 4 minutes.

2.10.3 Exterior Air Static Pressure. The exterior air static pressure at the inlet point of the unit shall be adjusted to maintain a negative pressure of 0.20″ ± 0.05″ water column (62 Pascals ± 12.5 Pascals) for all air flow rates supplied to the unit. The pressure sensor shall be located on a straight duct with a distance of at least 7.5 times the diameter of the duct upstream and a distance of at least 3 times the diameter of the duct downstream. There shall be four static pressure taps at 90° angles apart. The four pressures shall be averaged by interconnecting the four pressure taps. The air pressure measuring instrument shall have an error no greater than 0.01″ water column (2.5 Pascals).

3. Test Control Settings

3.1 Model with no User Operable Temperature Control. A test shall be performed to measure the compartment temperatures and energy use. A second test shall be performed with the temperature control electrically short circuited to cause the compressor to run continuously.

3.2 Models with User Operable Temperature Control. Testing shall be performed in accordance with one of the following sections using the following standardized temperatures:

All-Refrigerator: 39 °F (3.9 °C) fresh food compartment temperature;

Refrigerator: 15 °F (− 9.4 °C) freezer compartment temperature, 39 °F (3.9 °C) fresh food compartment temperature;

Refrigerator-Freezer: 0 °F (− 17.8 °C) freezer compartment temperature, 39 °F (3.9 °C) fresh food compartment temperature; and

Variable Anti-Sweat Heater Model (Temperatures for variable anti-sweat heater test of section 4.1.3): 0 °F (− 17.8 °C) freezer compartment temperature and 39 ± 2 °F (3.9 ± 1.1 °C) fresh food compartment temperature during steady-state conditions with no door-openings. If both settings cannot be obtained, then test with the fresh food compartment temperature at 39 ± 2 °F (3.9 ± 1.1 °C) and the freezer compartment as close to 0 °F (− 17.8 °C) as possible.

For the purposes of comparing compartment temperatures with standardized temperatures, as described in sections 3.2.1 through 3.2.3, the freezer compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable freezer compartments, and the fresh food compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable fresh food compartments. Applicable compartments for these calculations may include a first freezer compartment, a first fresh food compartment, and any number of separate auxiliary compartments.

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, knob detents shall be mechanically defeated if necessary to attain a median setting. 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 which 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 for all-refrigerators or Table 2 for refrigerators with freezer compartments and refrigerator-freezers to determine if a third test is required, and which test results to use in the energy consumption calculation.

TABLE 1—TEMPERATURE SETTINGS FOR ALL—REFRIGERATORS

First test		Second test		Third test settings	Energy calculation based on:
Settings	Results	Settings	Results		
Mid	Low	Warm	Low	None	Second Test Only.
			High	None	First and Second Tests.
	High	Cold	Low	None	First and Second Tests.

TABLE 1—TEMPERATURE SETTINGS FOR ALL—REFRIGERATORS—Continued

First test		Second test		Third test settings	Energy calculation based on:
Settings	Results	Settings	Results		
			High	Warm	Second and Third Tests.

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

First test		Second test		Third test settings	Energy calculation based on:
Settings	Results	Settings	Results		
Fzr Mid FF Mid	Fzr Low FF Low	Fzr Warm FF Warm	Fzr Low FF Low	None	Second Test Only.
			Fzr Low FF High	None	First and Second Tests.
			Fzr High FF Low	None	First and Second Tests.
			Fzr High FF High	None	First and Second Tests.
	Fzr Low FF High	Fzr Cold FF Cold	Fzr Low FF High	Fzr Warm FF Warm	Second and Third Tests.
			Fzr Low FF Low	None	First and Second Tests.
	Fzr High FF Low	Fzr Cold FF Cold	Fzr High FF Low	Fzr Warm FF Warm	Second and Third Tests.
			Fzr Low FF Low	None	First and Second Tests.
	Fzr High FF High	Fzr Cold FF Cold	Fzr Low FF Low	None	First and Second Tests.
			Fzr Low FF High	None	First and Second Tests.
			Fzr High FF Low	Fzr Warm FF Warm	Second and Third Tests.
			Fzr High FF High	Fzr Warm FF Warm	Second and Third Tests.

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

3.2.2 Alternatively, a first test may be performed with all temperature controls set at their warmest setting. If all compartment temperatures are below the appropriate standardized temperatures, then the result of this test alone will be used to determine energy consumption. If the above conditions are not met, then the unit shall be tested in accordance with 3.2.1.

3.2.3 Alternatively, a first test may be performed with all temperature controls set at their coldest setting. If (1) for all-refrigerators the compartment temperature is above the appropriate standardized temperature, or (2) for refrigerators and refrigerator-freezers the freezer compartment temperature is above the appropriate standardized temperature, a second test shall be performed with all controls set at their warmest control setting and the results of these two tests shall be used to determine energy consumption. If the above condition is not met, then the unit shall be tested in accordance with 3.2.1.

4. Test Period

4.1 Test Period. Tests shall be performed by establishing the conditions set forth in section 2, and using control settings set forth in section 3.

4.1.1 Nonautomatic Defrost. If the model being tested has no automatic defrost system, the test time period shall start after steady-state conditions have been achieved and be no less than 3 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 will occur, as determined during the stabilization period, the test period shall be 3 hours. If incomplete cycling occurs (*i.e.* less than two compressor cycles during a 24-hour period), the results of the 24-hour period shall be used.

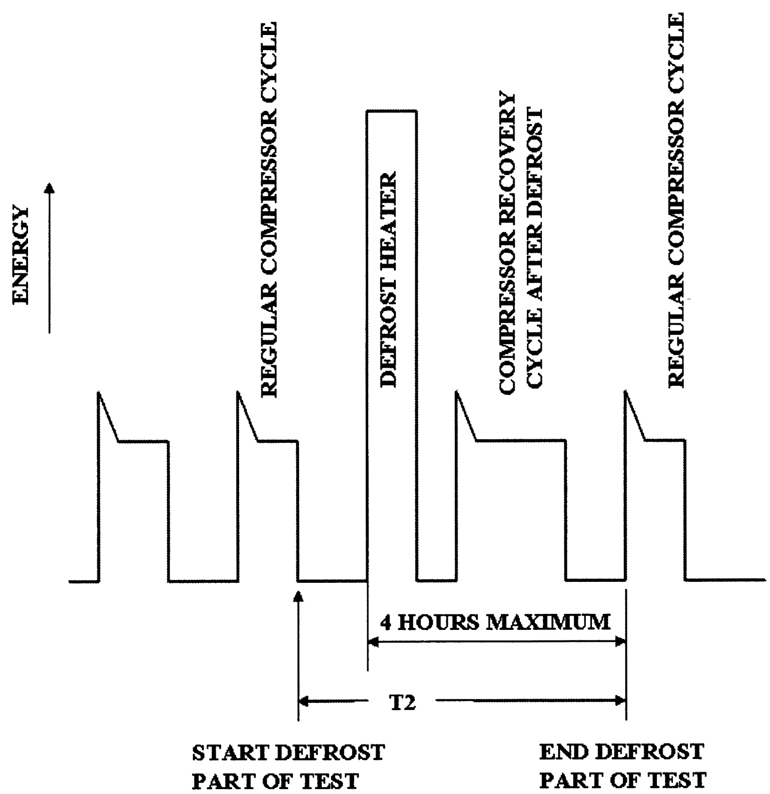
4.1.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test time period shall start after steady-state conditions have been achieved and be from one point during a defrost period to the same point during the next defrost period. If the model being tested has a long-time automatic defrost system, the alternative provisions of 4.1.2.1 may be used. If the model being tested has a variable defrost control, the provisions of section 4.1.2.2 shall apply. If the model has a dual compressor system with automatic defrost for both systems, the provisions of 4.1.2.3 shall apply. If the model being tested has long-time automatic or variable defrost control involving multiple defrost cycle types, such as for a system with a single compressor with two or more evaporators in which the evaporators are defrosted at different frequencies, the provisions of section 4.1.2.4 shall apply. If the model being tested has multiple defrost cycle types for which compressor run time between defrosts is a fixed time less than 14 hours for all such cycle types, and for which the compressor run time between defrosts for different defrost cycle types are equal to or multiples of each other, the test time 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, energy consumption shall be calculated as described in section 5.2.1.1.

4.1.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the two-part test described in this section may be used. The first part is the same as the test for a unit having no defrost provisions (section 4.1.1). The second part starts when the compressor turns off at the end of a period of steady-state cycling operation just before initiation of the defrost control sequence. If the compressor does not cycle during steady-state operation between defrosts, the second part starts at a time when the compartment temperatures are within their ranges measured during steady state operation, or within 0.5 °F of the average during steady state operation for a compartment with a temperature range during steady state operation no greater than 1 °F. This control sequence may include additional compressor operation prior to energizing the defrost heater. The second part terminates when the compressor turns on the second time after the defrost control sequence or 4 hours after the defrost heater is energized, whichever occurs first. See Figure 1.

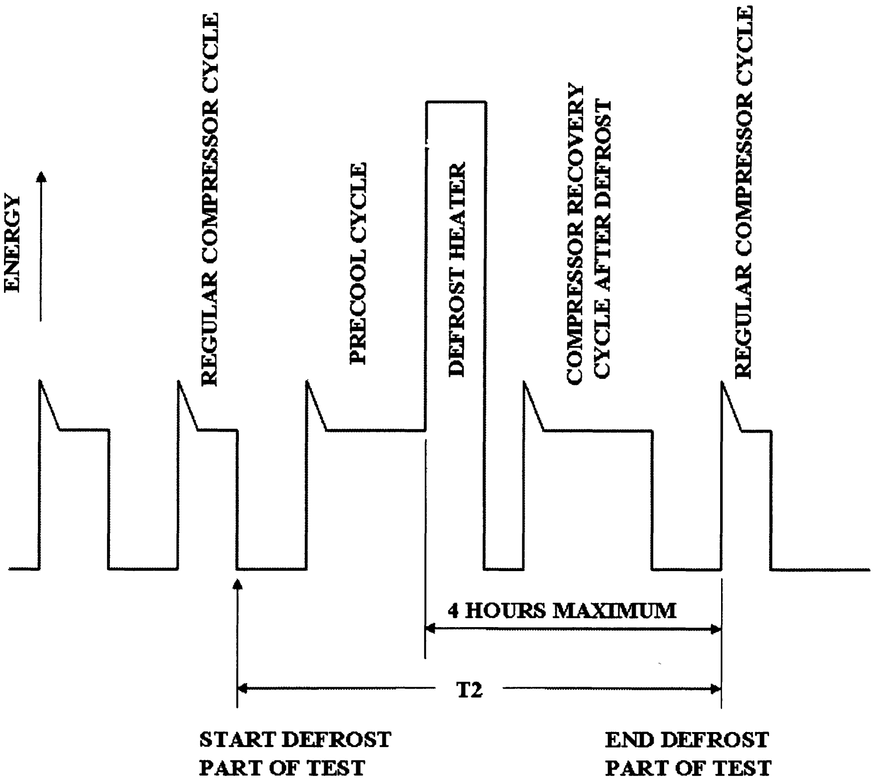
BILLING CODE 6450–01–P

Figure 1

Long-time Automatic Defrost Diagrams



Second Part of Test with Compressor off Prior to Defrost



Second Part of Test with Precool Prior to Defrost

BILLING CODE 6450–01–C

4.1.2.2 Variable Defrost Control. If the model being tested has a variable defrost control system, the test shall consist of the same two parts as the test for long-time automatic defrost (section 4.1.2.1).

