## 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:** Final rule, Interim final rule.

**SUMMARY:** On May 27, 2010, the U.S. Department of Energy (DOE) issued a notice of proposed rulemaking (NOPR) to amend the test procedures for refrigerators, refrigerator-freezers, and freezers. That proposed rulemaking serves as the basis for today's action. DOE is issuing a final rule regarding Appendix A1 and Appendix B1, and an interim final rule for Appendix A and Appendix B. The final rule amends the current procedures, incorporating changes that will take effect 30 days after the final rule publication date. These changes will be mandatory for product testing to demonstrate compliance with the current energy standards and for representations starting 180 days after publication. These changes, which will not affect measured energy use, include test procedures to account for refrigerator-freezers equipped with variable anti-sweat heater controls, establishing test procedures for refrigerator-freezers equipped with more than two compartments, making minor adjustments to eliminate any potential ambiguity regarding how to conduct tests, and clarifying certain reporting requirements. The interim final rule establishes 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 and will apply to newly manufactured products starting in 2014. Today's action also discusses the treatment of combination wine storage-freezer products that were the subject of a recent test procedure waiver, energy use measurement round-off, and additional topics raised by stakeholders during the rulemaking's comment period.

While the amended test procedures will 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. These measurements will provide a more comprehensive accounting of energy usage by these products. The amended test procedure will modify the long-time automatic defrost test procedure to capture all energy use associated with the defrost cycle, establish a test procedure for products with a single compressor and multiple evaporators with active defrost cycles, incorporate into the energy use metric the energy use associated with icemaking for products with automatic icemakers, and clarify requirements on temperature control settings during testing.

**DATES:** The amendments to §§ 430.2, 430.3, 430.23 and Appendix A1 and Appendix B1 (the final rule) are effective January 18, 2011. The additions of Appendix A and Appendix B (the interim rule) are effective April 15, 2011.

The final rule changes will be mandatory for product testing starting June 14, 2011. Comments on the interim final rule are due February 14, 2011.

The incorporation by reference of ANSI/AHAM HRF–1–1979, ("HRF–1–1979"), (Revision of ANSI B38.1–1970), 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, in the final rule is approved by the Director of the Office of the Federal Register as of January 18, 2011.

The incorporation by reference of AHAM Standard HRF–1–2008 ("HRF–1–2008"), Association of Home Appliance Manufacturers, Energy and Internal Volume of Refrigerating Appliances (2008), including Errata to Energy and Internal Volume of Refrigerating Appliances, Correction Sheet issued November 17, 2009, IBR approved for Appendices A and B to Subpart B, in the interim rule is approved by the Director of the Office of the Federal Register as of April 15, 2011.

**ADDRESSES:** The public may review copies of all materials related to this rulemaking at the U.S. Department of Energy, Resource Room of the Building Technologies Program, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC, (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 regarding visiting the Resource Room.

**FOR FURTHER INFORMATION CONTACT:** Mr. Subid Wagley, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121, 202–287–1414, e-mail: *Subid.Wagley@ee.doe.gov* or Mr. Michael Kido, U.S. Department of Energy, Office of the General Counsel, GC–71, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 586–8145. E-mail: *Michael.Kido@hq.doe.gov*.

**SUPPLEMENTARY INFORMATION:** This final rule and interim final rule incorporate by reference into part 430 the following industry standards:

(1) ANSI/AHAM HRF–1–1979, (Revision of ANSI B38.1–1970), ("HRF–1–1979"), *American National Standard, Household Refrigerators, Combination Refrigerator-Freezers and Household Freezers,* approved May 17, 1979;

(2) AHAM Standard HRF–1–2008, ("HRF–1–2008"), Association of Home Appliance Manufacturers, Energy and Internal Volume of Refrigerating Appliances (2008), including Errata to Energy and Internal Volume of Refrigerating Appliances, Correction Sheet issued November 17, 2009.

You can purchase copies of AHAM standards from the Association of Home Appliance Manufacturers, 1111 19th Street, NW., Suite 402, Washington, DC 20036, 202–872–5955, or *http://www.aham.org.*

You can also view copies of these standards at the U.S. Department of Energy, Resource Room of the Building Technologies Program, 950 L'Enfant Plaza, SW., 6th Floor, Washington, DC 20024, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays.

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## I. Background and Authority

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

By way of background, the National Appliance Energy Conservation Act of 1987 (NAECA), Public Law 100–12, amended EPCA by including, among other things, performance standards for 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)). To comply with this requirement, DOE began a new rulemaking to examine the potential adoption of new energy conservation standards for these products. 75 FR 59470 (Sept. 27, 2010) (hereafter, "standards NOPR"). On September 18, 2008, DOE issued 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 AHAM Standard HRF–1–2008, ("HRF–1–2008"), Association of Home Appliance Manufacturers, Energy and Internal Volume of Refrigerating Appliances (2008), including Errata to Energy and Internal Volume of Refrigerating Appliances, Correction Sheet issued November 17, 2009; (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) DOE initiated this test procedure rulemaking in part to address these issues, and published a notice of proposed rulemaking on May 27, 2010, hereafter referred to as "the NOPR." 75 FR 29824.

In response to issue (3) mentioned above as applied to automatic icemakers, DOE separately published a guidance document addressing 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)).

### General Test Procedure Rulemaking Process

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

In 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. (42 U.S.C. 6293(b)(2)). When considering amending a test procedure, DOE must determine "to what extent, if any, the proposed test procedure would alter the * * * measured energy use * * * 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 energy use of a covered product, DOE must also amend the applicable energy conservation standard accordingly. (42 U.S.C. 6293(e)(2)).

With respect to today's rulemaking, DOE has determined that five of the amendments it is adopting (compartment temperature changes (described in section III.E.4), volume calculation method changes (described in section III.E.5), amendments to capture precooling and partial recovery energy use (described in section III.E.1), amendments in the test procedures for special compartments using heat addition to control temperature (described in section III.D.5), and new test procedures that address products with a single compressor with multiple evaporators with active defrost cycles (described in section III.E.2)) will change the measured energy use of refrigeration products when compared to the current test procedure. In such situations, EPCA requires a standards rulemaking to address such changes in measured energy efficiency. (42 U.S.C. 6293(e)(2)). DOE is considering the impacts of these changes as part of its standards rulemaking for refrigeration products, noted above.

Today's rule also fulfills DOE's obligation to periodically review its test procedures under 42 U.S.C. 6293(b)(1)(A). DOE anticipates that its next evaluation of this test procedure will occur in a manner consistent with the timeline set out in this provision.

*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), dual-compressor refrigerator-freezers, and freezers equipped with "quick-freeze" (a manually-initiated feature that bypasses the thermostat and runs the compressor continuously until terminated). 54 FR 36238. DOE 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 or variable 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 11 waivers, which fall into two broad groupings. First, on April 24, 2007, DOE granted a waiver to Liebherr Hausgeräte (Liebherr waiver), permitting testing of 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 temperature prescribed for fresh food compartments of refrigerators and refrigerator-freezers. 72 FR 20333, 20334.

Second, DOE has granted 10 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 variable anti-sweat 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. The full set of such waivers is summarized in Table I.1 below.

TABLE I.1—VARIABLE ANTI-SWEAT HEATER CONTROL WAIVERS

| Manufacturer | Waiver status | Case No. | Date | Federal Register citation |
|---|---|---|---|---|
| GE | Granted | RF–007 | 2/27/2008 | 73 FR 10425 |
| Whirlpool | Granted | RF–008 | 5/5/2009 | 74 FR 20695 |
| Electrolux | Granted | RF–009 | 12/15/2009 | 74 FR 66338 |
| Electrolux | Granted | RF–010 | 3/11/2010 | 75 FR 11530 |
| Samsung | Granted | RF–011 | 3/18/2010 | 75 FR 13120 |
| Electrolux | Granted | RF–012 | 4/29/2010 | 75 FR 22584 |
| Haier | Granted | RF–013 | 6/7/2010 | 75 FR 32175 |
| Samsung | Granted | RF–014 | 8/3/2010 | 75 FR 45623 |
| GE | Granted | RF–015 | 8/19/2010 | 75 FR 51262 |
| LG | Granted | RF–016 | 8/19/2010 | 75 FR 51264 |

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). This rulemaking addresses this requirement. Once today's final 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 August 31, 1989, final rule mentioned above established test procedures for freezers with variable defrost control and freezers with the quick-freeze feature. 54 FR 36238. The test procedures were amended on September 20, 1989, to correct the effective date published in the August 31, 1989 rule. 54 FR 38788. The current 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.

*Current Refrigeration Product Test Procedure Rulemaking*

The NOPR for this rulemaking was published on May 27, 2010. 75 FR 29824. The public meeting was held June 22, 2010. At the meeting, DOE discussed the NOPR, detailed the proposed revisions, and solicited oral comments from meeting participants. Numerous stakeholders attended the meeting and/or provided written comments. These parties are identified in Table I.2 below.

TABLE I.2—STAKEHOLDERS THAT SUBMITTED ORAL OR WRITTEN COMMENTS

| Name | Acronym | Type* | Oral comments | Written comments |
| --- | --- | --- | --- | --- |
| AcuTemp/ThermoCor | ThermoCor | CS | | ✔ |
| American Council for an Energy Efficient Economy | ACEEE | EA | ✔ | ✔ |
| Association of Home Appliance Manufacturers | AHAM | IR | ✔ | ✔ |
| California Investor-Owned Utilities | IOUs | U | | ✔ |
| Earthjustice | Earthjustice | EA | ✔ | ✔ |
| Electrolux Major Appliances North America | Electrolux | M | ✔ | ✔ |
| Energy Solutions for California Investor-Owned Utilities | IOUs | U | ✔ | |
| Fisher & Paykel Appliances Ltd | Fisher & Paykel | M | | ✔ |
| General Electric Consumer and Industrial | GE | M | ✔ | ✔ |
| NanoPore Insulation, LLC | NanoPore | CS | | ✔ |
| National Institute of Standards and Technology | NIST | TE | ✔ | |
| Natural Resources Defense Council | NRDC | EA | ✔ | ✔ |
| People's Republic of China WTO/TBT National Notification & Enquiry Center. | PRC | FG | | ✔ |
| Sanyo E&E Corporation | Sanyo | M | ✔ | |
| Sub Zero-Wolf, Inc | Sub Zero | M | ✔ | ✔ |
| Whirlpool Corporation | Whirlpool | M | ✔ | ✔ |
| Penfield Appliances | Penfield | I | .................... | ✔ |

* IR: Industry Representative; M: Manufacturer; EA: Efficiency/Environmental Advocate; CS: Component Supplier: TE: Technical Expert: I: Individual; U: Utility; FG: Foreign Government Agency.

## II. Summary of the Final Rule and Interim Final Rule

The final rule amends the current DOE test procedures for refrigeration products. These changes will not affect measured energy use of these products. Instead they will primarily clarify the manner in which to test for compliance with the current energy conservation standards. As indicated in greater detail below, these amendments apply to the current procedures in Appendices A1 and B1, to the definitions set forth in 10 CFR 430.2, to the current procedures in 10 CFR 430.23. These minor amendments will eliminate any potential ambiguity contained in these sections of the test procedures and clarify the 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. The current procedures are also being amended to help account for, among other things, the various waivers granted by DOE. The final rule also makes a minor change to the text of 10 CFR 430.32(a) in order to ensure consistency with the test procedure amendments.

The interim final rule establishes comprehensive changes to the manner in which the procedures are conducted by creating new Appendices A and B. These appendices include the modifications being adopted today as part of the modified Appendices A1 and B1 prescribed in this regulation. The procedures contained in the new Appendices A and B apply only to those products that would be covered by any new standard that DOE promulgates and are organized separately from the current test procedures found in Appendices A1 and B1. DOE will retain current Appendices A1 and B1 for this interim final rulemaking to cover products manufactured before any new standards DOE is currently considering would need to be met. However, once manufacturers are required to comply with any new standards, those appendices will be replaced by Appendices A and B, respectively.

The final rule amendments discussed in this notice will take effect 30 days after publication of this final rule. However, manufacturers do not need to use the new versions of Appendices A1 and B1 for testing to verify compliance with the energy standards until 180 days from the final rule's publication. The interim final rule will take effect 120 days after date of publication of this final rule. Manufacturers will not need to use the new Appendices A and B until the compliance date for the 2014 standards that DOE is considering. The date of compliance with those new standards 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)). In order to ensure that new Appendices A and B adequately address the new energy standards currently under development, DOE is issuing these appendices on an interim final basis and offering an additional 60 day comment period.

The revised Appendices A1 and B1 achieve three primary goals. First, they address certain issues raised throughout the standards rulemaking. Second, they incorporate test procedures for refrigerator-freezers with variable anti-sweat heater controls that were the subject of test procedure waivers and interim waivers granted to GE and other manufacturers. Finally, the amendments clarify the test procedures for addressing special compartments and those refrigeration products that are equipped with more than one fresh food compartment or more than one freezer compartment.