4.1.2.3 Dual Compressor Systems with Automatic Defrost. If the model being tested has separate compressor systems for the refrigerator and freezer sections, each with its own automatic defrost system, then the two-part method in 4.1.2.1 shall be used. The second part of the method will be conducted separately for each automatic defrost system. The components (compressor, fan motors, defrost heaters, anti-sweat heaters, etc.) associated with each system will be identified and their energy consumption will be separately measured during each test.

4.1.2.4 Systems with Multiple Defrost Frequencies. This section is applicable to models with long-time automatic or variable defrost control with multiple defrost cycle types, such as models with single compressors and multiple evaporators in which the evaporators have different defrost frequencies. The two-part method in 4.1.2.1 shall be used. The second part of the method will be conducted separately for each distinct defrost cycle type.

4.1.3 Variable Anti-Sweat Heater Test. The test shall be conducted three times with the test conditions at three different relative humidities as set forth in section 2 and the test control settings as set forth in section 3. For a product with an anti-sweat heater switch, the tests shall be conducted with the switch in the on position. Each of the three portions of the test shall be conducted in the same manner as for a unit having no automatic defrost (section 4.1.1). If during the time between one of the portions of the test and the next portion the ambient temperature conditions are maintained, the procedure for evaluating steady state (section 2.9) is not required for the second of these two portions of the test. However, in such a case, a control stabilization period of two hours is required after the ambient humidity conditions have reached the required range before start of the test.

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 cabinet do not conform with those shown in Figure 7.1 and 7.2 of HRF–1–1979, the product may be tested by relocating the temperature sensors from the locations specified in the Figures by no more than 2 inches to avoid interference with hardware or components within the cabinet, 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 430.62(d). For those products equipped with a cabinet that does not conform with Figures 7.1 or 7.2 and cannot be tested in the manner described above, the manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product.

5.1.1 Measured Temperature. The measured temperature of a compartment is to be 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.

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 one or more complete compressor cycles. One compressor cycle is one complete motor "on" and one complete motor "off" period. For long-time automatic defrost models, compartment temperatures shall be those measured in the first part of the test period specified in section 4.1.2.1. For models equipped with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.1.2.2.

5.1.2.1 The number of complete compressor cycles over which the measured temperatures in a compartment are to be averaged to determine compartment temperature shall be equal to the number of minutes between measured temperature readings, rounded up to the next whole minute or a number of complete compressor cycles over a time period exceeding 1 hour, whichever is greater. One of the compressor cycles shall be the last complete compressor cycle during the test period.

5.1.2.2 If no compressor cycling occurs, the compartment temperature shall be the average of the measured temperatures taken during the last 32 minutes of the test period.

5.1.2.3 If incomplete compressor cycling occurs, the compartment temperatures shall be the average of the measured temperatures taken during the last three hours of the last complete compressor "on" period.

5.2 Energy Measurements.

5.2.1 Per-Day Energy Consumption. The energy consumption in kilowatt-hours per day, ET, for each test period shall be the energy expended during the test period as specified in section 4.1 adjusted to a 24-hour period. The adjustment shall be determined as follows.

5.2.1.1 Nonautomatic and Automatic Defrost Models. 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.

5.2.1.2 Long-time Automatic Defrost. If the two-part test method is used, 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:

ET and 1440 are defined in 5.2.1.1;
EP1 = energy expended in kilowatt-hours during the first part of the test;
EP2 = energy expended in kilowatt-hours during the second part of the test;
T1 and T2 = length of time in minutes of the first and second test parts respectively;
CT = defrost timer run time in hours required to cause it to go through a complete cycle, to the nearest tenth hour per cycle; and
12 = factor to adjust for a 50 percent run time of the compressor in hours 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 = least or shortest time between defrosts in hours rounded to the nearest tenth of an hour (greater than or equal to 6 but less than or equal to 12 hours);
CT_M = maximum time between defrost cycles 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; and
For variable defrost models with no values for CT_L and CT_M in the algorithm, the default values of 12 and 84 shall be used, respectively.

5.2.1.4 Dual Compressor Systems with Dual Automatic Defrost. The two-part test method in section 4.1.2.4 must be used, and the energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$$ET = (1440 \times EP1/T1) + (EP2_F - (EP_F \times T2/T1)) \times (12/CT_F) + (EP2_R - (EP_R \times T3/T1)) \times (12/CT_R)$$

Where:

1440, EP1, T1, EP2, 12, and CT are defined in 5.2.1.2;
EP_F = freezer system energy in kilowatt-hours expended during the first part of the test;
$EP2_F$ = freezer system energy in kilowatt-hours expended during the second part of the test for the freezer system;
EP_R= refrigerator system energy in kilowatt-hours expended during the first part of the test;
$EP2_R$ = refrigerator system energy in kilowatt-hours expended during the second part of the test for the refrigerator system;
T2 and T3 = length of time in minutes of the second test part for the freezer and refrigerator systems respectively;
CT_F = compressor "on" time between freezer defrosts (in hours to the nearest tenth of an hour); and
CT_R = compressor "on" time between refrigerator defrosts (in hours to the nearest tenth of an hour).

5.2.1.5 Variable Anti-Sweat Heater Test. The energy consumption in kilowatt-hours per day for each of the portions of the test shall be calculated equivalent to:

$$ET_{XX} = EP_{XX} \times 1440/T_{XX}$$

Where:

1440 is defined in 5.2.1.1;
subscript XX = 25, 65, and 95, representing the three relative humidities for which the test is conducted;
ET_{XX} = test cycle energy expended in kilowatt-hours per day;
EP_{XX} = energy expended during the test period in kilowatt-hours; and
T_{XX} = length of time of the test period in minutes.

5.2.1.6 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:

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

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, and for variable defrost control equal to $(CT_{Li} \times CT_{Mi})/(F \times (CT_{Mi} - CT_{Li}) + CT_{Li})$;
CT_{Li} = least or shortest time between instances of defrost cycle type i in hours rounded to the nearest tenth of an hour (greater than or equal to 6 but less than or equal to 12 hours);
CT_{Mi} = maximum 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);
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 12 and 84 shall be used, respectively.
D is the total number of distinct defrost cycle types.

5.3 Volume Measurements. The electric refrigerator or electric refrigerator-freezer 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, 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 refrigerators or refrigerator-freezers with automatic icemakers, the volume occupied by the automatic icemaker, including its ice storage bin, is to be included in the volume measurement.

5.4 Externally Vented Refrigerator or Refrigerator-Freezer Units. All test measurements for the externally vented refrigerator or refrigerator-freezer shall be made in accordance with the requirements of other sections of this Appendix, except as modified in this section or other sections expressly applicable to externally vented refrigerators or refrigerator-freezers.

5.4.1 Operability of "Thermostatic" and "Mixing of Air" Controls. Before conducting energy consumption tests, the operability of thermostatic controls that permit the mixing of exterior and ambient air when exterior air temperatures are less than 60 °F (15.6 °C) must be verified. The operability of such controls shall be verified by operating the unit under ambient air temperature of 90 °F (32.2 °C) and exterior air temperature of 45 °F (7.2 °C). If the inlet air entering the condenser or condenser/compressor compartment is maintained at 60 ± 3 °F (15.6 ± 1.7 °C), energy consumption of the unit shall be measured under 5.4.2.2 and 5.4.2.3. If the inlet air entering the condenser or condenser/compressor compartment is not maintained at 60 ± 3 °F (15.6 ± 1.7 °C), energy consumption of the unit shall also be measured under 5.4.2.4.

5.4.2 Energy Consumption Tests.

5.4.2.1 Correction Factor Test. To enable calculation of a correction factor, K, two full cycle tests shall be conducted to measure energy consumption of the unit with air mixing controls disabled and the condenser inlet air temperatures set at 90 °F (32.2 °C) and 80 °F (26.7 °C). Both tests shall be conducted with all compartment temperature controls set at the position midway between their warmest and coldest settings and the anti-sweat heater switch off. Record the energy consumptions ec_{90} and ec_{80}, in kWh/day.

5.4.2.2 Energy Consumption at 90 °F. The unit shall be tested at 90 °F (32.2 °C) exterior air temperature to record the energy consumptions $(e_{90})_i$ in kWh/day. For a given setting of the anti-sweat heater, the value i corresponds to each of the two states of the compartment temperature control positions.

5.4.2.3 Energy Consumption at 60 °F. The unit shall be tested at 60 °F (26.7 °C) exterior air temperature to record the energy consumptions $(e_{60})_i$ in kWh/day. For a given setting of the anti-sweat heater, the value i corresponds to each of the two states of the compartment temperature control positions.

5.4.2.4 Energy Consumption if Mixing Controls do not Operate Properly. If the operability of temperature and mixing controls has not been verified as required under 5.4.1, the unit shall be tested at 50 °F (10.0 °C) and 30 °F (−1.1 °C) exterior air temperatures to record the energy consumptions $(e_{50})_i$ and $(e_{30})_i$. For a given setting of the anti-sweat heater, the value i corresponds to each of the two states of the compartment temperature control positions.

6. Calculation of Derived Results From Test Measurements

6.1 Adjusted Total Volume.

6.1.1 Electric Refrigerators. The adjusted total volume, VA, for electric refrigerators under test shall be defined as:

$$VA = (VF \times CR) + VFF$$

Where:

VA = adjusted total volume in cubic feet;
VF and VFF are defined in 5.3; and
CR = dimensionless adjustment factor of 1.47 for refrigerators other than all-refrigerators, or 1.0 for all-refrigerators.

6.1.2 Electric Refrigerator-Freezers. The adjusted total volume, VA, for electric refrigerator-freezers under test shall be calculated as follows:

$$VA = (VF \times CRF) + VFF$$

Where:

VF and VFF are defined in 5.3 and VA is defined in 6.1.1, and
CRF = dimensionless adjustment factor of 1.76.

6.2 Average Per-Cycle Energy Consumption. For the purposes of calculating per-cycle energy consumption, as described in this section, freezer compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable freezer compartments, and fresh food compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable fresh food compartments. Applicable compartments for these calculations may include a first freezer compartment, a first fresh food compartment, and any number of separate auxiliary compartments.

6.2.1 All-Refrigerator Models. 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 depend upon the temperature attainable in the fresh food compartment as shown below.