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. None of these changes is expected to result in any change in measured energy efficiency or energy use of refrigeration products.

The additional test procedure revisions in the new Appendices A and B would (1) include new compartment temperatures and volume adjustment factors,[1] (2) include new methods for measuring compartment volumes, (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) establish test procedures for products with a single compressor and multiple evaporators with active defrost cycles. The first two of these amendments will improve harmonization with relevant international standards and assure test repeatability. The compartment temperature changes will significantly impact the energy use measured by the test for refrigerators and refrigerator-freezers. The temperature changes will 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. The new volume calculation method will affect the calculation for compartment volumes and adjusted volume for all refrigeration products. Since the standards for refrigeration products are expressed as equations that specify maximum energy use as a function of adjusted volume, the modifications impact the allowable energy use for all of these products. The changes also affect the energy factor, which is equal to adjusted volume divided by daily energy consumption.

The final rule also discusses the combination wine storage-freezer products that were the subject of the Liebherr waiver. DOE expects to propose modified product definitions to include coverage of wine storage products in a separate future rulemaking. This final rule treats wine coolers and other hybrid products that combine wine storage compartments with freezer or fresh food compartments in a consistent manner, by modifying the definition of electric refrigerator-freezer to require compartment temperatures in the fresh food compartment that effectively exclude combination wine storage-freezer products from coverage.

Lastly, the interim final rule also addresses the measurement of icemaking energy use. This measurement adds a fixed value to account for the energy used to produce ice in refrigeration products that are equipped with automatic icemakers. However, DOE intends to support development in 2011 of a test procedure for measurement of icemaker energy use and to initiate in 2012 a test procedure rulemaking to incorporate the new measurement into the refrigeration product test procedure. The icemaker energy use addition, which is included only in the new Appendices A and B, will improve the consistency of the measurement with the representative use cycle for such products.

## III. Discussion

Table III.1 below summarizes the subsections of this section and indicates where the amendments would appear in the CFR. Seven of the subsections address changes in the CFR other than in appendices A1, B1, A, or B, and six of the subsections have no test procedure changes associated with them. Section E addresses the amendments that are part of the interim final rule. In addition, two of the interim final rule amendments are addressed in parts of section III.D (in sections III.D.2 and III.D.5). The remaining sections address the amendments that are part of the final rule.

TABLE III.1—SECTION III SUBSECTIONS

| Section | Title | Affected CFR sections | Appendices | | | |
|---|---|---|---|---|---|---|
| | | | A1 | B1 | A | B |
| A | Products Covered by the Proposed Revisions. | 430.2 | NA | | | |
| B | Combination Wine Storage-Freezer Units | 430.2 | NA | | | |
| C | Establishing New Appendices A and B, and Compliance Dates for the Amended Test Procedures. | Subpt. B | ✔ | ✔ | ✔ | ✔ |
| D.1 | Procedures for Test Sample Preparation | 430.23, Subpt. B | ✔ | ✔ | ✔ | ✔ |
| D.2 | Product Clearance Distances to Walls During Testing. | Subpt. B | ✔ | ✔ | ✔ | ✔ |
| D.3 | Alternative Compartment Temperature Sensor Locations. | New pt. 429*, Subpt. B | ✔ | ✔ | ✔ | ✔ |
| D.4 | Median Temperature Settings for Electronic Control Products and Establishment of Dual Standardized Temperatures. | Subpt. B | ✔ | ✔ | ✔ | ✔ |
| D.5 | Test Procedures for Convertible Compartments and Special Compartments. | Subpt. B | ✔ | ✔ | ✔ | ✔ |
| D.6 | Establishing a Temperature-Averaging Procedure for Auxiliary Compartments. | Subpt. B | ✔ | ✔ | ✔ | ✔ |

[1] Volume adjustment factors are used in calculation of the adjusted volume, which is the basis for the energy conservation standard equations for refrigeration products.

TABLE III.1—SECTION III SUBSECTIONS—Continued

| Section | Title | Affected CFR sections | Appendices | | | |
|---|---|---|---|---|---|---|
| | | | A1 | B1 | A | B |
| D.7 | Modified Definition for Anti-Sweat Heater | Subpt. B | ✔ | ✔ | ✔ | ✔ |
| D.8 | Applying the Anti-Sweat Heater Switch Averaging Credit to Energy Use Calculations. | 430.23 | NA | | | |
| D.9 | Incorporation of Test Procedures for Products with Variable Anti-Sweat Heating Control Waivers. | Subpt. B | ✔ | ✔ | ✔ | ✔ |
| D.10 | Elimination of Part 3 of the Variable Defrost Test. | Subpt. B | ✔ | ✔ | ✔ | ✔ |
| D.11 | Simplification of Energy Use Equation for Products with Variable Defrost Control. | Subpt. B | ✔ | ✔ | ✔ | ✔ |
| | Energy Testing and Energy Use Equation for Products with Dual Automatic Defrost. | Subpt. B | ✔ | | ✔ | |
| | Freezer Variable Defrost | Subpt. B | | ✔ | | ✔ |
| D.12 | Including in Certification Reports Basic Information Clarifying Energy Measurements. | New pt. 429* | NA | | | |
| D.13 | Rounding Off Energy Test Results | 430.23, 430.32(a) | NA | | | |
| E.1 | Modification of Long-Time and Variable Defrost Test Method to Capture Precooling and Temperature-Recovery Energy. | Subpt. B | | | ✔ | ✔ |
| E.2 | Establishing Test Procedures for Multiple Defrost Cycle Types. | Subpt. B | | | ✔ | |
| E.3 | Incorporating by Reference AHAM Standard HRF–1–2008 for Measuring Energy and Internal Volume of Refrigerating Appliances. | Subpt. B | | | ✔ | ✔ |
| E.4 | Establishing New Compartment Temperatures. | Subpt. B | | | ✔ | ✔ |
| E.5 | Establishing New Volume Calculation Method. | Subpt. B | | | ✔ | ✔ |
| E.6 | Control Settings for Refrigerators and Refrigerator-Freezers During Testing. | Subpt. B | | | ✔ | ✔ |
| E.7 | Icemakers and Icemaking | Subpt. B | | | ✔ | ✔ |
| F.1 | Electric Heaters | No changes to the regulatory language are associated with these sections of the Final Rule | | | | |
| F.2 | Vacuum Insulation Panel Performance | | | | | |
| F.3 | Metric Units | | | | | |
| G.1 | Test Burden | | | | | |
| G.2 | Potential Amendments to Include Standby and Off Mode Energy Consumption. | | | | | |
| G.3 | Addressing Changes in Measured Energy Use. | | | | | |

*See the Certification, Compliance, and Enforcement (CCE) NOPR, 75 FR 56796 (September 16, 2010). The changes discussed in section III.D.12 are discussed here but not included in this final rule—they will instead be implemented in the CCE rulemaking.

*A. Products Covered by the Proposed Revisions*

The NOPR solicited comments regarding certain definitions related to refrigeration products. In particular, DOE sought comment regarding a proposed modification to the electric refrigerator-freezer definition that would clarify that the fresh food compartments of these products are designed for the refrigerated storage of food at temperatures above 32 °F and below 39 °F. DOE proposed this change to address the coverage of combination wine storage-freezer products (i.e. to exclude them from coverage as electric refrigerator-freezers), and to improve consistency with the current definition for electric refrigerators. 75 FR 29828–29829.

Additionally, while DOE did not propose specific changes to the electric refrigerator definition, the agency solicited comments on possible improvements to enhance the definition's clarity. Most of these comments addressed concerns about the 32 °F to 39 °F temperature range, already part of the electric refrigerator definition, that DOE proposed in the NOPR to apply also to the electric refrigerator-freezer definition. These comments, applicable to both definitions, are discussed in section III.B below.

AHAM also recommended that any changes to the definition for "electric refrigerator" and/or "electric refrigerator-freezer" should also be made in the related Federal Trade Commission (FTC) Energy Guide labeling rules in order to ensure consistency across all government agencies. (AHAM, No. 16.1 at p. 4) DOE notes that to achieve consistency, the FTC would need to update the definitions of "electric refrigerator" and "electric refrigerator-freezer" in 16 CFR part 305.2. DOE will work with FTC to ensure that consistency is maintained between the two sets of regulations.

With respect to freezers, 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. DOE did not propose altering this definition.

Earthjustice commented that all products that can store frozen food should be covered as freezers, even if they cannot maintain temperature as low as 0 °F. The comment pointed to walk-in freezers as an example, which are statutorily defined as commercial equipment that maintain a temperature at or below 32 °F. (Earthjustice, No. 22.1 at p. 2) See EISA 2007, sec. 312(a)(3) (codified at 42 U.S.C. 6311(20)) and 10 CFR 431.302. DOE could define freezers in a similar manner, and may consider doing so in a future rulemaking. However, several reasons militate against such an approach at this time.

Although Earthjustice raised the possibility that refrigeration products with compartment temperatures between 0 °F and 32 °F are being sold as freezers, they provided no information regarding how prevalent such sales might be, which would provide justification for immediate action. DOE is reluctant to apply the current energy standards for freezers to products that provide substandard performance because they do not achieve the temperatures specified for freezers. Instead, DOE would consider establishing standards with lower maximum energy levels for new freezer product classes that provide warmer freezing temperatures. However, such an approach would require developing appropriate product class definitions, as well as producing an analysis supporting the selection of appropriate energy standards. In order to properly examine Earthjustice's proposed approach, DOE believes that a separate rulemaking would be the appropriate means of addressing this issue and would provide all interested parties with a sufficient opportunity for comment. Such a process is not in the scope of the current test procedure rulemaking or within the applicable timeframe, but DOE may consider Earthjustice's approach when it re-examines this procedure. DOE also notes that creating such product classes and accompanying standards would create potential conflicts with the Joint Comment's proposed levels that DOE is currently considering as part of its separate standards rulemaking. (See Joint Comment, No. 20.1 at p. 2).

*B. Combination Wine Storage-Freezer Units*

In its November 19, 2001, final rule, DOE amended its definition of electric refrigerators to exclude wine storage products. 66 FR 57845. DOE modified the definition to exclude products that do not maintain internal temperatures below 39 °F to clarify that wine coolers are not covered by DOE's standards for refrigerators. 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." *Id.* at 57846. The final rule also noted the small number of sales of these products and the likely absence of any significant impact from this approach. *Id.*

When this change occurred, wine storage-freezer appliances were unavailable as a consumer product. Subsequently, when Liebherr Hausgeräte (Liebherr) introduced a line of wine storage-freezer appliances in 2005, containing both freezer and wine storage compartments, they could not be accurately categorized by any of the current DOE product classes. Because of this gap, Liebherr petitioned the agency for a test procedure waiver to address this product, which DOE granted on April 24, 2007 (Liebherr waiver). 72 FR 20333. The waiver specified that testing shall be conducted following the test procedure for refrigerator-freezers, except that the standard temperature for the wine-storage compartment shall be 55 °F. *Id.* at 20334.

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 appliances. Consequently, in the NOPR, DOE proposed modifying the definition of refrigerator-freezer to exclude products which combine a freezer and a wine storage compartment. 75 FR 29829. The proposed definition invoked the same clause used in the refrigerator definition, "designed for the refrigerated storage of food at temperatures above 32 °F and below 39 °F", which would be applied to any fresh food compartments of refrigerator-freezers. *Id.*

AHAM, NRDC, Sub-Zero and Whirlpool all agreed with the principle of excluding such products from the refrigerator-freezer definition (AHAM, No. 16.1 at p. 10; NRDC No. 21.1 at p. 5; Sub-Zero, Public Meeting Transcript, No. 10 at p. 32; Whirlpool No. 12.1 at p. 6). However, ACEEE, AHAM, Sub-Zero, and Whirlpool all opposed the wording of the temperature range clause, commenting that this change appears to exclude all products that have the capability of temperatures warmer than 39 °F in the fresh food compartment. In their view, this exclusion would be inappropriate. (ACEEE, No. 19.1 at p.1; AHAM, No. 16.1 at p. 4; AHAM, Public Meeting Transcript, No. 10 at p. 24; Whirlpool, Public Meeting Transcript, No. 10 at p. 27–28; Sub-Zero, Public Meeting Transcript, No. 10 at p. 32; Whirlpool, No. 12.1 at p. 1) Whirlpool suggested that the definition impose a 39 °F maximum when the controls are set in the coldest position. (Whirlpool, No. 10 at pp. 27–28; Whirlpool, No. 12.1 at p. 1)

As mentioned above, the clause, "designed for the refrigerated storage of food at temperatures above 32 °F and below 39 °F" was added to the electric refrigerator definition in 2001 to clarify that wine storage products are not refrigerators, since wine storage products are designed for warmer temperatures, and generally cannot achieve temperatures below 39 °F with temperature controls set in their coldest positions. 66 FR 57845.

DOE does not intend to exclude from coverage those refrigeration products that are capable of controlling fresh food compartments at temperatures cooler than 39 °F at cold settings and warmer than 39 °F at warm settings, including those currently available on the market characterized as wine storage products. In response to these comments and to prevent the inadvertent exclusion of products, DOE is adjusting the definitions of both "electric refrigerator" and "electric refrigerator-freezer" to clarify that temperature control above 39 °F is not a basis for exclusion from the definition. DOE will replace the temperature-range clause highlighted by stakeholders with "designed to be capable of achieving storage temperatures above 32 °F and below 39 °F". The words "designed to be capable" are intended to clarify that (1) the product can achieve temperatures below 39 °F, but that temperatures above 39 °F do not disqualify it from the definition, and (2) that a poorly constructed product that happens to be incapable of actually achieving the 39 °F is not excluded from coverage. Also, the specification of "storage temperatures" clarifies that the storage areas of the product are subject to the 39 °F temperature requirement, rather than, for example, the evaporator, which may be somewhat colder during compressor operation. The storage temperature is distinct from "compartment temperature", which has a specific meaning as described in 10 CFR part 430, subpart B, appendix A1, section 5.1.2. In particular, storage temperature is not subject to the requirements for averaging of temperature sensors within the compartment. DOE further notes that the definition does not specify the ambient conditions for which the storage temperature range applies. Hence, a product that achieves the storage temperature range in a 70 °F ambient but not during a 90 °F energy test is not excluded from coverage.

Stakeholders also raised a related issue. AHAM asked if DOE had a proposal addressing combination wine storage-refrigerators, which Sanyo confirmed as having already been commercialized. (AHAM, Public Meeting Transcript, No. 10 at pp. 30–31; Sanyo, Public Meeting Transcript, No. 10 at pp. 33–34) DOE had been unaware of such products and had not developed a proposal to address them. In light of potential coverage concerns, DOE is treating these combination products as covered products. DOE is concerned that removing such combination products from coverage could create a potentially significant gap within its regulatory program that could, in turn, undermine the Department's efforts to improve the energy efficiency of consumer appliances. Manufacturers of products that cannot meet the required testing conditions prescribed by today's rule would, as currently required, need to avail themselves of the waiver regulations in 10 CFR 430.27. DOE intends, however, to address such wine storage-refrigeration combination products further in a separate rulemaking.

In light of these comments and concerns, DOE has modified its "electric refrigerator" definition to read as follows:

*Electric refrigerator* means a cabinet designed for the refrigerated storage of food, designed to be capable of achieving storage temperatures above 32 °F (0 °C) and below 39 °F (3.9 °C), 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 (0 °C), but does not provide a separate low temperature compartment designed for the freezing and storage of food at temperatures below 8 °F (−13.3 °C).

DOE is also modifying its definition for "electric refrigerator-freezer" in a similar fashion to read 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 and designed to be capable of achieving storage temperatures above 32 °F (0 °C) and below 39 °F (3.9 °C), and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8 °F (−13.3 °C) which may be adjusted by the user to a temperature of 0 °F (−17.8 °C) or below. The source of refrigeration requires single phase, alternating current electric energy input only.

These definitions exclude products with wine storage or other compartments that cannot attain temperatures suitable for fresh food storage.

The Liebherr waiver will terminate on the effective date of this final rule, as indicated in the waiver. 72 FR 20333 (April 24, 2007). To the extent that the products covered by this waiver do not meet the definition of electric refrigerator and electric refrigerator-freezer, DOE plans to address these wine storage and related refrigeration products in a separate rulemaking.

Finally, the Department clarifies that this final rule excludes most wine storage products because they are designed to be incapable of attaining temperatures suitable for fresh food storage (i.e., those temperatures below 39 °F) and not because they store beverages rather than solid food. Although EPCA does not define the term "food," a number of other federal statutes define "food" to include beverages. *See* 21 U.S.C. 321(f) (defining "food" in the Federal Food, Drug, and Cosmetic Act to include "articles used for food or drink for man or other animals"; 15 U.S.C. 55(b) (using same definition in the false advertising context); 42 U.S.C. 1791(b)(4) (defining "food" in the Bill Emerson Good Samaritan Food Donation Act as "any raw, cooked, processed, or prepared edible substance, ice, beverage, or ingredient used or intended for use in whole or in part for human consumption.") DOE believes that including beverages—such as milk, juice, wine and beer—within the meaning of the term "food" is likewise appropriate in the context of defining refrigeration products for purposes of the Federal energy conservation standards. Thus, those beverage storage products, including wine chillers, beer refrigerators, or other beverage refrigeration products, that are designed to be capable operating with storage temperatures below 39 °F 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 part 430.

### *C. Establishing New Appendices A and B, and Compliance Dates for the Amended Test Procedures*

DOE proposed to establish new Appendices A and B. In addition, DOE has now separated the amendments into two sets. The first set consists of amendments that must be in effect before the compliance date for the 2014 residential refrigeration products energy conservation standards. The second set consists of amendments that must go into effect starting on the compliance date for the 2014 standards. The majority of the first set of amendments will be implemented as part of the currently existing Appendices A1 and B1. (The remaining amendments in the first set include changes to other related sections of the CFR, such as 10 CFR 430.2 and 430.23.) The second set of amendments appears only in new Appendices A and B and constitutes the interim final rule of this notice. These new appendices will include all of the amendments implemented in Appendices A1 and B1.

As indicated earlier, while the effective date for the final rule amendments is 30 days after the publication of this final rule in the **Federal Register**, only the amendments to Appendices A1 and B1 and to 10 CFR 430.2 and 430.23 have an immediate impact on manufacturers. For purposes of representations, under 42 U.S.C. 6293(c)(2), effective 180 days after DOE amends a test procedure, manufacturers cannot make representations regarding energy use and efficiency unless the product was tested in accordance with the amended 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)) For the purposes of this final rule, DOE interprets the date of amendment to be coincident with the date of publication of the final rule.

Manufacturers will need to use new Appendices A and B once they are required to comply with the amended energy conservation standards. Likewise, Appendices A and B will be mandatory for representations regarding energy use or operating cost of these products once manufacturers must comply with the new energy conservation standards.

Under EPCA, DOE must determine by December 31, 2010, whether to amend energy conservation standards that would apply to refrigeration products manufactured in 2014. DOE has proposed amending its energy conservation standards for these products, as required by 42 U.S.C. 6293(e)(2). 75 FR 59470. The amended test procedures of Appendices A and B will be used in analyzing and finalizing the proposed standards.

DOE received no comments opposing the approach of using the proposed new Appendices A and B to organize the staging of implementation of test procedure amendments. Therefore, the establishment of the new appendices remains as proposed in the NOPR. However, the effective date for the new appendices has been delayed 90 days to allow time for the comment period associated with the interim final rule.

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

This section primarily addresses amendments that manufacturers must use prior to the compliance date for the new energy conservation standards. As described above, these amendments become effective in 30 days and will be required for certifying compliance with the current energy conservation standards and for representation purposes for products sold starting in 180 days. As described for each of the subsections, these amendments are made in 10 CFR 430.23. 10 CFR 430.32(a), and to the appropriate sections of Appendices A1 and B1. These amendments also appear in the new Appendices A and B.

Two of the amendments discussed in this section are made only in Appendices A and B. These amendments are included in sections III.D.2 and III.D.5 because they fall under the general topics of these subsections, which also address amendments made in Appendices A1 and B1.

DOE invited comment on whether any of the proposed amendments would affect measured energy use and asked commenters to quantify any potential impacts. AHAM identified four proposed amendments that would have a significant impact on measured energy use: (1) The test method for products with variable anti-sweat heaters; (2) the test procedures for convertible and special compartments; (3) the modified test procedure for products with long-time or variable defrost to capture precooling energy use; and (4) the proposed changes addressing multiple defrost cycle types. (AHAM, No. 16.1 at p. 3). The PRC indicated that measured energy use would be increased by: (1) The proposed test procedures addressing products with variable anti-sweat heaters and (2) modification of test procedures for products with long-time or variable defrost to capture precooling energy use. (PRC, No. 15.1 at p. 4) Whirlpool commented that a number of the amendments proposed to take effect prior to the new energy conservation standards would have a significant impact on measured energy use, manufacturer cost, facilities, testing capability, lead time, or combination thereof and requested that they not take effect prior to January 1, 2014: (1) Revision of the refrigerator definition; (2) test procedures for convertible and special compartments; (3) test procedures for products with variable anti-sweat heating; (4) modification of the test procedure for long-time or variable defrost to capture precooling energy; (5) procedures for products with multiple defrost cycle types; (6) clarification of instructions regarding the presence of ice in the ice bin during testing; and (7) disallowing energy use ratings for products that fail to meet standardized temperatures. (Whirlpool, No. 12.1 at p. 2)

DOE obtained clarification from Whirlpool that all of the above-cited proposals would affect measured energy use. Whirlpool also clarified how two of these proposed amendments affect measured energy use. The proposed refrigerator definition change would, in Whirlpool's view, make it impossible to set fresh food compartments at temperatures above 39 °F during testing, as compared with current testing with temperatures bracketing the 45 °F standardized temperature because the reduced compartment temperature would result in higher thermal load and energy use. Whirlpool also asserted that the proposed test procedure clarification that ice should not be in the ice bin during testing would change the measurement for manufacturers that currently test with the ice bins filled. (Whirlpool provided no evidence that any manufacturer tests in this fashion). (Clarification of Written Comments Submitted by Whirlpool Corporation, No. 35 at p. 1) The available information indicates otherwise—that all manufacturers test products without ice in the bins, due to AHAM support of the CSA Informs Bulletin of August 24, 2009, which discusses "mechanically simulating an ice-bin-full condition that produces identical results to testing with a full bin of ice" (AHAM Preliminary Proposal for Refrigerator-Freezer Verification Program, No. 30 at p. 4). NRDC filed comments asking that the procedures be effective as soon as is practical but offered no information regarding the potential measured energy use impacts of the proposed amendments. (NRDC, No. 21.1 at p. 2)

No commenter quantified the energy measurement impacts of the proposed amendments cited as having an impact on measurements. Consequently, DOE has no data or other factual information—other than what it developed on its own—with which to analyze the possible impacts flowing from its proposed amendments. Nevertheless, DOE gave careful consideration to these comments and made several modifications to its proposals to address the concerns raised by individual commenters. These modifications are described in detail in the sections that follow.

1. Procedures for Test Sample Preparation

To make the current procedure more clear, the NOPR proposed changing the manner in which samples are prepared for testing. Specifically, DOE proposed the following:

• Removing the text "as nearly as practicable" from the current set-up instructions that require testing set up to be in accordance with the printed instructions supplied with the cabinet, and adding specific deviations from this requirement for test repeatability and flexibility. This change was proposed for section 2 of Appendices A1, B1, A, and B in lieu of the current test procedure's reference to HRF–1–1979. 75 FR 29830.

• Adding "anti-circumvention" language in 10 CFR 430.23(a) and (b). *Id.*

• Requiring manufacturers to seek a waiver in those cases where (1) the prescribed test procedures do not yield measurements that would be representative of the product's energy use during normal consumer use, or (2) the set-up instructions are unclear. These requirements were proposed to be codified by portions of the proposed text described in the first two bullets above (in section 2 of Appendices A1, B1, A, and B, and in 10 CFR 430.23(a) and (b)), and by a new section 7 of Appendices A1, B1, A, and B. *Id.*

As part of the changes described in the first bullet above, the NOPR proposed to add specific deviations from the installation instructions supplied with the product:

(a) Not requiring the connection of water lines and installation of water filters during testing;

(b) Requiring clearance requirements from product surfaces to be consistent with those described elsewhere in the test procedure;

(c) Requiring the use of an electric power supply as described in HRF–1–2008, section 5.5.1;

(d) Applying the temperature control settings for testing as described in section 3 of Appendix A1, B1, A, or B but requiring the settings for convertible compartments and other temperature-controllable or special compartments to be those settings that are described elsewhere in the test procedure; and

(e) Not requiring the anchoring or securing of a product to prevent tipping during energy testing.

*Id.*

DOE sought comment on these proposals and specifically asked for suggestions regarding the need for additional deviations from the installation instructions.

AHAM and Whirlpool supported removing the words "as nearly as practical" from the test sample preparation language. (AHAM, No. 16.1 at p. 4; Whirlpool, No. 12.1 at p. 2). Electrolux commented that any deviations in product set-up should be specified in the owner's manual. (Electrolux, No. 17.2 at p. 1, cell H8). No other suggestions were offered by commenters.