6.2.1.1 If the fresh food compartment temperature is always below 39.0 °F (3.9 °C), the average per-cycle energy consumption shall be equivalent to:

$$E = ET1$$

Where:

ET is defined in 5.2.1; and
number 1 indicates the test period during which the highest fresh food compartment temperature is measured.

6.2.1.2 If one of the fresh food compartment temperatures measured for a test period is greater than 39.0 °F (3.9 °C), the average per-cycle energy consumption shall be equivalent to:

$$E = ET1 + ((ET2 - ET1) \times (39.0 - TR1)/(TR2 - TR1))$$

Where:

ET is defined in 5.2.1;
TR = fresh food compartment temperature determined according to 5.1.2 in degrees F; numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate; and
39.0 = standardized fresh food compartment temperature in degrees F.

6.2.2 Refrigerators and Refrigerator-Freezers. 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 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) in both tests and the freezer compartment temperature is at or below 15 °F (−9.4 °C) in both tests of a refrigerator or at or below 0 °F (−17.8 °C) in both tests of a refrigerator-freezer, the 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 0.23 for a product with an automatic icemaker and otherwise equals 0 (zero); and
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 per-cycle energy consumption shall be defined by the higher of the two values calculated by the following two formulas:

$$E = ET1 + ((ET2 - ET1) \times (39.0 - TR1)/(TR2 - TR1)) + IET \text{ and}$$
$$E = ET1 + ((ET2 - ET1) \times (k - TF1)/(TF2 - TF1)) + IET$$

Where:

E is defined in 6.2.1.1;
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 5.1.2 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.

6.2.3 Variable Anti-Sweat Heater Models. The energy consumption of an electric refrigerator-freezer having a variable anti-sweat heater control, E_{VASH}, expressed in kilowatt-hours per day, shall be calculated equivalent to:

E_{VASH} = E + (Correction Factor), where E is determined by 6.2.1.1, 6.2.1.2, 6.2.2.1, or 6.2.2.2, whichever is appropriate, with the anti-sweat heater in its minimum energy state corresponding to low ambient humidity during the test.

Where:

Correction Factor
= 0.034 * (Energy Difference at 5% Relative Humidity (RH)),
+ 0.211 * (Energy Difference at 15% RH)
+ 0.204 * (Energy Difference at 25% RH)
+ 0.166 * (Energy Difference at 35% RH)
+ 0.126 * (Energy Difference at 45% RH)
+ 0.119 * (Energy Difference at 55% RH)
+ 0.069 * (Energy Difference at 65% RH)
+ 0.047 * (Energy Difference at 75% RH)
+ 0.008 * (Energy Difference at 85% RH)
+ 0.015 * (Energy Difference at 95% RH)

Where:

Energy Difference at 65% RH = $ED_{65} - ET_{65} - ET_{25}$;
Energy Difference at 95% RH = $ED_{95} - ET_{95} - ET_{25}$;
ET_{25}, ET_{65}, and ET_{95} are determined in accordance with section 5.2.1.6; and
Energy Difference ED_{RH} at each other relative humidity RH is the greater of zero or the following:
$ED_{RH} = ED_{65} + (ED_{95} - ED_{65}) \times (DP_{RH} - DP_{65})/(DP_{95} - DP_{65})$,
Where the dew points DP_{RH} at each of the relative humidities RH in the equation are as follows:
$DP_5 = 5.06$;
$DP_{15} = 27.53$;
$DP_{25} = 38.75$;

DP_{35} = 46.43;
DP_{45} = 52.32;
DP_{55} = 57.13;
DP_{65} = 61.20;
DP_{75} = 64.74;
DP_{85} = 67.87;
DP_{95} = 70.69.

6.3 Externally vented refrigerator or refrigerator-freezers. Per-cycle energy consumption measurements for an externally vented refrigerator or refrigerator-freezer shall be calculated in accordance with the requirements of this Appendix, as modified in sections 6.3.1–6.3.7.

6.3.1 Correction Factor. The correction factor, K, shall be calculated as:

$$K = ec_{90}/ec_{80}$$

Where:

ec_{90} and ec_{80} are measured in section 5.4.2.1.

6.3.2 Combining Test Results of Different Settings of Compartment Temperature Controls. For a given setting of the anti-sweat heater, follow the calculation procedures of 6.2 to combine the test results for energy consumption of the unit at different temperature control settings for each condenser inlet air temperature tested under 5.4.2.2, 5.4.2.3, and 5.4.2.4, where applicable, $(e_{90})_i$, $(e_{60})_i$, $(e_{50})_i$, and $(e_{30})_i$. The combined values, ε_{90}, ε_{60}, ε_{50}, and ε_{30}, where applicable, are expressed in kWh/day.

6.3.3 Energy Consumption Corrections. For a given setting of the anti-sweat heater, adjust the energy consumptions ε_{90}, ε_{60}, ε_{50}, and ε_{30} calculated in 6.3.2 by multiplying the correction factor K to obtain the corrected energy consumptions per day in kWh/day:

$$E_{90} = K \times \varepsilon_{90},$$

$$E_{60} = K \times \varepsilon_{60},$$

$$E_{50} = K \times \varepsilon_{50}, \text{ and}$$

$$E_{30} = K \times \varepsilon_{30}$$

Where:

K is determined under section 6.3.1; and ε_{90}, ε_{60}, ε_{50}, and ε_{30} are determined under section 6.3.2.

6.3.4 Energy Profile Equation. For a given setting of the anti-sweat heater, calculate the energy consumption E_X, in kWh/day, at a specific exterior air temperature between 80 °F (26.7 °C) and 60 °F (15.6 °C) using the following equation:

$$E_X = E_{60} + (E_{90} - E_{60}) \times (T_X - 60)/30$$

Where:

T_X is the exterior air temperature in °F;
60 is the exterior air temperature for the test of section 6.4.2.3;
30 is the difference between 90 and 60;
E_{60} and E_{90} are determined in section 6.3.3.

6.3.5 Energy Consumption at 80 °F (26.7 °C), 75 °F (23.9 °C) and 65 °F (18.3 °C). For a given setting of the anti-sweat heater, calculate the energy consumptions at 80 °F (26.7 °C), 75 °F (23.9 °C) and 65 °F (18.3 °C) exterior air temperatures, E_{80}, E_{75} and E_{65}, respectively, in kWh/day, using the equation in 6.3.4.

6.3.6 National Average Per-Cycle Energy Consumption. For a given setting of the anti-sweat heater, calculate the national average energy consumption, E_N, in kWh/day, using one of the following equations:

$$E_N = 0.523 \times E_{60} + 0.165 \times E_{65} + 0.181 \times E_{75} + 0.131 \times E_{80},$$ for units not tested under section 5.4.2.4; and

$$E_N = 0.257 \times E_{30} + 0.266 \times E_{50} + 0.165 \times E_{65} + 0.181 \times E_{75} + 0.131 \times E_{80},$$ for units tested under section 5.4.2.4

Where:

E_{30}, E_{50}, and E_{60} are defined in 6.3.3;
E_{65}, E_{75}, and E_{80} are defined in 6.3.5; and
the coefficients 0.523, 0.165, 0.181, 0.131, 0.257 and 0.266 are weather-associated weighting factors.

6.3.7 Regional Average Per-Cycle Energy Consumption. If regional average per-cycle energy consumption is required to be calculated for a given setting of the anti-sweat heater, calculate the regional average per-cycle energy consumption, E_R, in kWh/day, for the regions in Figure 2. Use one of the following equations and the coefficients in Table A:

$$E_R = a_1 \times E_{60} + c \times E_{65} + d \times E_{75} + e \times E_{80},$$ for a unit that is not required to be tested under section 5.4.2.4; or

$$E_R = a \times E_{30} + b \times E_{50} + c \times E_{65} + d \times E_{75} + e \times E_{80},$$ for a unit tested under section 5.4.2.4

Where:

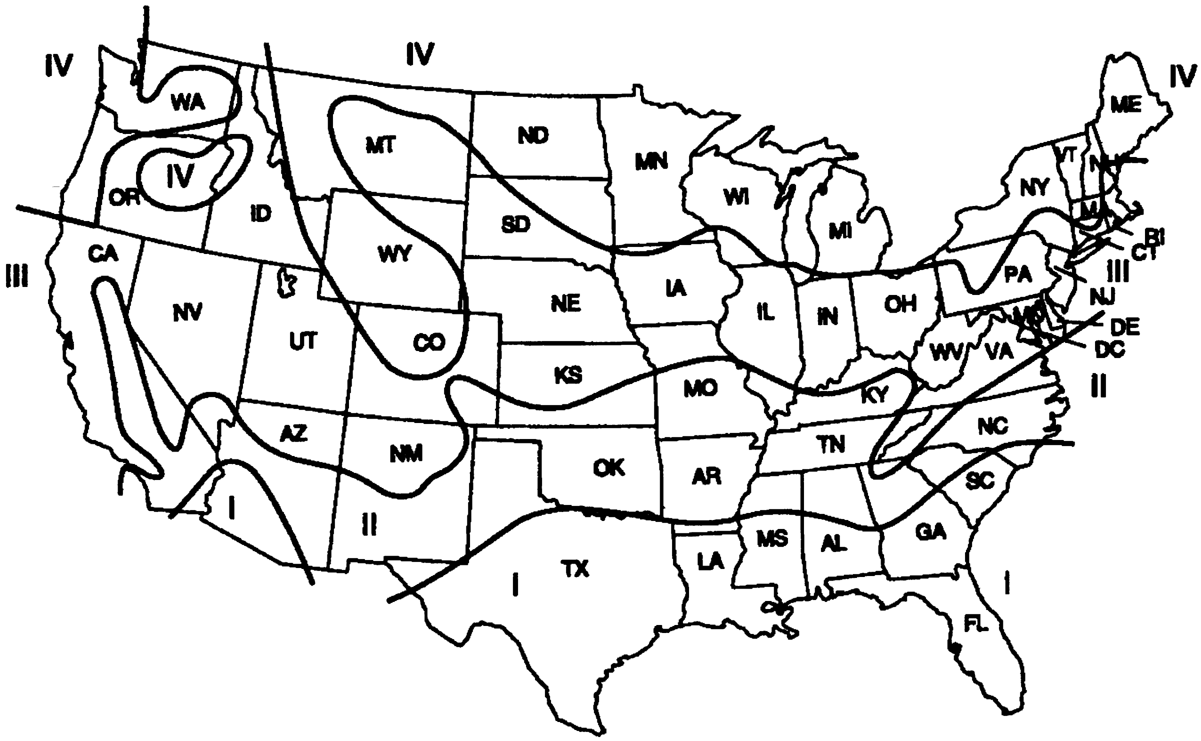
E_{30}, E_{50}, and E_{60} are defined in section 6.3.3;
E_{65}, E_{75}, and E_{80} are defined in section 6.3.5; and
a_1, a, b, c, d, and e are weather-associated weighting factors for the regions, as specified in Table A.