In response to the Electrolux comment, DOE believes that most of the deviations proposed in the NOPR are necessary in order to allow for consistent and repeatable testing. For instance, voltage requirements can play a role in determining the measured energy use of a particular product. Product owner manuals, however, do not specify a voltage range with the tight tolerance specified in HRF–1–1979 section 7.4.1 (within 1% of 115 volts). Instead, they typically allow refrigeration products to operate with electric power sources with a range of voltages near the nominal values. GE's owner's manual for GE Profile Side by Side refrigerators is one such example. The instructions do not specify an allowable voltage range other than that "[t]he refrigerator should always be plugged into its own individual electrical outlet which has a voltage rating that matches the rating plate." (Profile Side by Side Refrigerators, No. 28 at p. 4) The online specifications for one of these products provide only a nominal voltage: "Volts/Hertz/Amps 120v; 60Hz; 15A" (GE ENERGY STAR 25.9 Cu. Ft. Side-by-Side Refrigerator with Dispenser, No. 29 at p. 2) DOE believes that the tight tolerance on the voltage specification specified in HRF–1–1979 is necessary in order to assure repeatable testing. Repeatable testing that yields measurements that can be compared across product lines requires the use of consistent testing conditions, such as the use of an electric supply with a voltage very close to the nominal 115 volts. This is just one example of the need for the specific deviations from manufacturer's instructions proposed in the NOPR. Likewise, many of the other proposed deviations are also necessary to assure test repeatability. DOE believes that some of the other proposed deviations, such as not requiring connection of water lines and waiving instructions to secure the product so that it will not tip, do not affect the energy use measurement. DOE notes that Electrolux did not identify which of the proposed deviations are problematic nor did it explain the reasons for its position. No other stakeholders expressed concern about the deviations. Hence, DOE is adopting these deviations as proposed.

Regarding the "anti-circumvention" language, AHAM and Whirlpool urged DOE to adopt the exact language of HRF–1–2008, as adopted by ENERGY STAR, which does not use the term "average consumer use". (AHAM, No. 16.1 at p. 4; Whirlpool, No. 12.1 at p. 2). AHAM requested that if DOE decides to use the term "average consumer use", DOE should define the term, provide the data upon which the determination is reached, and allow for comment before releasing the final rule. (AHAM, No. 16.1 at pp. 4–5). Electrolux commented that the language would be acceptable if the 70 °F ambient condition is highlighted. (Electrolux, No. 17.2 at p. 1, cell H12).

As discussed in the NOPR, 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 burden. DOE's test procedures are carefully designed and circumscribed in order to attain an overall calculated measurement of average energy consumption during representative use, though certain conditions may not individually appear to be representative of the average use cycle. DOE has held the consistent view that products should not be designed in a way that would cause energy consumption to drop during testing as a result of these apparently unrepresentative conditions. Doing so would result in a biased measurement that would be unrepresentative of average consumer use and would circumvent the total test procedure.

The concept of average consumer use is not intended to represent an annual energy use in kWh to which a measurement according to the test procedure can be compared. Nor is it intended to represent a specific set of conditions for parameters that can affect energy use (including ambient temperature, ambient humidity, door opening patterns, etc.). Instead, deviation of a test procedure measurement from average consumer use must be established based on the specific control features used by a product and consideration of whether the product or any of its components operate in a fundamentally different way during the energy test than they would during representative consumer use. To this end, the NOPR provided an example of a product with anti-sweat heaters that are controlled by a humidity sensor. In a test under the current test procedure, the humidity of the test chamber is uncontrolled. Because the relative humidity level during a test could be at any level between 0% and 100%, it is unlikely that the measured energy use of the anti-sweat heaters under the current test would yield results consistent with their average energy use in a home.

The average consumer use concept is also illustrated in DOE's "Additional Guidance Regarding Application of Current Procedures for Testing Energy Consumption of Refrigerator-Freezers With Automatic Ice Makers". 75 FR 2122 (January 14, 2010). This document provides guidance regarding test set up for icemakers, particularly for refrigerator-freezers with bottom-mounted freezers and through-the-door ice service. In explaining that the icemaker must remain on but not producing ice, DOE noted that "keeping the ice maker and its associated components on, but preventing them from making ice, better represents the average use of a refrigerator-freezer, such as when the machine has a full bin of ice in a consumer's home. Turning off either the ice maker or components associated with the ice maker, by contrast, does not represent the average use of a refrigerator-freezer, and may cause the machine to consume less energy than when the ice maker is on, but not making ice." *Id.* at 2123.

Hence, DOE believes that the concept of average consumer use, as used, for example, in the icemaker treatment guidance described above, is sufficiently understood in the context of the regulatory language. Therefore the phrase has neither been eliminated from the amended language nor specifically defined. The concept is invoked in the proposed passage that requires manufacturers to obtain a waiver if a product operates in a way that makes the test procedure unsuitable for measuring its energy use. The language retains this passage to reinforce EPCA's requirement that the test procedures measure energy use under a representative average use cycle or period of use. 42 U.S.C. 6293(b)(3).

However, DOE has considered comments favoring the adoption of the existing anti-circumvention language in HRF–1–2008, which were based on the collective belief that harmonization of anti-circumventions language will improve compliance. The modified anti-circumvention language that DOE is adopting today retains all of the HRF–1–2008 text and reads as follows:

The following principles of interpretation should be applied to the test procedure. The intent of the energy test procedure is to simulate typical room conditions (approximately 70 °F (21 °C)) with door openings, by testing at 90 °F (32.2 °C) without door openings. Except for operating characteristics that are affected by ambient temperature (for example, compressor percent run time), the unit, when tested under this test procedure, shall operate in a manner equivalent to the unit in typical room conditions. The energy used by the unit shall be calculated when a calculation is provided by the test procedure. Energy consuming components that operate in typical room conditions (including as a result of door openings, or a function of humidity), and that are not exempted by this test procedure, shall operate in an equivalent manner during energy testing under this test procedure, or be accounted for by all calculations as provided for in the test procedure. 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), a manufacturer must obtain a waiver in accordance with the relevant provisions of 10 CFR 430. Examples:

1. Energy saving features that are designed to be activated by a lack of door openings 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 operating 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 test procedure.

This modification includes the specification of 70 °F as typical for room conditions, as requested in the Electrolux comment. (Electrolux, No. 17.2 at p. 1, cell H12). It also includes the proposed requirement that a manufacturer must petition for a waiver when the test procedure cannot be used to measure the energy use of a product.

DOE dropped the proposed text's description of a type of product feature that would make the energy test procedure unsuitable for testing the product: "smoothly varying functions of the operating conditions and the control inputs." AHAM viewed this clause as deficient. (AHAM, Public Meeting Transcript, No. 10 at p. 43). Upon re-examining this example, DOE acknowledges that the control systems that this example attempted to highlight are not necessarily incompatible with the test procedure. One such system is the variable anti-sweat heater control system, which can use on/off control or discrete power input steps rather than a gradual increase in power as humidity increases. An on/off control system is not "smoothly varying", but that does not necessarily mean that the test procedure cannot provide a representative measurement. Accordingly, DOE decided to eliminate this example from the proposed regulatory text.

Regarding the proposed requirement for a manufacturer to obtain a waiver, Whirlpool and AHAM commented that DOE should use an expedited process such as the FAQ process to address variations in setup instead of the complex and lengthy waiver process. (Whirlpool, No. 12.1 at p. 2; AHAM, No. 16.1 at p. 5). Whirlpool also commented that any process used to address exceptions should involve less disclosure of design details than the waiver process. (Whirlpool, No. 12.1 at p. 3).

DOE appreciates the significance of the issues raised by the commenters regarding the waiver process. Separate from this proceeding, DOE has launched a new online database offering guidance on the Department's test procedures for consumer products and commercial equipment. See *http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1.* The new database will provide a publicly accessible forum for anyone with questions about—or needing clarification of—DOE's test procedures. However, the Department's waiver process covers cases where "the basic model contains one or more design characteristics which either prevent testing of the basic model according to the prescribed test procedures, or the prescribed test procedures may evaluate the basic model in a manner so unrepresentative of its true energy consumption characteristics * * * as to provide materially inaccurate comparative data." (10 CFR 430.27(a)(1)). The language DOE is adopting simply reiterates this requirement and illustrates specific cases in which it applies to refrigeration products. Hence, the amended test procedures retain the proposed language requiring manufacturers to seek a waiver if that product, when tested under the prescribed procedure, would produce results unrepresentative of that product's true energy consumption.

2. Product Clearance Distances to Walls During Testing

DOE proposed to modify the rear wall clearance requirement during testing by adding a new rear wall clearance subsection as part of section 2 of Appendices A1, B1, A, and B. 75 FR 29832. Wall clearance is a necessary element to refrigerator and refrigerator-freezer energy efficiency testing because condenser performance is affected by the amount of available air flow. The condenser removes heat from the refrigeration system to the ambient air and placing the back of a refrigerator closer to a wall can restrict the amount of condenser air flow. Reducing this air flow can impact the energy consumption of a tested product—the condenser will need to operate at a higher temperature, which implies a higher discharge pressure and higher power input for the compressor. Similarly, increasing the distance between the refrigerator and wall can ease the load on the compressor, which lowers the tested product's overall energy consumption. In this regard, the current procedure references 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) (10 CFR part 430, subpart B, appendix A1, section 2.2).

In contrast, HRF–1–2008 provides greater detail by specifying 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).

DOE proposed to include in Appendices A1, B1, A, and B, language that would help clarify the applicable clearance distances:

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.

75 FR 29832.

DOE believes that these proposed requirements are consistent with the current test procedures, as well as the clearance requirements found in HRF–1–1979 and HRF–1–2008.

AHAM and Whirlpool suggested using less complex language that simply required the space between the back of the cabinet and the wall to be the minimum distance in accordance with manufacturer's instructions. (AHAM, No. 16.1 at p. 9; Whirlpool, No. 12.1 at p. 6) Electrolux noted that some products lack automatic door closers, and that they are installed in an orientation tipped slightly rearward for gravity to assist in door closing. The product owner's manual includes instruction for further adjustment for unlevel flooring for proper operation of the product. (Electrolux, No. 17.2 at p. 1, cell H18).

NRDC requested that DOE specify the maximum distance allowable for clearance during testing to avoid potential gaming by manufacturers seeking to maximize the amount of cooling space around the condenser coil. (NRDC, No. 21.1 at p. 5). Fisher & Paykel suggested that the DOE test procedure be synchronized with the IEC test procedure by specifying a maximum allowable distance of not more than "50 mm from the plane of the back panel to the vertical surface unless any permanent rear spacers extend further than that. In that case, the appliance shall be located so that those spacers are in contact with the vertical surface." (Fisher & Paykel, No. 24.2 at p. 1).

Although DOE is adjusting its approach to account for the issues raised by some manufacturers, DOE shares the concerns of NRDC and Fisher & Paykel regarding the potential selection of a rear clearance instruction in owners' manuals that is unrealistically large. In some cases such as chest freezers, the specified rear clearance is consistent with reasonable best practice, but is still large enough that many consumers may ignore the instruction. For instance, the GE Model FCM20SUWW 20-cubic foot chest freezer's installation manual recommends a three-inch clearance (Food Freezers, No. 31 at p. 13), but DOE suspects that many consumers do not maintain this clearance. The purpose of requiring permanent mechanical spacers to be installed on the product if the rear clearance needs to be greater than a certain distance is to ensure consistency between the test procedure and field use of the product. By setting this requirement at a larger, rather than smaller, rear clearance, this approach has a greater potential to save energy in the field.

The modified requirement will incorporate the language suggested by AHAM. This modification is made to section 3 of Appendices A1, B1, A, and B.

The additional provision suggested by Fisher & Paykel requiring use of mechanical stops if testing is conducted with clearances larger than a threshold value will also be implemented in Appendices A and B, using the suggested 50 mm threshold value, which converts to 2 inches in English units.

3. Alternative Compartment Temperature Sensor Locations

DOE proposed to modify section 5.1 of Appendix A1 (alternative temperature sensor locations) in order to provide clearer instructions and to reduce the incidence of deviation from the standard temperature sensor locations. The proposal would have permitted manufacturer selection of new locations only in cases where small deviations from the standard locations were involved. Otherwise, a manufacturer would need to petition for a waiver. 75 FR 29832. DOE proposed this approach to facilitate the development of new diagrams addressing new compartment configurations. In DOE's view, these new diagrams would help ensure future coverage of a broader range of potential configurations in the standard set of diagrams that currently exist. Broader coverage in standardized diagrams would help improve test consistency. Additionally, DOE proposed that where sensor locations deviated less than 2 inches from their standard locations, a manufacturer could simply report that the locations changed in the certification report and identify the locations of these deviations in the product's certification test reports. *Id.*

DOE also sought comment on the frequency of temperature sensor location revisions from the specifications of the figures of HRF–1–1979, and on whether the proposed 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.

AHAM, Whirlpool, and Sub-Zero supported a requirement that manufacturers must report changes to temperature sensor locations as long as such information is treated confidentially until the certification report is submitted to DOE. (AHAM, No. 16.1 at p. 5; AHAM, Public Meeting Transcript, No. 10 at pp. 48–49; Whirlpool, No. 12.1 at p. 3; Sub-Zero, Public Meeting Transcript, No. 10 at p. 51). AHAM and Sub-Zero commented that alternative temperature sensor placement should not require a waiver under the current waiver procedure due to the public nature of the process and the delay in time to market that it can cause. (AHAM, No. 16.1 at p. 5; Sub-Zero, Public Meeting Transcript, No. 10 at pp. 51–52). Electrolux commented that HRF–1–2008 requires even spacing of shelving within the product, which can create conflicts between the placement of drawers or pans and the specified sensor locations. Electrolux also recommended reporting of alternative locations in certification reports. (Electrolux, No. 17.2 at p. 1, cell H20).

DOE appreciates the manufacturers' sensitivity regarding time and confidentiality. In light of this concern, and the absence of any comments to the contrary, DOE has decided to eliminate its proposed waiver requirement. Instead, the use of alternative temperature sensor locations will be required to be reported in the certification report. These nonstandard sensor locations, whether significant or minor deviations, would be reported in the certification test reports. These modified amendments make any public disclosure of proprietary information unnecessary until product certification, as requested by stakeholders. DOE will make these changes in section 5.1 of Appendices A1, B1, A, and B, which will include the requirement to identify the new sensor locations in test reports, and in a new 10 CFR part 429, which will provide the amended list of data required in the certification report. The part 429 changes, if adopted, will be made as part of the Certification, Compliance, and Enforcement (CCE) rulemaking. See 75 FR 56796, 56819 (September 16, 2010). In addition, because new requirements for the maintenance of records are under consideration as part of a new 10 CFR part 429, the proposed clarification for the section 5.1 amendments regarding test reports (i.e., that manufacturers maintain test data records "in accordance with 10 CFR 430.62(d).") will be treated separately as part of the ongoing CCE rulemaking. This potential requirement is also discussed in section III.D.12.

4. Median Temperature Settings for Electronic Control Products and Establishment of Dual Standardized Temperatures

Median Temperature Settings

DOE proposed to modify the test procedure language related to temperature control settings, as detailed in section 3 of Appendix A1, to clarify the procedure for products with electronic controls. Many current products have electronic controls, which generally have setpoints indicating specific control temperatures. Section 3.2.1 indicates that a first test is conducted with temperature controls set in a median position. For electronic controls, an average of the coldest and warmest temperature settings is generally used as the median temperature for purposes of testing. 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.

DOE proposed that the test procedure 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 settings. This modification was proposed for Appendices A1 and B1 and would be retained for new Appendices A and B. 75 FR 29833.

AHAM supported the proposed approach. (AHAM, Public Meeting Transcript, No. 10 at p. 55; AHAM, No. 16.1 at p. 10). During the public meeting, the National Institute of Standards and Technology (NIST) recommended that DOE consider adopting what is commonly known as the "triangulation approach" in place of the interpolation approach. (NIST, Public Meeting Transcript, No. 10 at pp. 55–56). The triangulation approach, which has been a part of the Australian/New Zealand Standard AS/NZS 4474 [2] for many years, maps both the refrigerator and freezer compartment temperatures exactly to the target temperatures by allowing up to three control setting combinations surrounding the standardized compartment temperatures. GE concurred that this approach is more flexible and repeatable, because it gives results at the exact desired sets of temperatures (i.e. 0 °F/39 °F for testing starting in 2014—see section III.E.4 below) rather than close to those temperatures. (GE, Public Meeting Transcript, No. 10 at pp. 58–59). Whirlpool agreed that the triangulation approach may be appropriate for adopting into the DOE test procedure in the future, but that it would incur redevelopment expense if introduced now. (Whirlpool, Public Meeting Transcript, No. 10 at p. 59). GE indicated that the triangulation approach could be adopted as an option for temperature settings, rather than the required procedure. (GE, Public Meeting Transcript, No. 10 at p. 59). AHAM also supported adopting the triangulation approach as an option. (AHAM, No. 16.1 at p. 10).

While the triangulation method presents advantages with respect to temperature settings, the adoption of this method will require additional examination by DOE to ascertain its suitability for inclusion as part of its regulations. DOE may further examine this method with greater scrutiny as part of a future rulemaking to amend its test procedure. In light of the significant changes already being introduced to the final rule that is being adopted today, and in recognition of the fact that a procedure needs to be finalized in coordination with the parallel standards rulemaking that is underway, DOE is declining to adopt the triangulation method as part of today's rule.

Accordingly, based on the above considerations, DOE is adopting the proposed amendments addressing median temperature settings for electronic control products.

[2] "Australian/New Zealand Standard, Performance of Household Electrical Appliances—Refrigerating Appliances, Part 1: Energy Consumption and Performance", AS/NZS 4474.1:2007, Appendix M, available for purchase at *http://infostore.saiglobal.com/store/results2.aspx?searchType=simple&publisher=all&keyword=AS/NZS%204474*

Dual Standardized Temperatures

DOE proposed extensive changes to instructions for setting temperatures as part of Appendices A and B. 75 FR 29843–29846. One concept adopted for these changes included using dual standardized temperatures for refrigerator-freezers and basic refrigerators—products that have two (or more) compartments. The current test procedures allow manufacturers to select "second-test" temperature settings based only on test results for the freezer compartment. (See Appendix A1, section 3.2 and sections 3.2.1 through 3.2.3). NIST advised DOE that, in practice, manufacturers use the warmest setting for the second test only when both compartments are cooler than their standardized temperatures during the first test. DOE asked stakeholders to help clarify the approach for setting of temperature controls for such products. 75 FR 29846.

GE commented that manufacturers currently use the approach described by DOE. (GE, Public Meeting Transcript, No. 10 at pp. 137–138). DOE received no comments indicating that its understanding of the manufacturers' approach to temperature settings is incorrect. In particular, DOE received no comments from any manufacturer that uses any different approach for setting of temperature controls. Hence, DOE will implement this change in Appendices A1 and A.

5. Test Procedures for Convertible Compartments and Special Compartments

DOE proposed changing the test procedure for special compartments to make this procedure consistent with the convertible compartment test procedure. 75 FR 29833. 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.) The procedure for special compartments calls for the controls to be "set to provide the coldest temperature". (HRF–1–1979 section 7.4.2) To simplify these requirements to make them consistent with each other, DOE proposed to require the highest energy use position for both convertible and special compartments. 75 FR 29833.

DOE also proposed to specify that if a convertible compartment has external doors (i.e. that the compartment's doors open directly to the exterior of the product), the compartment shall be tested as a fresh food or freezer compartment, whichever of these functions represents the highest energy use position. *Id.* Such an approach is different than requiring the highest energy use position for the compartment. For example, a compartment that can be controlled for any temperature between −5 °F and 35 °F would likely use the most energy at its −5 °F setting. However, testing the compartment as a freezer compartment, which would most likely represent a higher energy use than when testing that compartment as a fresh food compartment, would place its energy use at a 5 °F standardized temperature under the current test procedure. Testing the compartment as a freezer compartment would involve a temperature setting 10 °F warmer than testing in the highest energy use position. This scenario would most likely use less energy than using the −5 °F setting. The proposal retained the current instructions to use the highest energy use position to test convertible compartments that do not have external doors. DOE also proposed a definition for "separate auxiliary compartments" to identify compartments that have doors that open to the product's exterior. *Id.*

ACEEE supported the proposal to test special compartments in their highest energy usage position, adding that, in the absence of data detailing how such compartments are used by consumers, the highest energy usage position makes the most sense. (ACEEE, No. 19.1 at p. 1). NRDC also supported the proposal to test special compartments in their maximum energy use position to assure that energy ratings are not overly optimistic. (NRDC, No. 21.1 at p. 3).

Other stakeholders opposed the proposal for special compartments, and some offered alternative approaches. AHAM and Whirlpool claimed that a change from the lowest temperature setting to highest energy use would add test burden, because multiple tests may be required to determine which setting results in the highest energy use measurement. (AHAM, No. 16.1 at p. 5; AHAM, Public Meeting Transcript, No. 10 at p. 61; Whirlpool, No. 12.1 at p. 3). AHAM claimed that virtually every model, without identifying any representative models, has temperature controllable compartments, and thus the proposed change could dramatically increase the test burdens on all manufacturers. (AHAM, No. 16.1 at p. 5). Electrolux commented that the highest energy use approach is unclear. (Electrolux, No. 17.2 at p. 1, cell H28). Electrolux discussed some of the complications associated with the highest energy use position requirement, mentioning (a) the difference between externally-accessible and internally-accessible compartments (e.g. such as internal drawers), (b) the possibility that the highest energy use position is not necessarily consistent with normal use, and (c) compartments that may engage a feature that increases energy use for a limited period of time. (Electrolux, No. 17.2 at p. 1, cell H26). Electrolux also questioned DOE's suggestion of a 2 cubic foot maximum size delineator for special compartments. (Electrolux, No. 17.2 at p. 1, cell H28). The PRC echoed Electrolux's comment (b) above, indicating that use of the highest energy use position may not be the best representation of the "actual use". (PRC, No. 15.1 at p. 5).

Additionally, Electrolux pointed out the need for definitions to help clarify the functions of different compartments, indicating that there are many different types of compartments, and the test procedures may not be the same for all of them. (Electrolux, No. 17.2 at p. 1, cell H26). To this end, AHAM offered definitions for both "compartment" and "sub-compartment", presumably with the intent that the proposed amendments may apply to one of these types and not the other. (AHAM, No. 16.1 at p. 11). Whirlpool recommended that special compartments subject to the proposed approach should not exceed 10% of total capacity (total product volume), adding that temperatures should be volume-weighted, but did not elaborate. (Whirlpool, No. 12.1 at p. 3). AHAM recommended using volume-weighted temperature averaging for special compartments, but did not provide reasons for adopting this approach. (AHAM, No. 16.1 at p. 6). Electrolux recommended that DOE consider including a volume adjustment factor dependent on the (typically cooler) temperature of a special compartment when determining a product's adjusted volume. While such a change may impact the related energy usage calculations, it would not affect the manner in which test sample is set up or the test is conducted and Electrolux offered no explanation as to how its proposed change would affect the actual testing of a given product. (Electrolux, No. 17.2 at p. 1, cell H28). (DOE notes that the volume adjustment factor is used to calculate adjusted volume (see Appendix A1 section 6.1), which in turn is used to calculate energy factor (see 10 CFR 430.23(a)(4)) and maximum allowable energy use (see 10 CFR 430, subpart C, section 32(a)), none of which impact test set-up and conduct of the test. Since this discussion addresses the test set-up for special compartments, DOE concludes that the comment, addressing volume adjustment factor, is not relevant.)

AHAM, Whirlpool, and Electrolux asserted that the measured energy use under the proposed special compartment procedure would change. (AHAM, No. 16.1 at pp. 3, 5, 6; AHAM, Public Meeting Transcript, No. 10 at p. 61; Whirlpool, No. 12.1 at p. 3; Electrolux, No. 17.2 at p. 1, cell H26). Whirlpool further commented that the proposed change should not be adopted prior to 2014. (Whirlpool, No. 12.1 at p. 2). Whirlpool further commented that special compartments should be tested at their coldest temperature position. (Whirlpool, No. 12.1 at p. 3)

In consideration of AHAM's comment that nearly every refrigeration product has separate compartments with temperature control, DOE randomly reviewed the refrigerator-freezer product offerings of three major brands (Whirlpool, GE, and Frigidaire) on their Web sites. These are the major brands of Whirlpool, GE, and Electrolux, manufacturers who comprise more than 80% market share for standard-size refrigerator-freezers.[3] The research, involving five randomly selected products from three key product categories (Class 3: refrigerator-freezers—automatic defrost with top-mounted freezers without through-the-door ice service; Classes 5 and 5A: refrigerator-freezers—automatic defrost with bottom-mounted freezers; and Classes 4 and 7: refrigerator-freezers—automatic defrost with side-mounted freezers) of each of the three brands indicates that one-fifth of these products have special compartments. (These product classes are currently listed in 10 CFR 430.32.) (Special Compartment: Research Summary, No. 36 at p.1, cell F65). The examined classes are those that would be most likely to employ these types of features because they contain multiple sub-compartments such as drawers within their fresh food compartments and constitute a majority of the refrigeration products sold in the market (roughly 70% of refrigeration product shipments).[4] DOE also notes that of the eleven refrigerator-freezer products purchased for reverse engineering teardowns as part of the energy conservation standard rulemaking, only two had a separate compartment with separate temperature

[3] "32nd Annual Portrait of the U.S. Appliance Industry", *Appliance Magazine,* September 2009, Vol. 66, No. 7.

[4] Shipments of standard-size refrigerator-freezers were near 10 million in 2008, while shipments of compact refrigerators, standard-size freezers, and compact freezers totaled close to 4.5 million. See the TSD, Chapter 3, "Market and Technology Assessment", section 3.2.6.1.

control—both were refrigerator-freezers with bottom-mounted freezers. Hence, DOE believes that the level of test burden associated with these test procedure amendments would be less severe than predicted by AHAM.