TABLE A—COEFFICIENTS FOR CALCULATING REGIONAL AVERAGE PER-CYCLE ENERGY CONSUMPTION

[Weighting factors]

Regions	a1	a	b	c	d	e
I	0.282	0.039	0.244	0.194	0.326	0.198
II	0.486	0.194	0.293	0.191	0.193	0.129
III	0.584	0.302	0.282	0.178	0.159	0.079
IV	0.664	0.420	0.244	0.161	0.121	0.055

Figure 2. Weather Regions for the United States



Alaska Region IV

Hawaii Region I

7. Test Procedure Waivers

To the extent that the procedures contained in this appendix do not provide a means for determining the energy consumption of a refrigerator or refrigerator-freezer, a manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product. Such instances could, for example, include situations where the test set-up for a particular refrigerator or refrigerator-freezer basic model is not clearly defined by the provisions of section 2. For details regarding the criteria and procedures for obtaining a waiver, please refer to 10 CFR 430.27.

6. Appendix A1 to subpart B of part 430 is amended by:

a. Adding an introductory note after the appendix heading;

b. Revising section 1. Definitions;

c. In section 2. Test Conditions, by:

1. Redesignating sections 2.3, 2.4, 2.5, 2.6, 2.6.1, 2.6.2 and 2.6.3 as 2.4, 2.5, 2.9, 2.10, 2.10.1, 2.10.2 and 2.10.3;

2. Revising sections 2.1, 2.2 and redesignated section 2.4;

3. Adding new sections 2.3, and 2.6 through 2.8;

d. In section 3. Test Control Settings, by:

1. Revising sections 3.2 and 3.2.1;

2. Removing section 3.3;

e. In section 4. Test Period, by:

1. Revising sections 4.1.1, 4.1.2, 4.1.2.1, and 4.1.2.2;

2. Removing section 4.1.2.3;

3. Redesignating section 4.1.2.4 as 4.1.2.3 and revising redesignated 4.1.2.3;

2. Revising Figure 1 to section 4;

3. Adding new sections 4.1.2.4 and 4.1.3;

f. In section 5. Test Measurements, by:

1. Revising existing sections 5.1, 5.1.2, 5.1.2.1, 5.1.2.2, 5.1.2.3, and 5.2.1.3;

2. Removing section 5.2.1.4;

3. Redesignating section 5.2.1.5 as 5.2.1.4 and revising redesignated 5.2.1.4;

2. Adding new sections 5.2.1.5 and 5.2.1.6;

g. In section 6. Calculation of Derived Results from Test Measurements, by:

1. Revising Section 6.2;

2. Adding new section 6.2.3;

3. Redesignating Figure 1 in section 6 as Figure 2.

h. Adding a new section 7, Test Procedure Waivers.

The additions and revisions read as follows:

Appendix A1 to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Electric Refrigerators and Electric Refrigerator-Freezers

The provisions of Appendix A1 shall apply to all products manufactured prior to the effective date of any amended standards promulgated by DOE pursuant to Section 325(b)(4) of the Energy Policy and Conservation Act of 1975, as amended by the Energy Independence and Security Act of 2007 (to be codified at 42 U.S.C. 6295(b)(4)).

1. Definitions

Section 3, *Definitions,* of HRF–1–1979 (incorporated by reference; see § 430.3) is applicable to this test procedure.

1.1 "Adjusted total volume" means the sum of (i) the fresh food compartment volume as defined in HRF–1–1979 in cubic feet, and (ii) the product of an adjustment factor and the net freezer compartment volume as defined in HRF–1–1979, in cubic feet.

1.2 "All-refrigerator" means an electric refrigerator which does not include a compartment for the freezing and long time storage of food at temperatures below 32 °F. (0.0 °C.). It may include a compartment of 0.50 cubic feet capacity (14.2 liters) or less for the freezing and storage of ice.

1.3 "Anti-sweat heater" means a device incorporated into the design of a refrigerator or refrigerator-freezer to prevent the accumulation of moisture on exterior or interior surfaces of the cabinet.

1.4 "Anti-sweat heater switch" means a user-controllable switch or user interface which modifies the activation or control of anti-sweat heaters.

1.5 "Automatic defrost" means a system in which the defrost cycle is automatically initiated and terminated, with resumption of normal refrigeration at the conclusion of the defrost operation. The system automatically prevents the permanent formation of frost on all refrigerated surfaces. Nominal refrigerated food temperatures are maintained during the operation of the automatic defrost system.

1.6 "Automatic icemaker" means a device that can be supplied with water without user intervention, either from a pressurized water supply system or by transfer from a water reservoir located inside the cabinet, that automatically produces, harvests, and stores ice in a storage bin, with means to automatically interrupt the harvesting operation when the ice storage bin is filled to a pre-determined level.

1.7 "Cycle" means the period of 24 hours for which the energy use of an electric refrigerator or electric refrigerator-freezer is calculated as though the consumer activated compartment temperature controls were set so that the standardized temperatures (see section 3.2) were maintained.

1.8 "Cycle type" means the set of test conditions having the calculated effect of operating an electric refrigerator or electric refrigerator-freezer for a period of 24 hours, with the consumer activated controls other than those that control compartment temperatures set to establish various operating characteristics.

1.9 "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 sequence of control for defrost such as the number of defrost heaters energized. Each such variation establishes a separate distinct defrost cycle type.

1.10 "Externally vented refrigerator or refrigerator-freezer" means an electric refrigerator or electric refrigerator-freezer that: has an enclosed condenser or an enclosed condenser/compressor compartment and a set of air ducts for transferring the exterior air from outside the building envelope into, through and out of the refrigerator or refrigerator-freezer cabinet; is capable of mixing exterior air with the room air before discharging into, through, and out of the condenser or condenser/compressor compartment; includes thermostatically controlled dampers or controls that enable the mixing of the exterior and room air at low outdoor temperatures, and the exclusion of exterior air when the outdoor air temperature is above 80 °F or the room air temperature; and may have a thermostatically actuated exterior air fan.

1.11 "HRF–1–1979" means the Association of Home Appliance Manufacturers standard for household refrigerators, combination refrigerator-freezers, and household freezers, also approved as an American National Standard as a revision of ANSI B 38.1–1970. Only sections of HRF–1–1979 (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 HRF–1–1979.

1.12 "Long-time Automatic Defrost" means an automatic defrost system where successive defrost cycles are separated by 14 hours or more of compressor-operating time.

1.13 "Separate auxiliary compartment" means a freezer compartment or a fresh food compartment of a refrigerator or refrigerator-freezer having more than two compartments that is not the first freezer compartment or the first fresh food compartment. Access to a separate auxiliary compartment is through a separate exterior door or doors rather than through the door or doors of another compartment. Separate auxiliary compartments may be convertible (*e.g.,* from fresh food to freezer).

1.14 "Stabilization Period" means the total period of time during which steady-state conditions are being attained or evaluated.

1.15 "Standard cycle" means the cycle type in which the anti-sweat heater control, when provided, is set in the highest energy consuming position.

1.16 "Variable anti-sweat heater control" means an anti-sweat heater control that varies the average power input of the anti-sweat heater(s) based on operating condition variable(s) and/or ambient condition variable(s).

1.17 "Variable defrost control" means a long-time automatic defrost system (except the 14-hour defrost qualification does not apply) where successive defrost cycles are determined by an operating condition variable or variables other than solely compressor operating time. This includes any electrical or mechanical device. Demand defrost is a type of variable defrost control.

2. Test Conditions

2.1 Ambient Temperature and Humidity. The ambient temperature shall be 90.0 ± 1 °F (32.2 ± 0.6 °C) during the stabilization period and the test period. If the product being tested has variable anti-sweat heater control, the ambient relative humidity shall be no more than 35%. For the variable anti-sweat heater test described in section 4.1.3, the ambient temperature shall be 72 ± 1 °F (22.2 ± 0.6 °C) dry bulb and the relative humidities for the three portions of the test shall be 25 ± 10%, 65 ± 2%, and 95 ± 2%.

2.2 Operational Conditions. The electric refrigerator or electric refrigerator-freezer shall be installed and its operating conditions maintained in accordance with HRF–1–1979, (incorporated by reference; see § 430.3), section 7.2 through section 7.4.3.3, except that 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. Defrost controls are to be operative. Other exceptions and provisions to the cited sections of HRF–1–1979 are noted in sections 2.3 through 2.8, and 5.1 below.

2.3 Anti-Sweat Heaters.

(a) User-Controllable Anti-Sweat Heaters. The anti-sweat heater switch is to be on during one test and off during a second test.

(b) Variable Anti-Sweat Heaters. In the case of an electric refrigerator-freezer equipped with variable anti-sweat heater control, the test shall be conducted with the anti-sweat heater controls activated to allow the anti-sweat heater to be energized but operating in their minimum energy state corresponding to operation in low humidity conditions, as a result of testing conducted using an ambient relative humidity level as specified in section 2.1. If the product has an anti-sweat heater switch, it shall be switched on. The variable anti-sweat heater test (described in section 4.1.3) shall be conducted to determine the energy consumption of the anti-sweat heater in higher humidity conditions. The standard cycle energy consumption shall be determined using the equation described in section 6.2.3.

2.4 Conditions for Automatic Defrost Refrigerator-Freezers. For automatic defrost refrigerator-freezers, the freezer compartments shall not be loaded with any frozen food packages during testing. Cylindrical metallic masses of dimensions 1.12 ± 0.25 inches (2.9 ± 0.6 cm) in diameter and height shall be attached in good thermal contact with each temperature sensor within the refrigerated compartments. All temperature measuring sensor masses shall be supported by low-thermal-conductivity supports in such a manner to ensure that there will be at least 1 inch (2.5 cm) of air space separating the thermal mass from contact with any interior surface or hardware inside the cabinet. In case of interference with hardware at the sensor locations specified in section 5.1, the sensors shall be placed at the nearest adjacent location such that there will be a 1-inch air space separating the sensor mass from the hardware.

* * * * *

2.6 The cabinet and its refrigerating mechanism shall be assembled and set up in accordance with the printed consumer instructions supplied with the cabinet. Set-up of the refrigerator or refrigerator-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 not required;

(b) Clearance requirements from surfaces of the product shall be as described in section 2.8 below;

(c) The electric power supply shall be as described in HRF–1–1979 (incorporated by reference; see § 430.3) section 7.4.1;

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

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

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).

2.7 Compartments that are convertible (*e.g.,* from fresh food to freezer) shall be operated in the highest energy use position. For the special case of convertible separate auxiliary compartments, this means that the compartment shall be treated as a freezer compartment or a fresh food compartment, depending on which of these represents higher energy use. Other compartments with separate temperature control (such as crispers convertible to meat keepers), with the exception of butter conditioners, shall also be tested with controls set in the highest energy use position.