Definitions of Compartment Types To Improve Clarity

DOE considered the need for additional definitions, for a variety of terms—e.g. "compartment" and "sub-compartment"—as suggested by AHAM, (AHAM, No. 16.1 at p. 11), to clarify which types of compartments are subject to the different requirements. Because AHAM indicated that the suggested definitions for these terms were derived from the Australian/New Zealand standards,[5] DOE considered this approach and factored in the international harmonization concerns raised by some stakeholders (AHAM, Public Meeting Transcript, No. 10 at pp. 42–43; AHAM, No. 16.1 at pp. 1, 7, 10, 11; Whirlpool, No. 12.1 at p. 5), when it examined the need for new definitions.

AHAM proposed to define a "compartment" as "an enclosed space within a refrigerating appliance, which is directly accessible through one or more external doors." Under the AHAM proposal, a compartment "may contain one or more sub-compartments and one or more convenience features." (AHAM, No. 16.1 at p. 11).

In DOE's view, this definition, if adopted, would define a compartment as having one or more external doors, in spite of the fact that the freezer compartments of many refrigeration products do not have external doors. The definitions for "electric refrigerator" and "electric refrigerator-freezer" do not prescribe that the compartments associated with these products have external doors (see 10 CFR 430.2), thus, the AHAM-proposed definition would conflict with the agency's use of the term "compartment" within its regulations. At this time, DOE declines to make this change.

DOE also considered whether any additional definitions are needed to clarify which instructions apply to which compartment types. The following discussion walks the reader through these considerations. The NOPR proposed a series of amendments regarding compartments:

- First, DOE proposed a definition for "separate auxiliary compartments" that defined this term as "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)." 75 FR 29833–29835.
- Next, DOE proposed a new section 2.7 (for Appendices A1 and A—parts of it also appear as section 2.5 in Appendices B1 and B) that would specify the manner in which convertible and special compartments would be tested: "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." *Id.* DOE notes that these "other compartments" fall under the "special compartment" definition in HRF–1–1979 and HRF–1–2008. DOE did not establish a definition for "special compartment" in its proposal, since it considered that the amended section 2.7 clarifies adequately that the highest energy use position would be used for the compartments that fit the description provided in the section.
- Finally, DOE proposed new text for sections 3.2 and 6.2 (for Appendices A1, B1, A, and B): "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." *Id.* These sections describe the additional procedures associated with convertible separate auxiliary compartments when treated as fresh food or freezer compartments.

Table III.2 below notes the terminology used in the NOPR for the listed compartments and also lists the test procedure instructions as proposed.

TABLE III.2—COMPARTMENT TYPES OTHER THAN THE FIRST FRESH FOOD COMPARTMENT OR THE FIRST FREEZER COMPARTMENT

| Temperature range | Doors accessible directly from exterior? | Separate temperature control | Notes | NOPR Testing instructions |
|---|---|---|---|---|
| Fresh Food | Y | Y | Separate Auxiliary Fresh Food Compartment. | Test as a Fresh Food compartment. |
| | | N | | |
| | N | Y | Special Compartment | Highest Energy Use. |
| | | N | | None. |
| Freezer | Y | Y | Separate Auxiliary Freezer Compartment. | Test as a Freezer compartment. |
| | | N | | |
| | N | Y | Special Compartment | Highest Energy Use. |
| | | N | | None. |
| Convertible | Y | Y | Convertible Separate Auxiliary Compartment. | Test as a Fresh Food or Freezer compartment, whichever results in the highest energy use. |
| | | N | Not likely to exist | None. |
| | N | Y | Convertible Compartment | Highest Energy Use. |
| | | N | Not likely to exist | None. |

[5] "Australian/New Zealand Standard, Performance of Household Electrical Appliances—Refrigerating Appliances, Part 1: Energy Consumption and Performance", AS/NZS 4474.1:2007.

The NOPR proposed to require separate auxiliary compartments that are not convertible to be tested as either fresh food or freezer compartments, depending on their temperature range. The instructions for setting any temperature controls for these compartments are described in section 3 of proposed Appendices A1, B1, A, and B. The proposed section 2.7 specified that convertible separate auxiliary compartments would also be tested either as fresh food or freezer compartments, depending on which of these selections results in a higher energy use measurement. The proposed section 2.7 also specified that convertible compartments that are not separate auxiliary compartments would be tested using the highest energy use position. Finally, the proposed section 2.7 specified that other compartments with separate temperature control that are not butter conditioners would be tested in the highest energy use position.

After re-examining this proposal and considering the relevant comments received, DOE recognizes that additional clarification would help stress that, for testing purposes, special compartments have no external doors, i.e. doors directly accessible from the exterior. To clarify the procedure, in light of commenters' concerns that the compartments involved should be more clearly identified (Electrolux, No. 17.2 at p. 1, cell H26; AHAM, No. 16.1 at p. 11), DOE has added a definition for "special compartment" in section 1 of Appendices A1, B1, A, and B.

With respect to the issue of volume, Whirlpool suggested that DOE adopt a size limit of 10 percent of the total refrigerated volume of a product for special compartments, but did not provide information or data justifying such a limit. (Whirlpool, No. 12.1 at p. 3). In contrast, Electrolux criticized as arbitrary the 2-cubic foot size delineation used in the NOPR for discussion purposes. (This volume was not proposed as a size limit). (Electrolux, No. 17.2 at p. 1, cell H26). DOE notes that there is no available information indicating typical consumer usage patterns (i.e. typical temperature settings) for special compartments and the dependence of these temperature settings on compartment size. DOE believes, however, that most such compartments are small, as described in the NOPR. 75 FR 29834. DOE notes that the definitions for the term "special compartment" in HRF–1–1979 and HRF–1–2008 mention several compartment types that are typically small (i.e. less than 2 cubic feet in size): butter or margarine conditioners, cheese compartments, crispers, ice storage bins, and meat keepers (HRF–1–1979 section 3.18; HRF–1–2008 section 3.24). Because these compartments tend to be small, there is no clear need for a size limitation since manufacturers will likely continue to limit the sizes of these compartments. For this reason, and the absence of any available information to help support the selection of an appropriate size limit, DOE has decided not to incorporate a size limitation on special compartments. Accordingly, the new definition for special compartment reads as follows.

"Special compartment" means any compartment other than a butter conditioner, without doors directly accessible from the exterior, and with separate temperature control (such as crispers convertible to meat keepers) that is not convertible from fresh food temperature range to freezer temperature range.

(See section 1 of Appendices A1 and A. A similar definition has been inserted in Appendices B1 and B)

Instructions for Testing of Special Compartments

As discussed above, stakeholders expressed concern about DOE's proposal to require testing using the highest energy use positions of special compartments rather than the lowest temperature. The comments indicated that the requirement would potentially require manufacturers to conduct multiple tests to verify that the highest energy use position was used in a test. DOE acknowledges this possibility. To address this concern, DOE has decided to modify the amendments so that they are based on temperature settings rather than the highest energy use position. Further, DOE has decided to revert to the current test procedure requirement for the coldest setting for most special compartments. For products that use the addition of heat to adjust the temperature of temperature-controllable compartments, the test procedure will require averaging of tests conducted with the temperature settings in the warmest and coldest settings. In making these changes, the potential testing burden will be minimized while ensuring that the energy consumed by these features is sufficiently captured under the test procedure.

Based on its examination of a variety of refrigeration products, DOE expects that most of those products that are equipped with special compartments provide temperature control of these compartments by increasing or decreasing the amount of cold air diverted from the refrigeration system to the special compartment. (In other words, when more air is diverted into the special compartment, that compartment's compartment temperature is lower.) As mentioned above, two of the eleven refrigerator-freezers DOE purchased for its reverse engineering analysis for the energy conservation standard rulemaking had special compartments with separate temperature control. Both of these products were designed to adjust air flow to control the temperature in these compartments. When a greater quantity of cold air is diverted to provide a lower temperature in the special compartment, less air is available to cool the rest of the fresh food compartment. This situation extends the cooldown time for the fresh food compartment, which extends the compressor run time and increases the measured energy use of the product. For such compartments, the coldest temperature setting and the highest energy use setting are generally the same. Hence, the proposed approach should not create any change in energy use measurement.

DOE proposed the change calling for the highest energy use position to establish consistency with the requirements for convertible compartments (for which the highest energy use position is prescribed—see HRF–1–1979 section 7.4.2), and to assure that this highest energy approach is also applied to products that might use resistive heating to control the temperature in special compartments. For such products, the coldest temperature setting would likely be the lowest energy use setting, because less resistance heat would be needed to raise the temperature of such a compartment above its minimum temperature.

The modified amendments specify that the requirement for averaging tests with the settings in the coldest and warmest positions applies to special compartments that use any form of heat addition for any part of the controllable temperature range of the compartments. DOE has decided to modify its earlier proposal and implement this modification only in Appendices A and B, which will require manufacturers to use this procedure in conjunction with the new energy standards that DOE is currently considering promulgating. DOE believes that these changes in the amendments will eliminate most of the added test burden potentially associated with them, since DOE's examination of the market indicates that most products do not use heat addition for special compartment temperature control. By delaying implementation of the exception for heated temperature control, the change will also eliminate the impact of the test procedure change on products manufactured prior to the compliance date for the new energy conservation standards. Likewise, because, as described above, the coldest and highest energy use settings are equivalent for most special compartments (i.e. those controlled by adjusting the flow of cooling air), DOE believes that this amendment (coldest position, except for the minority special compartments using heat addition) does not significantly alter the proposal (highest energy use position) and will adequately capture the energy use of these features.

DOE recognizes that the highest energy use position may not be consistent with normal use, as indicated by Electrolux and PRC (Electrolux, No. 17.2 at p. 1, cell H26; PRC, No. 15.1 at p. 5). ACEEE and NRDC both supported use of the highest energy use position in light of the lack of such consumer data. (ACEEE, No. 19.1 at p. 1: NRDC, No. 21.1 at p. 3) The modified amendment addresses the concerns of Electrolux and PRC by allowing the use of averaging of warmest-setting and coldest-setting measurements for products with special compartments with heated temperature control systems. Neither stakeholder submitted any information suggesting what temperature settings are used by consumers. There is no currently agreed-upon standard as to what constitutes a normal use setting for special and convertible compartments. Based on its careful analysis, DOE believes its selected averaging approach is likely to provide a reasonable representation of consumer use for these compartments, because the approach does not represent an extreme control setting.

Regarding Electrolux's comment about temporary functions associated with special compartments (Electrolux, No. 17.2 at p. 1, cell H26), Electrolux did not provide any description of the types of such functions that might be at issue. However, DOE notes that "features" are addressed by HRF–1–2008, section 5.5.2 which are manually initiated and which operate temporarily, such as quick-chill compartments. In response to these comments, DOE chose to modify the proposed amendment to clarify that the requirement for temperature setting of special compartments do not apply to any such temporary feature or functions. This change will appear in section 2.7 of Appendices A1 and A, and in section 2.5 of Appendices B1 and B.

Instructions for Testing of Separate Auxiliary Convertible Compartments

Convertible compartments are those compartments that can operate as either freezer compartments or fresh food compartments. As discussed above, a separate auxiliary convertible compartment would be tested as either a freezer compartment or a fresh food compartment, depending on which of these functions uses more energy. Because these compartments have temperature ranges spanning those of both freezer and fresh food compartments, using the standard coldest, median, and warmest settings during testing as a freezer or fresh food compartment may be inappropriate in certain cases. For example, a separate auxiliary convertible compartment could have a range of temperature settings from −6 °F to 46 °F. The median setting would be 20 °F, which is too high a setpoint for a freezer compartment of a refrigerator-freezer and too low for a fresh food compartment. To resolve this issue, DOE has added language in the final rule specifying settings (a) within 2 °F of the standardized temperatures as the median settings, (b) at least 5 °F above the standardized temperature as the warmest setting for testing the compartment as a freezer compartment, and (c) at least 5 °F below the standardized temperature as the coldest setting for testing as a fresh food compartment. The new language also indicates that if the control setpoints do not represent specific temperatures (i.e. as might be the case for mechanical controls), that the measured compartment temperatures rather than the setpoints must meet these requirements. This change is incorporated in section 3 of Appendices A1 and A.

Additional Discussion

DOE agrees in principle with AHAM's comment that volume-weighted temperature averaging may be appropriate for special compartments. However, as AHAM indicated (AHAM, No. 16.1 at p. 6), such an approach represents a departure from the current test procedure that would change the measured energy use. The current test procedure requires that these compartments be set in their coldest position and does not include a procedure to measure their temperatures. The modified test procedure established by the final rule and the interim final rule requires the coldest temperature position for these compartments for most products, i.e. those that do not utilize heat addition for temperature control. DOE has adopted this approach to maintain greater consistency with the current test procedure. DOE may consider use of volume-weighted temperature averaging in a future test procedure rulemaking.