2.8 The space between the back of the cabinet and the test room wall or simulated wall shall be the minimum distance in accordance with the manufacturer's instructions. If the instructions do not specify a minimum distance, the cabinet shall be located such that the rear of the cabinet touches the test room wall or simulated wall. The test room wall facing the rear of the cabinet or the simulated wall shall be flat within ¼ inch, and vertical to within 1 degree. The cabinet shall be leveled to within 1 degree of true level, and positioned with its rear wall parallel to the test chamber wall or simulated wall immediately behind the cabinet. Any simulated wall shall be solid and shall extend vertically from the floor to above the height of the cabinet and horizontally beyond both sides of the cabinet.

* * * * *

3. Test Control Settings

* * * * *

3.2 Model with User Operable Temperature Control. Testing shall be performed in accordance with one of the following sections using the standardized temperatures of:

All-Refrigerator: 38 °F (3.3 °C) fresh food compartment temperature;

Refrigerator: 15 °F (−9.4 °C) freezer compartment temperature;

Refrigerator-Freezer: 5 °F (−15 °C) freezer compartment temperature; and

Variable Anti-Sweat Heater Model (Temperatures for the variable anti-sweat heater test of section 4.1.3): 5 °F (−15 °C) freezer compartment temperature and 38 ± 2 °F (3.3 ± 1.1 °F) fresh food compartment temperature during steady-state conditions with no door-openings. If both settings cannot be obtained, then test with the fresh food compartment temperature at 38 ± 2 °F (3.3 ± 1.1 °C) and the freezer compartment as close to 5 °F (-15 °C) as possible.

For the purposes of comparing compartment temperatures with standardized temperatures, as described in sections 3.2.1 through 3.2.3, the freezer compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable freezer compartments, and the fresh food compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable fresh food compartments. Applicable compartments for these calculations may include a first freezer compartment, a first fresh food compartment, and any number of separate auxiliary compartments.

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, knob detents shall be mechanically defeated if necessary to attain a median setting. 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. If the compartment temperature measured during the first test is higher than the standardized temperature, the second test shall be conducted with the controls set at the coldest settings. If the compartment temperature measured during the first test is lower than the standardized temperature, the second test shall be conducted with the controls set at the warmest settings. If the compartment temperatures measured during these two tests bound the standardized temperature for the product being tested, 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, a third test shall be performed with all controls set at their warmest setting and the result of this test shall be used with the result of the test performed with all controls set at their coldest setting to determine energy consumption. If the compartment temperature measured with all controls set at their warmest setting is below the standardized temperature; and the fresh food compartment temperature is below 45 °F (7.22 °C) in the case of a refrigerator or a refrigerator-freezer, excluding an all-refrigerator, then the result of this test alone will be used to determine energy consumption.

* * * * *

4. Test Period

* * * * *

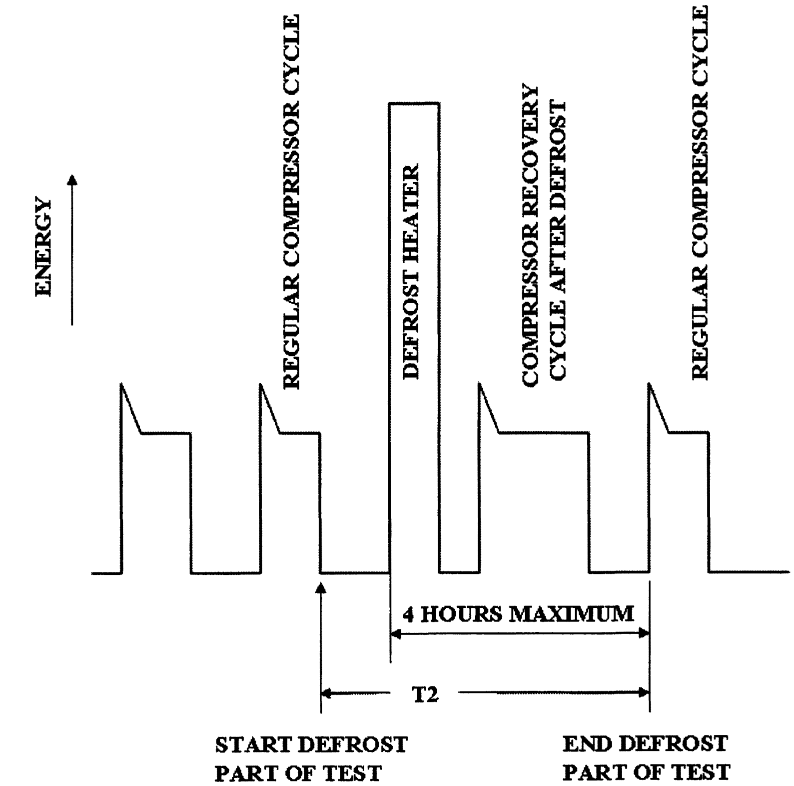
4.1.1 Nonautomatic Defrost. If the model being tested has no automatic defrost system, the test time period shall start after steady state conditions have been achieved, and be of not less than three hours in duration. During the test period the compressor motor shall complete two or more whole compressor cycles (a compressor cycle is a complete "on" and a complete "off" period of the motor). If no "off" cycling will occur, as determined during the stabilization period, the test period shall be 3 hours. If incomplete cycling occurs (less than two compressor cycles during a 24-hour period), the results of the 24-hour period shall be used.

4.1.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test time 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 4.1.2.1 may be used. If the model being tested has a variable defrost control, the provisions of section 4.1.2.2 shall apply. If the model has a dual compressor system with automatic defrost for both systems, the provisions of 4.1.2.3 shall apply. If the model being tested has long-time automatic or variable defrost control involving multiple defrost cycle types, such as for a system with a single compressor with two or more evaporators in which the evaporators are defrosted at different frequencies, the provisions of section 4.1.2.4 shall apply. If the model being tested has multiple defrost cycle types for which compressor run time between defrosts is a fixed time less than 14 hours for all such cycle types, and for which the compressor run time between defrosts for different defrost cycle types are equal to or multiples of each other, the test time 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, energy consumption shall be calculated as described in section 5.2.1.1.

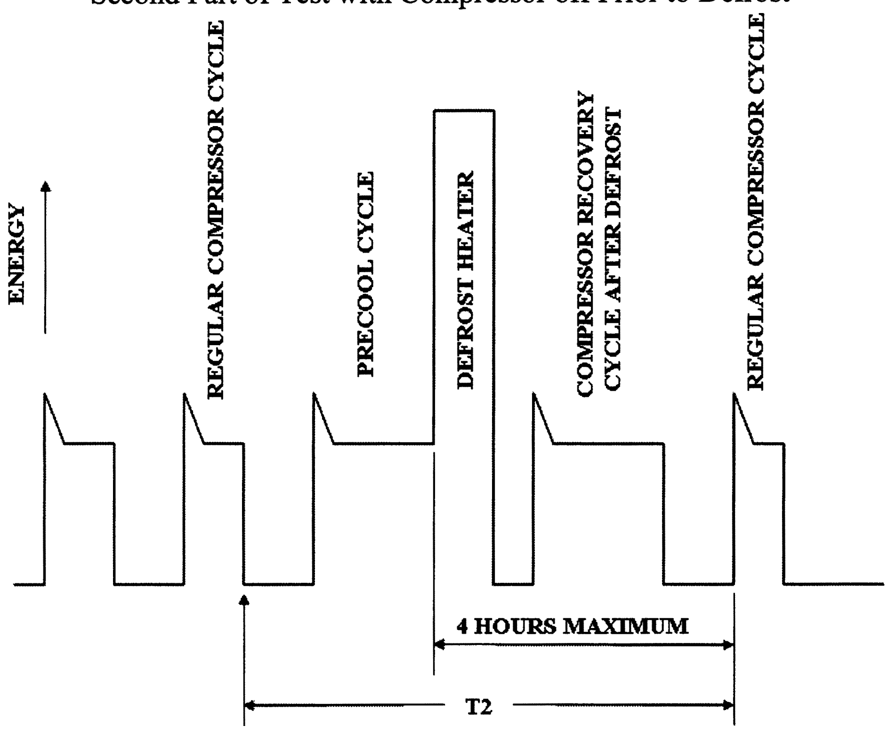
4.1.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the two-part test described in this section may be used. The first part is the same as the test for a unit having no defrost provisions (section 4.1.1). The second part starts when the compressor turns off at the end of a period of steady-state cycling operation just before initiation of the defrost control sequence. If the compressor does not cycle during steady-state operation between defrosts, the second part starts at a time when the compartment temperatures are within their ranges measured during steady state operation, or within 0.5 °F of the average during steady state operation for a compartment with a temperature range during steady state operation no greater than 1 °F. This control sequence may include additional compressor operation prior to energizing the defrost heater. The second part terminates when the compressor turns on the second time after the defrost control sequence or 4 hours after the defrost heater is energized, whichever occurs first. See Figure 1.

BILLING CODE 6450–01–P

Figure 1
Long-time Automatic Defrost Diagrams



Second Part of Test with Compressor off Prior to Defrost



BILLING CODE 6450–01–C

4.1.2.2 Variable Defrost Control. If the model being tested has a variable defrost control system, the test shall consist of the same two parts as the test for long-time automatic defrost (section 4.1.2.1).

4.1.2.3 Dual Compressor Systems with Automatic Defrost. If the model being tested has separate compressor systems for the refrigerator and freezer sections, each with its own automatic defrost system, then the two-part method in 4.1.2.1 shall be used. The second part of the method will be conducted separately for each automatic defrost system. The components (compressor, fan motors, defrost heaters, anti-sweat heaters, etc.) associated with each system will be identified and their energy consumption will be separately measured during each test.

4.1.2.4 Systems with Multiple Defrost Frequencies. This section is applicable to models with long-time automatic or variable defrost control with multiple defrost cycle types, such as models with single compressors and multiple evaporators in which the evaporators have different defrost frequencies. The two-part method in 4.1.2.1 shall be used. The second part of the method will be conducted separately for each distinct defrost cycle type.

4.1.3 Variable Anti-Sweat Heater Test. The test shall be conducted three times with the test conditions at three different relative humidities as set forth in section 2 and the test control settings as set forth in section 3. For a product with an anti-sweat heater switch, the tests shall be conducted with the switch in the on position. Each of the three portions of the test shall be conducted in the same manner as for a unit having no automatic defrost (section 4.1.1). If during the time between one of the portions of the test and the next portion the ambient temperature conditions are maintained, the procedure for evaluating steady state (section 2.9) is not required for the second of these two portions of the test. However, in such a case, a control stabilization period of two hours is required after the ambient humidity conditions have reached the required range before start of the test.

5. Test Measurements

5.1 Temperature Measurements. Temperature measurements shall be made at the locations prescribed in Figures 7.1 and 7.2 of HRF–1–1979 (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 cabinet do not conform with those shown in Figure 7.1 and 7.2 of HRF–1–1979, the product may be tested by relocating the temperature sensors from the locations specified in the Figures by no more than 2 inches to avoid interference with hardware or components within the cabinet, 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 430.62(d). For those products equipped with a cabinet that does not conform with Figures 7.1 or 7.2 and cannot be tested in the manner described above, the manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product.

* * * * *

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 one or more complete compressor cycles. One compressor cycle is one complete motor "on" and one complete motor "off" period. For long-time automatic defrost models, compartment temperatures shall be those measured in the first part of the test period specified in section 4.1.2.1. For models equipped with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.1.2.2.

5.1.2.1 The number of complete compressor cycles over which the measured temperatures in a compartment are to be averaged to determine compartment temperature shall be equal to the number of minutes between measured temperature readings, rounded up to the next whole minute or a number of complete compressor cycles over a time period exceeding 1 hour, whichever is greater. One of the compressor cycles shall be the last complete compressor cycle during the test period.

5.1.2.2 If no compressor cycling occurs, the compartment temperature shall be the average of the measured temperatures taken during the last 32 minutes of the test period.

5.1.2.3 If incomplete compressor cycling occurs, the compartment temperatures shall be the average of the measured temperatures taken during the last three hours of the last complete compressor "on" period.

* * * * *

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 = least or shortest time between defrosts in hours rounded to the nearest tenth of an hour (greater than or equal to 6 but less than or equal to 12 hours);

CT_M = maximum time between defrost cycles 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 12 and 84 shall be used, respectively.

* * * * *

5.2.1.4 Dual Compressor Systems with Dual Automatic Defrost. The two-part test method in section 4.1.2.4 must be used, and the energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$$ET = (1440 \times EP1/T1) + (EP2_F - (EP_F \times T2/T1)) \times (12/CT_F) + (EP2_R - (EP_R \times T3/T1)) \times (12/CT_R)$$

Where:

1440, EP1, T1, EP2, 12, and CT are defined in 5.2.1.2;

EP_F = freezer system energy in kilowatt-hours expended during the first part of the test;

$EP2_F$ = freezer system energy in kilowatt-hours expended during the second part of the test for the freezer system;

EP_R= refrigerator system energy in kilowatt-hours expended during the first part of the test;

$EP2_R$ = refrigerator system energy in kilowatt-hours expended during the second part of the test for the refrigerator system;

T2 and T3 = length of time in minutes of the second test part for the freezer and refrigerator systems respectively;

CT_F = compressor "on" time between freezer defrosts (in hours to the nearest tenth of an hour); and

CT_R = compressor "on" time between refrigerator defrosts (in hours to the nearest tenth of an hour).

* * * * *

5.2.1.5 Variable Anti-Sweat Heater Test. The energy consumption in kilowatt-hours per day for each portion of the test shall be calculated equivalent to:

$$ET_{XX} = EP_{XX} \times 1440/T_{XX}$$

Where:

1440 is defined in 5.2.1.1;

subscript XX = 25, 65, and 95, representing the three relative humidities for which the test is conducted;

ET_{XX} = test cycle energy expended in kilowatt-hours per day;

EP_{XX} = energy expended during the test period in kilowatt-hours;

T_{XX} = length of time of the test period in minutes.

5.2.1.6 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

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

Where:

1440 is defined in 5.2.1.1 and EP1 and T1 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, and for variable defrost control equal to $(CT_{Li} \times CT_{Mi})/(F \times (CT_{Mi} - CT_{Li}) + CT_{Li})$;

CT_{Li} = least or shortest time between instances of defrost cycle type i in hours rounded to the nearest tenth of an hour (greater than or equal to 6 but less than or equal to 12 hours);

CT_{Mi} = maximum 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);

F = default defrost energy consumption factor, equal to 0.20 in lieu of testing to find CT_i;

For variable defrost models with no values for CT_{Li} and CT_{Mi} in the algorithm, the default values of 12 and 84 shall be used, respectively.

D is the total number of distinct defrost cycle types.

* * * * *

6. Calculation of Derived Results From Test Measurements

* * * * *

6.2 Average Per-Cycle Energy consumption.

For the purposes of calculating per-cycle energy consumption, as described in this section, the freezer compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable freezer compartments, and the fresh food compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable fresh food compartments. Applicable compartments for these calculations may include a first freezer compartment, a first fresh food compartment, and any number of separate auxiliary compartments.

* * * * *

6.2.3 Variable Anti-Sweat Heater Models. The energy consumption of an electric refrigerator-freezer having a variable anti-sweat heater control, E_{VASH}, expressed in kilowatt-hours per day, shall be calculated equivalent to:

E_{VASH} = E + (Correction Factor), where E is determined by 6.2.1.1, 6.2.1.2, 6.2.2.1, or 6.2.2.2, whichever is appropriate, with the anti-sweat heater in its minimum energy state corresponding to low ambient humidity during the test.

Where Correction Factor:

= 0.034 * (Energy Difference at 5% Relative Humidity (RH)),
+ 0.211 * (Energy Difference at 15% RH)
+ 0.204 * (Energy Difference at 25% RH)
+ 0.166 * (Energy Difference at 35% RH)
+ 0.126 * (Energy Difference at 45% RH)
+ 0.119 * (Energy Difference at 55% RH)
+ 0.069 * (Energy Difference at 65% RH)
+ 0.047 * (Energy Difference at 75% RH)
+ 0.008 * (Energy Difference at 85% RH)
+ 0.015 * (Energy Difference at 95% RH)

Where:

Energy Difference at 65% RH = $ED_{65} = ET_{65} - ET_{25}$;

Energy Difference at 95% RH = $ED_{95} = ET_{95} - ET_{25}$;

ET_{25}, ET_{65}, and ET_{95} are determined in accordance with section 5.2.1.6; and

Energy Difference DE_{RH} at each other relative humidity RH is the greater of zero or the following:

$ED_{RH} = ED_{65} + (ED_{95} - ED_{65}) \times (DP_{RH} - DP_{65})/(DP_{95} - DP_{65})$,

Where the dew points DP_{RH} at each of the relative humidities RH in the equation are as follows:

$DP_5 = 5.06$
$DP_{15} = 27.53$;
$DP_{25} = 38.75$;
$DP_{35} = 46.43$;
$DP_{45} = 52.32$;
$DP_{55} = 57.13$;
$DP_{65} = 61.20$;
$DP_{75} = 64.74$;
$DP_{85} = 67.87$;
$DP_{95} = 70.69$.

* * * * *

7. Test Procedure Waivers

To the extent that the procedures contained in this appendix do not provide a means for determining the energy consumption of a refrigerator or refrigerator-freezer, a manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product. Such instances could, for example, include situations where the test set-up for a particular refrigerator or refrigerator-freezer basic model is not clearly defined by the provisions of section 2. For details regarding the criteria and procedures for obtaining a waiver, please refer to 10 CFR 430.27.

7. Add a new Appendix B to subpart B of part 430 to read as follows:

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

The provisions of Appendix B shall apply to all products manufactured on or after the effective date of any amended standards promulgated by DOE pursuant to Section 325(b)(4) of the Energy Policy and Conservation Act of 1975, as amended by the Energy Independence and Security Act of 2007 (to be codified at 42 U.S.C. 6295(b)(4)).

1. Definitions

Section 3, *Definitions,* of HRF–1–2008 (incorporated by reference; see § 430.3) is applicable to this test procedure.

1.1 "Adjusted total volume" means the product of the freezer volume as defined in HRF–1–2008 (incorporated by reference; see § 430.3) in cubic feet times an adjustment factor.

1.2 "Anti-sweat heater" means a device incorporated into the design of a freezer to prevent the accumulation of moisture on exterior or interior surfaces of the cabinet under conditions of high ambient humidity.

1.3 "Anti-sweat heater switch" means a user-controllable switch or user interface which modifies the activation or control of anti-sweat heaters.

1.4 "Automatic defrost" means a system in which the defrost cycle is automatically initiated and terminated, with resumption of normal refrigeration at the conclusion of defrost operation. The system automatically prevents the permanent formation of frost on all refrigerated surfaces. Nominal refrigerated food temperatures are maintained during the operation of the automatic defrost system.

1.5 "Automatic icemaker" means a device, that can be supplied with water without user intervention, either from a pressurized water supply system or by transfer from a water reservoir located inside the cabinet, that automatically produces, harvests, and stores ice in a storage bin, with means to automatically interrupt the harvesting operation when the ice storage bin is filled to a pre-determined level.

1.6 "Cycle" means the period of 24 hours for which the energy use of a freezer is calculated as though the consumer-activated compartment temperature controls were preset so that the standardized temperatures (see section 3.2) was maintained.

1.7 "Cycle type" means the set of test conditions having the calculated effect of operating a freezer for a period of 24 hours with the consumer-activated controls other than the compartment temperature control set to establish various operating characteristics.

1.8 "HRF–1–2008" means the Association of Home Appliance Manufacturers standard *Energy, Performance and Capacity of Household Refrigerators, Refrigerator-Freezers and Freezers* that was approved September 13, 2008. Only sections of HRF–1–2008 (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 HRF–1–2008.

1.9 "Long-time automatic defrost" means an automatic defrost system where successive defrost cycles are separated by 14 hours or more of compressor operating time.

1.10 "Quick freeze" means an optional feature on freezers that is initiated manually and shut off manually. It bypasses the thermostat control and places the compressor in a steady-state operating condition until it is shut off.

1.11 "Separate auxiliary compartment" means a freezer compartment of a freezer having more than one compartment that is not the first freezer compartment. Access to a separate auxiliary compartment is through a separate exterior door or doors rather than through the door or doors of another compartment.

1.12 "Stabilization period" means the total period of time during which steady-state conditions are being attained or evaluated.

1.13 "Standard cycle" means the cycle type in which the anti-sweat heater switch, when provided, is set in the highest energy-consuming position.

1.14 "Variable defrost control" means a long-time automatic defrost system (except the 14-hour defrost qualification does not apply) where successive defrost cycles are determined by an operating condition variable or variables other than compressor operating time. This includes any electrical or mechanical device performing this function. Demand defrost is a type of variable defrost control.

2. Test Conditions

2.1 Ambient Temperature. The ambient temperature shall be 90.0 ± 1.0 °F (32.2 ± 0.6 °C) during the stabilization period and the test period. The ambient temperature shall be 80 ± 2 °F (26.7 ± 1.1 °C) dry bulb and 67 °F (19.4 °C) wet bulb during the stabilization period and during the test period when the unit is tested in accordance with section 3.3.

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 through section 5.5.5.5 (but excluding sections 5.5.5.2 and 5.5.5.4), except that the vertical ambient 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. Defrost controls are to be operative and the anti-sweat heater switch is to be "on" during one test and "off" during a second test. The quick freeze option shall be switched off except as specified in section 3.1. Additional clarifications are noted in sections 2.3 through 2.6.