The test procedure for special compartments established with the interim final rule modifies the test procedure only for products that use heat addition for temperature control. Based on available information, which suggests that few products have such special compartments, DOE expects the number of products that are likely to be impacted by this change to be modest. Stakeholders have not provided any information suggesting otherwise nor have they provided data that would permit DOE to evaluate the likely effects of this change. However, in consideration of these comments, DOE has modified the timing of the amendments. This change will not require manufacturers of products using heat addition for temperature control to use the new averaging approach until the new energy conservation standards take effect. As a result, manufacturers will have additional time to redesign such products to adjust to the new procedure. Hence, the final changes in the procedures for convertible and special compartments are (1) new definitions for "separate auxiliary compartment" and "special compartment" in Appendices A1, B1, A, and B; (2) clarification that the highest energy use position requirement for convertible compartments implies they shall be tested as a freezer or fresh food compartment only if they are separate auxiliary compartments in Appendices A1 and A; (3) requirements for special compartments reiterating current procedures calling for the coldest temperature settings in Appendices A1, B1, A, and B; and (4) instructions for temperature settings for separate auxiliary convertible compartments that take into account the wide temperature control range of these compartments, which will be inserted in Appendices A1 and A. In addition, the interim final rule change is an exception to the requirements for special compartments in products that use heat addition for temperature control, for which the averaging of the warmest- and coldest-temperature settings tests shall be used, which will be prescribed as part of Appendices A and B.

6. Establishing a Temperature-Averaging Procedure for Auxiliary Compartments

The NOPR proposed amendments that would address the testing of external-door compartments other than the two main compartments of a refrigerator-freezer. Specifically, DOE proposed requirements for (1) adjusting temperature controls, (2) measuring auxiliary compartment temperatures, and (3) incorporating the auxiliary compartment temperature into the calculation of energy consumption. 75 FR 29833–29835. DOE proposed the following:

(1) Temperature settings, generally—Consistent with current requirements, the temperature controls for auxiliary compartments with external doors that have individual temperature control capability would be set at the same median, cold, or warm setting used for the first fresh food compartment and/or the first freezer compartment, or some combination thereof as described in section 3.2.1 of Appendix A1 or B1. *Id.*

(2) Auxiliary compartment temperature measurements—Measurement of external door-equipped auxiliary compartment temperatures would be done in the same manner as prescribed in the current test procedure for the main fresh food and freezer compartments, as described in section 5.1 of Appendix A1 or B1. *Id.*

(3) Incorporation of auxiliary compartment temperature measurements in the test procedure calculations—calculations for the freezer temperature for a product with more than one freezer compartment (including one or more auxiliary freezer compartments with external doors) would be performed using a volume-weighted average of the compartment temperatures measured within each freezer compartment. A similar approach would apply to fresh food compartments. These freezer and fresh food temperatures would be used to determine the appropriate temperature settings for subsequent testing, and to calculate the energy use. *Id.*

DOE proposed to insert these amendments into Appendices A1 and A to address those auxiliary compartments with external doors that are found in some refrigerators and refrigerator-freezers. DOE proposed similar amendments to Appendices B1 and B to address the auxiliary compartments found in some freezers. DOE further proposed to define "separate auxiliary compartments" to include auxiliary compartments with external doors in order to ensure they are treated consistently with other auxiliary compartments. *Id.*

Commenters generally supported this approach. For example, AHAM and Whirlpool both concurred that auxiliary compartment temperatures should be volume-weighted. (AHAM, Public Meeting Transcript, No. 10 at p. 65; Whirlpool, No. 12.1 at p. 4). AHAM provided an equation to illustrate the volume-weighted averaging of multiple compartments. (AHAM, No. 16.1 at p. 6).

While DOE agrees that AHAM's suggested equation properly represents the proposed approach, because it provides a weighted average of compartment temperatures in which the temperatures are weighted by the compartment volumes, the final rule and interim final rule adopt a more general equation that is functionally equivalent by averaging for a general number of fresh food compartments. DOE is also adopting an equivalent volume-averaging equation for the freezer compartment temperature. These changes have been made in Appendices A1, B1, A, and B. The requirements for testing of auxiliary compartments otherwise remain as they were proposed, except for the clarification regarding temperature settings for convertible separate auxiliary compartments, discussed above in section III.D.5.

7. Modified Definition for Anti-Sweat Heater

DOE proposed to modify the definitions of anti-sweat heater in both the refrigerator and refrigerator-freezer test procedures and in the freezer test procedures to clarify that such heaters can be used for both interior and exterior surfaces. 75 FR 29835.

The current DOE test procedure definition for anti-sweat heater applies to heaters that prevent the accumulation of moisture on the exterior surfaces of the cabinet (see 10 CFR part 430, subpart B, appendix A1, section 1.3 and appendix B1, section 1.2). However, 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 moisture accumulation inside the fresh food compartment near the air duct embedded in the side wall that carries refrigerated air to the ice compartment.

To account for heaters that operate in this manner, DOE proposed to change the anti-sweat heater definition found in Appendices A1 and B1. DOE also proposed to include these modified definitions in Appendices A and B. This proposed modification would not change the test procedure but would clarify that interior heaters used to prevent sweating are to be treated as anti-sweat heaters for purposes of calculating energy usage under the procedure. *Id.*

AHAM, Whirlpool, ACEEE, and NRDC supported the DOE proposal for the anti-sweat heater to apply to both interior and exterior surfaces (AHAM, No. 16.1 at p. 6; Whirlpool, No. 12.1 at p. 4; ACEEE, No. 19.1 at p. 2; NRDC, No. 21.1 at p. 3). There were no comments objecting to this proposal.

DOE also sought comment on whether the proposed definition needed to be modified 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. Commenters provide no views on this issue.

In light of the support from commenters for DOE's proposed approach, and the absence of any additional comment regarding any further modifications to address heaters that prevent moisture accumulation, DOE has decided to adopt its proposal to modify the definition of anti-sweat heater to apply to interior as well as exterior cabinet surfaces.

8. Applying the Anti-Sweat Heater Switch Averaging Credit to Energy Use Calculations

DOE proposed to modify the calculation for annual energy use to make it consistent with the annual operating cost calculation. 75 FR 29835. Currently, the energy conservation standards for refrigeration products are based on the annual energy use calculated for these products. This value is calculated based on a "standard cycle." (see 10 CFR 430.23(a)(5) and (b)(5)). The standard cycle is defined as "the cycle type in which the anti-sweat heater control, when provided, is set in the highest energy consuming position." (see Appendix A1, section 1.7 or Appendix B1, section 1.5).

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 "in the position set at the factory just prior to shipping". (see 10 CFR 430.23(a)(2) and (b)(2)). Manufacturers generally set the switch off prior to shipping. Thus, the annual operating cost is calculated as an average of tests with the switch on and off. This is referred to as the "anti-sweat heater switch averaging credit" for the purposes of this discussion. DOE understands that most manufacturers test and rate refrigeration products equipped with anti-sweat heater switches using the averaging credit and use the same results for reporting both energy use and annual operating cost.

DOE proposed to modify the annual energy use calculation to ensure consistency with the annual operating cost calculation by making changes to

10 CFR 430.23(a) and 10 CFR 430.23(b). 75 FR 29835.

Electrolux favored preserving the current test procedure for testing with an anti-sweat heater switch and sought clarification regarding the agency's rationale for its proposed change. (Electrolux, No. 17.2 at p. 1, cell H50). DOE received no comments calling for elimination of the anti-sweat heater switch averaging credit. To clarify, DOE's proposed modification would change the test procedure to ensure consistency with the manner in which manufacturers already test products—by averaging the test results with the anti-sweater heater switch positioned in the on and the factory-set positions. As explained in the NOPR, this approach was the original intent of the test procedure, and there is nothing from the preamble to the final rule that first established the annual energy use metrics of 10 CFR 430.23(a) and 430.23(b) (see 54 FR 6062 (February 7, 1989)) to indicate that the omission of the anti-sweat heater averaging credit in these metrics was anything but an oversight. 75 FR 29835. Having received no other comment from stakeholders, DOE has decided to proceed with the proposed modification.

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

Variable anti-sweat heating (VASH) control systems are used to adjust the use of anti-sweat heaters based on ambient conditions. These systems are typically active under high humidity conditions but deactivate when their sensors detect that ambient humidity conditions are dry enough such that their operation is not required. Commercialized products incorporating such control systems have been tested for certification under test procedure waivers using a test procedure based on calculation rather than measurements. This procedure was initially proposed in a GE waiver petition, which was granted February 27, 2008 (GE waiver). 73 FR 10425, 10427. This procedure calculates the additional energy use of the anti-sweat heaters based on manufacturers' data for average heater power input at 10 different humidity levels. *Id.* To address products that have these systems, the NOPR proposed an alternative test procedure prescribing a method for measuring the energy use impact of the anti-sweat heaters during the product's operation, rather than the procedure described in the GE waiver. 75 FR 29835–29837.

The proposed test would require measuring a product's energy use in a chamber controlled at 72 °F at three different humidity levels, including a low humidity level for which the anti-sweat heater would be expected to be inactive. The difference in energy use measurements made in moderate- and high-humidity tests and the energy use measurement of the low-humidity test would provide a measurement of the energy use associated with the heaters operating under VASH control. These measurements would be used to calculate the energy use contribution associated with the anti-sweat heaters at the 10 humidity levels of the GE waiver. A weighted average of these energy use contributions, based on the same weighting factors of the GE waiver procedure, would constitute an adjustment factor that a manufacturer would add to the energy use measured during a test in a 90 °F ambient with the anti-sweat heaters deactivated, similar to the approach of the GE waiver. DOE had proposed that deactivation of the anti-sweat heaters in this 90 °F test would be achieved by requiring a low ambient humidity (i.e. less than 35% relative humidity) to ensure that the VASH control system would not engage the heaters. DOE proposed this procedure rather than adopt the GE waiver's calculation approach because DOE initially did not consider the calculation approach amenable to verification. DOE also proposed to use the standard cycle for calculating energy use for products with VASH control and anti-sweat heater switches rather than using the averaging credit for such products, as allowed in the GE waiver procedure because of concern that the additional energy savings associated with the switch is not likely to occur during consumer use if the VASH control already turns off the heaters when they are not needed. *Id.*

Responding to this proposal, AHAM, Fisher & Paykel, and Whirlpool, asserted that (1) it is possible to independently verify published energy consumption measured under the GE waiver, (2) DOE's proposal imposes undue test burden on the manufacturer without a corresponding increase in accuracy, (3) DOE's proposal penalizes variable anti-sweat heater systems compared to fixed anti-sweat heater systems (because of the proposed elimination of the anti-sweat heater switch averaging credit), and (4) DOE's proposal has a significant impact on measured energy use, requiring adjustment of the energy conservation standards. (AHAM, No. 16.1 at pp. 2–3; Fisher & Paykel, No. 24.3 at p. 1; Whirlpool, No. 12.1 at pp. 4–5). GE also asserted that an independent laboratory could verify the reported energy consumption by measuring the wattage of the heater at the various humidity levels at the appropriate ambient temperature. (GE, Public Meeting Transcript, No. 10 at pp. 80–81).

AHAM noted that the requirement to control relative humidity in test chambers below 35 percent would increase test burden. (AHAM, Public Meeting Transcript, No. 10 at p. 85) GE added that achieving 95 percent relative humidity is difficult because of the heavy amount of condensation that would result during testing. (GE, Public Meeting Transcript, No. 10 at p. 166) Electrolux expressed concern over the significant transition time when changing chamber humidity levels and allowing the product to reach equilibrium. (Electrolux, Public Meeting Transcript, No. 10 at pp. 167–168) Whirlpool, Electrolux, and GE reiterated that available humidity chambers are not currently capable of achieving the required accuracy for measuring energy consumption with the prescribed level of accuracy under the proposed procedure and that making the required upgrades to achieve this accuracy would not be possible within the proposed 30-day period.[6] Whirlpool requested that these proposed changes take place in conjunction with the 2014 standards that DOE is currently promulgating, but not earlier. (Whirlpool, Public Meeting Transcript, No. 10 at pp. 78–79; Electrolux, No. 17.2 at p. 1, cell H65; GE, Public Meeting Transcript, No. 10 at pp. 165–166).

AHAM and Fisher & Paykel urged DOE to adopt the GE waiver in its entirety without modification. (AHAM, No. 16.1 at pp. 2–3; Fisher & Paykel, No. 24.3 at p. 1) In addition, AHAM stated in the public meeting that there is industry consensus around several issues: (1) 30 days is insufficient to begin testing under this proposed procedure, (2) the increase in test burden would likely not change the test results, (3) Japanese researchers have presented data showing that the 1.3 system factor[7] is accurate, and (4) DOE should harmonize with IEC and Canada where possible. (AHAM, Public Meeting Transcript, No. 10 at pp. 79–80) DOE notes that the IEC has not yet published

[6] Stakeholders apparently have interpreted the effective date of the test procedure amendments, which is 30 days after the final rule, to also be the date that representations regarding energy use of manufactured products must start to be based on the amended test procedures. As explained earlier, the transition to representations based on the amended test procedure must occur within 180 days of the final rule.