2.3 Conditions for Automatic Defrost Freezers. For automatic defrost freezers, the freezer compartments shall not be loaded with any frozen food packages during testing. Cylindrical metallic masses of dimensions 1.12 ± 0.25 inches (2.9 ± 0.6 cm) in diameter and height shall be attached in good thermal contact with each temperature sensor within the refrigerated compartments. All temperature measuring sensor masses shall be supported by low-thermal-conductivity supports in such a manner to ensure that there will be at least 1 inch (2.5 cm) of air space separating the thermal mass from contact with any interior surface or hardware inside the cabinet. In case of interference with hardware at the sensor locations specified in section 5.1, the sensors shall be placed at the nearest adjacent location such that there will be a 1-inch air space separating the sensor mass from the hardware.

2.4 The cabinet and its refrigerating mechanism shall be assembled and set up in accordance with the printed consumer instructions supplied with the cabinet. 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) Clearance requirements from surfaces of the product shall be as described in section 2.5 below;

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

(c) Temperature control settings for testing shall be as described in section 3 below; and

(d) The product does not need to be anchored or otherwise secured to prevent tipping during energy testing.

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).

2.5 The space between the back of the cabinet and the test room wall or simulated wall shall be the minimum distance in accordance with the manufacturer's instructions. If the instructions do not specify a minimum distance, the cabinet shall be located such that the rear of the cabinet touches the test room wall or simulated wall. The test room wall facing the rear of the cabinet or the simulated wall shall be flat within ¼ inch, and vertical to within 1 degree. The cabinet shall be leveled to within 1 degree of true level, and positioned with its rear wall parallel to the test chamber wall or simulated wall immediately behind the cabinet. Any simulated wall shall be solid and shall extend vertically from the floor to above the height of the cabinet and horizontally beyond both sides of the cabinet.

2.6 Steady State Condition. Steady-state conditions exist if the temperature measurements taken at four minute intervals or less during a stabilization period are not changing at a rate greater than 0.042 °F (0.023 °C) per hour as determined by the applicable condition of A or B described below.

A—The average of the measurements during a 2-hour period if no cycling occurs or during a number of complete repetitive compressor cycles occurring through a period of no less than 2 hours is compared to the average over an equivalent time period with 3 hours elapsing between the two measurement periods.

B—If A above cannot be used, the average of the measurements during a number of complete repetitive compressor cycles occurring through a period of no less than 2 hours and including the last complete cycle before a defrost period (or if no cycling occurs, the average of the measurements during the last 2 hours before a defrost period) are compared to the same averaging period before the following defrost period.

3. Test Control Settings

3.1 Model with No User Operable Temperature Control. A test shall be performed during which the compartment temperature and energy use shall be measured. A second test shall be performed with the temperature control electrically short circuited to cause the compressor to run continuously. If the model has the quick freeze option, this option must be used to bypass the temperature control.

3.2 Model with User Operable Temperature Control. Testing shall be performed in accordance with one of the following sections using the standardized temperature of 0.0 °F (−17.8 °C).

For the purposes of comparing compartment temperatures with standardized temperatures, as described in sections 3.2.1 through 3.2.3, the freezer compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable freezer compartments. Applicable compartments for these calculations may include a first freezer compartment and any number of separate auxiliary freezer compartments.

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, knob detents shall be mechanically defeated if necessary to attain a median setting. 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 which 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, a third test shall be performed with all controls set at their warmest setting and the result of this test shall be used with the result of the test performed with all controls set at their coldest setting to determine energy consumption. 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 below, which summarizes these requirements.

TABLE 1—TEMPERATURE SETTINGS FOR FREEZERS

First test		Second test		Third test settings	Energy calculation based on:
Settings	Results	Settings	Results		
Mid	Low	Warm	Low	None	Second Test Only.

TABLE 1—TEMPERATURE SETTINGS FOR FREEZERS—Continued

First test		Second test		Third test settings	Energy calculation based on:
Settings	Results	Settings	Results		
			High	None	First and Second Tests.
	High	Cold	Low High	None Warm	First and Second Tests. Second and Third Tests.

3.2.2 Alternatively, a first test may be performed with all temperature controls set at their warmest setting. If the compartment temperature is below the standardized temperature, then the result of this test alone will be used to determine energy consumption. If the above condition is not met, then the unit shall be tested in accordance with section 3.2.1.

3.2.3 Alternatively, a first test may be performed with all temperature controls set at their coldest setting. If the compartment temperature is above the standardized temperature, a second test shall be performed with all controls set at their warmest setting and the results of these two tests shall be used to determine energy consumption. If the above condition is not met, then the unit shall be tested in accordance with section 3.2.1.

4. Test Period

4.1 Test Period. Tests shall be performed by establishing the conditions set forth in section 2 and using control settings as set forth in section 3 above.

4.1.1 Nonautomatic Defrost. If the model being tested has no automatic defrost system, the test time period shall start after steady-state conditions have been achieved and be no less than 3 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 will occur, as determined during the stabilization period, the test period shall be 3 hours. If incomplete cycling occurs (less than two compressor cycles during a 24-hour period), the results of the 24-hour period shall be used.

4.1.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test time 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 alternate provisions of 4.1.2.1 may be used. If the model being tested has a variable defrost control, the provisions of 4.1.2.2 shall apply.

4.1.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the two-part test described in this section may be used. The first part is the same as the test for a unit having no defrost provisions (section 4.1.1). The second part starts when the compressor turns off at the end of a period of steady-state cycling operation just before initiation of the defrost control sequence. If the compressor does not cycle during steady-state operation between defrosts, the second part starts at a time when the compartment temperatures are within their ranges measured during steady state operation, or within 0.5 °F of the average during steady state operation for a compartment with a temperature range during steady state operation no greater than 1 °F. This control sequence may include additional compressor operation prior to energizing the defrost heater. The second part terminates when the compressor turns on the second time after the defrost control sequence or 4 hours after the defrost heater is energized, whichever occurs first.

4.1.2.2 Variable Defrost Control. If the model being tested has a variable defrost control system, the test shall consist of the same two parts as the test for long-time automatic defrost (section 4.1.2.1).

5. Test Measurements.

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 cabinet do not conform with those shown in Figure 7.2 of HRF–1–1979, the product may be tested by relocating the temperature sensors from the locations specified in the Figures by no more than 2 inches to avoid interference with hardware or components within the cabinet, 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 430.62(d). For those products equipped with a cabinet that does not conform with Figure 7.2 and cannot be tested in the manner described above, the manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product.

5.1.1 Measured Temperature. The measured temperature is to be the average of all sensor temperature readings taken at a particular point in time. Measurements shall be taken at regular intervals not to exceed 4 minutes.

5.1.2 Compartment Temperature. The compartment temperature for each test period shall be an average of the measured temperatures taken during one or more complete compressor cycles. One compressor cycle is one complete motor "on" and one complete motor "off" period. For long-time automatic defrost models, compartment temperature shall be that measured in the first part of the test period specified in section 4.1.2.1. For models equipped with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.1.2.2.

5.1.2.1 The number of complete compressor cycles over which the measured temperatures in a compartment are to be averaged to determine compartment temperature shall be equal to the number of minutes between measured temperature readings rounded up to the next whole minute or a number of complete compressor cycles over a time period exceeding 1 hour. One of the compressor cycles shall be the last complete compressor cycle during the test period.

5.1.2.2 If no compressor cycling occurs, the compartment temperature shall be the average of the measured temperatures taken during the last 32 minutes of the test period.

5.1.2.3 If incomplete compressor cycling occurs (less than one compressor cycle), the compartment temperature shall be the average of all readings taken during the last 3 hours of the last complete compressor "on" period.

5.2 Energy Measurements:

5.2.1 Per-Day Energy Consumption. The energy consumption in kilowatt-hours per day for each test period shall be the energy expended during the test period as specified in section 4.1 adjusted to a 24-hour period. The adjustment shall be determined as follows:

5.2.1.1 Nonautomatic and Automatic Defrost Models. The energy consumption in kilowatt-hours per day shall be calculated equivalent to:

$$ET = (EP \times 1440 \times K)/T$$

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;
1440 = conversion factor to adjust to a 24-hour period in minutes per day; and
K = dimensionless correction factor of 0.7 for chest freezers and 0.85 for upright freezers to adjust for average household usage.

5.2.1.2 Long-time Automatic Defrost. If the two part test method is used, 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, 1440, and K are defined in section 5.2.1.1;
EP1 = energy expended in kilowatt-hours during the first part of the test;

EP2 = energy expended in kilowatt-hours during the second part of the test;
CT = defrost timer run time in hours required to cause it to go through a complete cycle, to the nearest tenth hour per cycle;
12 = conversion factor to adjust for a 50 percent run time of the compressor in hours per day; and
T1 and T2 = length of time in minutes of the first and second test parts respectively.

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:

ET 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 = least or shortest time between defrosts in hours rounded to the nearest tenth of an hour (greater than or equal to 6 hours but less than or equal to 12 hours);
CT_M = maximum 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 12 and 84 shall be used, respectively.

5.3 Volume Measurements. The 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.

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.

6. Calculation of Derived Results From Test Measurements

6.1 Adjusted Total Volume. The adjusted total volume, VA, for freezers under test shall be defined as:

$$VA = VT \times CF$$

Where:

VA = adjusted total volume in cubic feet;
VT = total refrigerated volume in cubic feet; and
CF = dimensionless correction factor of 1.76.

6.2 Average Per-Cycle Energy Consumption. For the purposes of calculating per-cycle energy consumption, as described in this section, the freezer compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable freezer compartments. Applicable compartments for these calculations may include a first freezer compartment and any number of separate auxiliary freezer compartments.

6.2.1 The average per-cycle energy consumption for a cycle type is expressed in kilowatt-hours per cycle to the nearest one hundredth (0.01) kilowatt-hour and shall depend on the compartment temperature attainable as shown below.

6.2.1.1 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:

E = total per-cycle energy consumption in kilowatt-hours per day;
ET is defined in 5.2.1;
Number 1 indicates the test period during which the highest compartment temperature is measured; and
IET, expressed in kilowatt-hours per cycle, equals 0.23 for a product with an automatic icemaker and otherwise equals 0 (zero).

6.2.1.2 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:

$$E = ET1 + ((ET2 - ET1) \times (0.0 - TF1)/(TF2 - TF1)) + IET$$

Where:

E and IET are defined in 6.2.1.1 and ET is defined in 5.2.1;
TF = compartment temperature determined according to 5.1.2 in degrees F;
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.

7. Test Procedure Waivers

To the extent that the procedures contained in this appendix do not provide a means for determining the energy consumption of a freezer, a manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product. Such instances could, for example, include situations where the test set-up for a particular freezer basic model is not clearly defined by the provisions of section 2. For details regarding the criteria and procedures for obtaining a waiver, please refer to 10 CFR 430.27.

8. Appendix B1 to subpart B of part 430 is amended by:

a. Adding an introductory note after the appendix heading;

b. In section 1. Definitions, by:

1. Adding an introductory note after the heading;
2. Redesignating section 1.1 as 1.7 and revising redesignated 1.7;
3. Revising section 1.2;
4. Redesignating 1.3 as 1.5 and revising redesignated 1.5;
5. Redesignating section 1.4 as 1.6;
6. Redesignating section 1.5 as 1.12;
7. Redesignating section 1.6 as 1.1;
8. Redesignating section 1.7 as 1.4;
9. Redesignating section 1.9 as 1.11;
10. Redesignating section 1.10 as 1.13;
11. Redesignating section 1.11 as 1.9;
12. Adding new sections 1.3, 1.9, and 1.10;

c. In section 2. Test Conditions, by:

1. Revising section 2.2;
2. Redesignating section 2.3 as 2.6;
3. Adding new sections 2.3 through 2.5;

d. In section 3. Test Control Settings, by:

1. Revising sections 3.1, 3.2, and 3.2.1;
2. Removing section 3.3;

e. In section 4, Test Period by:

1. Revising sections 4.1.2.1 and 4.1.2.2;
2. Removing section 4.1.2.3;

f. In section 5, Test Measurements, by:

1. Revising sections 5.1, 5.1.2, 5.1.2.1, 5.1.2.2, 5.1.2.3, and 5.2.1.3;
2. Removing section 5.2.1.4;

g. In section 6. Calculation of Derived Results From Test Measurements, by revising section 6.2;

h. Adding new section 7, Waivers.

The additions and revisions read as follows:

Appendix B1 to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Freezers

The provisions of Appendix B1 shall apply to all products manufactured prior to the effective date of any amended standards promulgated by DOE pursuant to Section 325(b)(4) of the Energy Policy and Conservation Act of 1975, as amended by the Energy Independence and Security Act of 2007 (to be codified at 42 U.S.C. 6295(b)(4)).

1. Definitions

Section 3, *Definitions,* of HRF–1–1979 (incorporated by reference; see § 430.3) is applicable to this test procedure.

* * * * *

1.2 "Anti-sweat heater" means a device incorporated into the design of a freezer to prevent the accumulation of moisture on exterior or interior surfaces of the cabinet under conditions of high ambient humidity.

1.3 "Anti-sweat heater switch" means a user-controllable switch or user interface which modifies the activation or control of anti-sweat heaters.

* * * * *

1.5 "Cycle" means the period of 24 hours for which the energy use of a freezer is calculated as though the consumer-activated compartment temperature controls were preset so that the standardized temperature (see section 3.2) was maintained.

* * * * *

1.7 "HRF–1–1979" means the Association of Home Appliance Manufacturers standard for household refrigerators, combination refrigerator-freezers, and household freezers, also approved as an American National Standard as a revision of ANSI B 38.1–1970. Only sections of HRF–1–1979 (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 HRF–1–1979.

* * * * *

1.10 "Separate auxiliary compartment" means a freezer compartment of a freezer having more than one compartment that is not the first freezer compartment. Access to a separate auxiliary compartment is through a separate exterior door or doors rather than through the door or doors of another compartment.

* * * * *

2.2 Operational Conditions. The freezer shall be installed and its operating conditions maintained in accordance with HRF–1–1979, (incorporated by reference; see § 430.3), section 7.2 through section 7.4.3.3 (but excluding section 7.4.3.2), except that the vertical ambient 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. Defrost controls are to be operative and the anti-sweat heater switch is to be "on" during one test and "off" during a second test. The quick freeze option shall be switched off except as specified in section 3.1. Additional clarifications are noted in sections 2.3 through 2.5.

2.3 Conditions for Automatic Defrost Freezers. For automatic defrost freezers, the freezer compartments shall not be loaded with any frozen food packages during testing. Cylindrical metallic masses of dimensions 1.12 ± 0.25 inches (2.9 ± 0.6 cm) in diameter and height shall be attached in good thermal contact with each temperature sensor within the refrigerated compartments. All temperature measuring sensor masses shall be supported by low-thermal-conductivity supports in such a manner to ensure that there will be at least 1 inch (2.5 cm) of air space separating the thermal mass from contact with any interior surface or hardware inside the cabinet. In case of interference with hardware at the sensor locations specified in section 5.1, the sensors shall be placed at the nearest adjacent location such that there will be a 1-inch air space separating the sensor mass from the hardware.

2.4 The cabinet and its refrigerating mechanism shall be assembled and set up in accordance with the printed consumer instructions supplied with the cabinet. 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) Clearance requirements from surfaces of the product shall be as specified in section 2.5 below;

(b) The electric power supply shall be as described in HRF–1–1979 (incorporated by reference; see § 430.3) section 7.4.1;

(c) Temperature control settings for testing shall be as described in section 3 below; and

(d) The product does not need to be anchored or otherwise secured to prevent tipping during energy testing.

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).

2.5 The space between the back of the cabinet and the test room wall or simulated wall shall be the minimum distance in accordance with the manufacturer's instructions. If the instructions do not specify a minimum distance, the cabinet shall be located such that the rear of the cabinet touches the test room wall or simulated wall. The test room wall facing the rear of the cabinet or the simulated wall shall be flat within ¼-inch, and vertical to within 1 degree. The cabinet shall be leveled to within 1 degree of true level, and positioned with its rear wall parallel to the test chamber wall or simulated wall immediately behind the cabinet. Any simulated wall shall be solid and shall extend vertically from the floor to above the height of the cabinet and horizontally beyond both sides of the cabinet.

* * * * *

3. Test Control Settings

3.1 Model with No User Operable Temperature Control. A test shall be performed during which the compartment temperature and energy use shall be measured. A second test shall be performed with the temperature control electrically short circuited to cause the compressor to run continuously. If the model has the quick freeze option, this option must be used to bypass the temperature control.

3.2 Model with User Operable Temperature Control. Testing shall be performed in accordance with one of the following sections using the standardized temperature of 0.0 °F (−17.8 °C).

For the purposes of comparing compartment temperatures with standardized temperatures, as described in sections 3.2.1 through 3.2.3, the freezer compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable freezer compartments. Applicable compartments for these calculations may include a first freezer compartment and any number of separate auxiliary freezer compartments.

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, knob detents shall be mechanically defeated if necessary to attain a median setting. 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. If the compartment temperature measured during the first test is higher than the standardized temperature, the second test shall be conducted with the controls set at the coldest settings. If the compartment temperature measured during the first test is lower than the standardized temperature, the second test shall be conducted with the controls set at the warmest settings. 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 settings is above the standardized temperature, a third test shall be performed with all controls set at their warmest settings and the result of this test shall be used with the result of the test performed with all controls set at their coldest settings to determine energy consumption. If the compartment temperature measured with all controls set at their warmest settings is below the standardized temperature, then the result of this test alone will be used to determine energy consumption.

* * * * *

4. Test Period

* * * * *

4.1.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the two-part test described in this section may be used. The first part is the same as the test for a unit having no defrost provisions (section 4.1.1). The second part starts when the compressor turns off at the end of a period of steady-state cycling operation just before initiation of the defrost control sequence. If the compressor does not cycle during steady-state operation between defrosts, the second part starts at a time when the compartment temperatures are within their ranges measured during steady state operation, or within 0.5 °F of the average during steady state operation for a compartment with a temperature range during steady state operation no greater than 1 °F. This control sequence may include additional compressor operation prior to energizing the defrost heater. The second part terminates when the compressor turns on the second time after the defrost control sequence or 4 hours after the defrost heater is energized, whichever occurs first.

4.1.2.2 Variable Defrost Control. If the model being tested has a variable defrost control system, the test shall consist of the same two parts as the test for long-time automatic defrost (section 4.1.2.1).

* * * * *

5. Test Measurements

5.1 Temperature Measurements. Temperature measurements shall be made at the locations prescribed in Figure 7.2 of HRF–1–1979 (incorporated by reference; see § 430.3) and shall be accurate to within ±0.5 °F (0.3 °C).

If the interior arrangements of the cabinet do not conform with those shown in Figure 7.2 of HRF–1–1979, the product may be tested by relocating the temperature sensors from the locations specified in the Figures by no more than 2 inches to avoid interference with hardware or components within the cabinet, 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 430.62(d). For those products equipped with a cabinet that does not conform with Figure 7.2 and cannot be tested in the manner described above, the manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product.

* * * * *

5.1.2 Compartment Temperature. The compartment temperature for each test period shall be an average of the measured temperatures taken during one or more complete compressor cycles. One compressor cycle is one complete motor "on" and one complete motor "off" period. For long-time automatic defrost models, compartment temperature shall be that measured in the first part of the test period specified in section 4.1.2.1. For models equipped with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.1.2.2.

5.1.2.1 The number of complete compressor cycles over which the measured temperatures in a compartment are to be averaged to determine compartment temperature shall be equal to the number of minutes between measured temperature readings rounded up to the next whole minute or a number of complete compressor cycles over a time period exceeding 1 hour. One of the compressor cycles shall be the last complete compressor cycle during the test period before start of the defrost control sequence for products with automatic defrost.

5.1.2.2 If no compressor cycling occurs, the compartment temperature shall be the average of the measured temperatures taken during the last 32 minutes of the test period.

5.1.2.3 If incomplete compressor cycling occurs (less than one compressor cycle), the compartment temperature shall be the average of all readings taken during the last 3 hours of the last complete compressor "on" period.

* * * * *

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:

ET and 1440 are defined in section 5.2.1.1 and 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 = least or shortest time between defrosts in hours rounded to the nearest tenth of an hour (greater than or equal to 6 hours but less than or equal to 12 hours);

CT_M = maximum 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 12 and 84 shall be used, respectively.

* * * * *

6. Calculation of Derived Results From Test Measurements

* * * * *

6.2 Average Per Cycle Energy Consumption. For the purposes of calculating per-cycle energy consumption, as described in this section, the freezer compartment temperature shall be equal to a volume-weighted average of the temperatures of all applicable freezer compartments. Applicable compartments for these calculations may include a first freezer compartment and any number of separate auxiliary freezer compartments.

* * * * *

7. Test Procedure Waivers

To the extent that the procedures contained in this appendix do not provide a means for determining the energy consumption of a freezer, a manufacturer must obtain a waiver under 10 CFR 430.27 to establish an acceptable test procedure for each such product. Such instances could, for example, include situations where the test set-up for a particular freezer basic model is not clearly defined by the provisions of section 2. For details regarding the criteria and procedures for obtaining a waiver, please refer to 10 CFR 430.27.

9. In § 430.62, revise paragraph (a)(4)(xii) to read as follows:

§ 430.62 Submission of data.

(a) * * *

(4) * * *

(xii) Refrigerators, refrigerator-freezers, and freezers, the annual energy use in kWh/yr, total adjusted volume in ft^3, whether the product has variable defrost control (in which case, manufacturers must also report the values, if any, of CT_L and CT_M (see for example Appendix A section 5.2.1.3) used in the calculation of energy consumption), whether the product has variable anti-sweat heater control, and 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.

* * * * *

[FR Doc. 2010–11957 Filed 5–25–10; 8:45 am]

BILLING CODE 6450–01–P