[7] The 1.3 system factor is used in the GE waiver test procedure to convert energy use of the anti-sweat heaters to energy use of the product.

a test procedure incorporating the GE waiver procedure.

The PRC requested that the test procedure should use relative humidity measurement points of 35 percent and 80 percent instead of 25 percent and 95 percent in order to yield representative results. The PRC asserted that a 25 percent relative humidity (RH) level would likely not require an anti-sweat heater and 95 percent RH conditions are rare. (PRC, No. 15.1 at p. 4) Whirlpool and Electrolux noted that the infiltration load (i.e. the thermal load added to the refrigeration system associated with leakage of ambient air into the cabinet) increases as ambient humidity increases. Hence, the adjustment factor determined using the measurement would include an adjustment for infiltration that is not associated with the anti-sweat heaters, which would exaggerate the impact of the heater energy use. (Whirlpool, Public Meeting Transcript, No. 10 at p. 167; Electrolux, Public Meeting Transcript, No. 10 at p. 71–73).

NRDC supported DOE's proposal to measure variable anti-sweat heater energy and to define the moisture content of the test chamber. (NRDC, No. 21.1 at p. 4) NRDC suggested that DOE should allow manufacturers to apply for a waiver to avoid the test burden associated with achieving 95 percent RH and allow manufacturers to use an alternative maximum-humidity condition for the test. NRDC also indicated that manufacturers should report the anti-sweat heater wattages at different humidity levels to aid DOE's verification efforts. *Id.* ACEEE noted that Thermotron, Cincinnati Sub Zero, and Scientific Climate Systems all supply temperature- and humidity-controlled environmental chambers capable of achieving a relative humidity range of 20 percent to 98 percent within 2–3 degrees of accuracy. (ACEEE, No. 19.1 at p. 2).

NIST also made a general request during the public meeting that DOE require manufacturers to report their heater control algorithms in certification reports. NIST also requested that DOE modify the test requirements to ensure that the humidity levels used during testing are selected based on the algorithm details to provide the most appropriate test for verifying the performance of a tested product's anti-sweat heater. (NIST, Public Meeting Transcript, No. 10 at pp. 75–76) Electrolux also pointed out that different products may use different control strategies. (Electrolux, No. 17.2 at p. 1, cell H53).

The IOUs recommended that DOE investigate VASH control characteristics to ensure that the test procedure favors those systems that use more adaptive controls. The IOUs also asked that DOE consider requiring confirmation during the test that the anti-sweat heater is off at the 25 percent RH condition to prevent circumvention of the test procedure. (IOUs, No. 14.1 at p. 4). Fisher & Paykel also voiced concern about the potential for circumvention associated with heaters that do not deactivate at 25 percent RH (Fisher & Paykel, No. 24.3 at p. 2). The company explained that because the incremental energy use associated with the proposed test at 65 percent and 95 percent relative humidities involves subtracting the measured energy use of those tests from the energy use measured in the 25 percent relative humidity test, any activation of the heaters in the 25 percent test would increase the energy measured in the 25 percent test, which would reduce the incremental energy use calculated by the subtractions for the 65 and 95 percent tests. A manufacturer can simply reduce the energy use adjustment determined for the anti-sweat heaters (which is determined based on the incremental measurements of the 65 and 95 percent tests) by allowing activation of the heaters during the 25 percent test. However, DOE notes that this concern was intended to be alleviated in the proposed procedure by also requiring that the 90 °F ambient test be conducted using sensor-based deactivation of the heaters, also in a 25 percent relative humidity ambient. Any reduction of measured heater energy use in the 72 °F/25 percent relative humidity test due to heater activation would be negated by higher energy measurement in the 90 °F/25 percent relative humidity test.

Fisher & Paykel also indicated that the proposed equations for the energy differences at 65 percent and 95 percent relative humidities presented in the proposed new Appendix A were incorrect, using minus signs where equals signs should have been. (Fisher & Paykel, No. 24.2 at p. 3). See 75 FR at 29864.

DOE acknowledges the potential burden associated with the proposed VASH test procedure and that the proposal did not fully address all VASH control variants, nor the possibility of exaggeration of the measurement as a result of infiltration (as suggested by the Electrolux and Whirlpool comments). Notwithstanding this fact, DOE continues to believe that the adoption of a measurement-based test as opposed to a calculation to account for the energy use of products employing these types of control systems is critical to ensuring that the procedures yield meaningful information regarding the performance of products equipped with these systems. Without such a method, DOE's ability to resolve cases of circumvention (i.e. a manufacturer claiming that a product has variable anti-sweat heater control when it does not) would be significantly weakened. This is because, although DOE could conduct tests to verify manufacturers' claims regarding their control algorithms, as suggested by some stakeholders (AHAM, No. 16.1 at pp. 2–3; Fisher & Paykel, No. 24.3 at p. 1; Whirlpool, No. 12.1 at pp. 4–5), the test procedures used for such verification are not codified and could be called into question. Also, the direct measurement of anti-sweat heater wattage as suggested in the comments may be difficult or impossible, depending on the routing of wires to these heaters. However, in lieu of a more comprehensive VASH test procedure, DOE is codifying the procedure that DOE previously approved as part of the test procedure waivers granted to several manufacturers. This approach will provide a uniform method to help account for the energy used by these systems until such time that DOE re-examines this procedure and decides on potentially more comprehensive modifications. Hence, the GE waiver procedure has been adopted in Appendices A1 and A.

DOE believes that the use of the averaging credit for products with anti-sweat heaters and VASH control is inconsistent with field usage, because, as described in the NOPR, an anti-sweat heater switch is not likely to provide additional savings if the VASH controls already respond to ambient conditions and turn off the heaters when they are not needed. 75 FR 29837. However, DOE believes that this provision should remain in place at this time, as specified in the GE waiver procedure, because without the ability to turn off the anti-sweat heater with such a switch, it would be difficult to conduct the test as specified in the waiver because turning off the heaters would require disconnecting the wires supplying their power, which may be difficult or impossible with damaging the product. It is not clear that universally-applicable instructions could be developed for running the 90 °F ambient test with the anti-sweat heater disengaged for products without such switches. Developing a general procedure addressing VASH systems would likely need to include development of an approach to address this issue for these products in order to ensure that the procedure provides results comparable to the energy usage found in the field.

DOE also sought comment on whether the VASH test procedures should apply to freezers as well as refrigerator-freezers. AHAM and Fisher & Paykel both indicated that these test procedures should apply to freezers (AHAM, No. 16.1 at p. 3: Fisher & Paykel, No. 24.2 at p. 1). Based on these responses, the final rule will add these procedures to Appendices B1 and B.

10. Elimination of Part 3 of the Variable Defrost Test

DOE proposed eliminating the optional third part of the test currently in place for products equipped with a variable defrost capability. 75 FR 29839–29840. The current procedure, which appears at 10 CFR part 430, subpart B, appendix A1, section 4.1.2.3, was added to the test procedures in 1989. 54 FR 36238. This test was designed to measure the mean time between defrosts for variable defrost-equipped products. DOE included this optional step to provide manufacturers with an alternative to the default specification for the CT value (10 CFR part 430, subpart B, appendix A1, section 5.2.1.3) that would ordinarily be used when calculating energy use. (CT represents the number of hours of compressor operation between defrost cycles)

As the NOPR explained, the time required to conduct this part of the test ranges from 1 to 2 weeks. To ascertain the impact on accuracy of using the default calculation for CT rather than the optional test, DOE tested a variable defrost product using the optional procedure. The test results showed that the calculated energy use using the CT determined by the optional third part of the test differs from the energy use determined using the default value of CT by less than 0.4% (Third Part Test, No. 33 at p. 1, cell E57). DOE is unaware of any manufacturer that has used the optional procedure to rate a refrigeration product, which indicates to DOE that the industry generally considers the default equation for CT to be adequately represent the performance of variable defrost systems. For this reason, and to simplify the test procedure, DOE proposed to eliminate this optional test from Appendices A1, B1, A, and B. 75 FR 29839–29840.

Both AHAM and Whirlpool supported the proposal to eliminate the optional third part of the test. (AHAM, No. 16.1 at p. 6; Public Meeting Transcript, No. 10 at p. 111; Whirlpool, No. 12.1 at p. 4) DOE did not receive any comments from manufacturers or other parties that indicate that the test has been used to rate a product's energy use. DOE did not receive any comments in favor of retaining this optional step. Hence, DOE has decided to adopt its proposal to eliminate this optional step.

11. Corrections and Other Test Procedure Language Changes

This section discusses three other amendments to the current test procedure.

Simplification of Energy Use Equation for Products With Variable Defrost Control

DOE proposed modifying Appendix A1 by removing the clarifying equations for F, $ET_M$, and $ET_L$, eliminating references to the optional third part of the test (see section III.D.10 above, which discusses eliminating this part of the test), and correcting the units in the definitions for $CT_M$ (maximum time between defrosts in hours of compressor run time) and $CT_L$ (lowest time between defrosts in hours of compressor run time). Additionally, DOE proposed 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.) 75 FR 29840.

AHAM supported the proposed modifications. (AHAM, No. 16.1 at pp. 6–7) Fisher & Paykel commented that the proposed language would not sufficiently clarify that the CT, $CT_M$ and $CT_L$ values represent compressor run time rather than clock time.

In order to address Fisher & Paykel's comment, DOE has modified the sections of the test procedure that use CT in the energy use equations (e.g. sections 5.2.1.2 through 5.2.1.5 of the new Appendix A) to help clarify that these values represent compressor run time rather than clock time. DOE notes that not all of these sections required exactly the same modifications. Similar adjustments have also been made in Appendices A1, B1, and B.

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

DOE proposed to amend Appendix A1 to correct certain errors in the instructions for testing dual automatic defrost-equipped products. These proposed amendments affected two areas. First, DOE proposed to modify the text in section 4.1.2.4 of Appendix A1 to explicitly include the compressor and defrost heater in the list of components associated with each system that must have their energy use separately measured. Second, DOE proposed to correct errors in the energy use equation that addresses this class of products (section 5.2.1.5 of Appendix A1 of the current test procedure). 75 FR 29841.

DOE received no comments objecting to these proposed changes. However, AHAM suggested that DOE adopt a different approach. Specifically, AHAM suggested removing the dual compressor system equations of section 5.2.1.4, removing the proposed test procedure for products with multiple defrost cycle types (proposed as section 5.2.1.6 of Appendix A—see section III.E.2 below), and inserting a more general procedure addressing multiple compressor systems as well as single-compressor systems with more than one active defrost cycle. AHAM's written comments included a draft test procedure for DOE's consideration. AHAM explained that the modified equations would be simpler and more efficient, and that, because they are under consideration by the IEC and other countries, their adoption would enhance international standards harmonization. (AHAM, No. 16.1 at p. 7) Sub Zero supported AHAM's comment regarding this issue. (Sub-Zero, No. 23.1 at p. 1)

DOE notes that a key distinction between the energy use calculations of proposed section 5.2.1.6 and the calculations of section 5.2.1.4 is that the former applies to products with a single compressor with multiple defrost cycle types, while the latter applies to products with two compressors. DOE believes that testing products equipped with two compressors is significantly more complicated than testing products with single compressors and multiple defrost cycle types because, when conducting the second part of the test that measures defrost cycle energy use for one of the two or more refrigeration systems, the operation of these other compressors continues. Unless the average energy use of these compressors and their fans is the same during the second part of the test conducted for the first compressor as it is for the first part of the test, the difference in their energy use for the two parts of the test will be added to or subtracted from the first-compressor defrost cycle energy measurement. The only way to avoid this addition or subtraction is by separately measuring the systems during both the first part of the test and during the second part of the test. In contrast, for a system with a single compressor but multiple evaporators, the compressor turns off during the defrost cycle for any of the evaporators, which allows the product's measured overall energy use to accurately measure defrost cycle energy use. Hence, establishing the proposed section 5.2.1.6 will both permit a simpler approach to testing single-compressor products with multiple defrost cycle types and ensure that energy measurement for these products is accurate.

After analyzing this alternative proposal for multiple compressors, DOE does not believe that it simplifies testing of systems with two or more compressors. In particular, it does not alleviate the test procedure burden associated with having to separately measure the energy use for the different systems, which is part of the procedure of the current dual-compressor product test procedure. DOE understands that this is a key difficulty in testing such systems since it introduces burden and that, in some cases, it may be impossible to accomplish, depending on the details of the internal wiring of such products. DOE is not convinced that AHAM's approach avoids the need for a separate measurement. AHAM's proposed equation includes a term $EP2_j$ that is defined as the average power for system "j" while system "i" is in defrost and recovery. Measuring the average power for this system would still require a separate measurement, as provided under the current test procedure for dual compressor systems. Thus, the AHAM-proposed procedure appears to represent little or no improvement over the current procedure.

DOE acknowledges that this final rule does not eliminate the difficulty of obtaining separate energy use measurements required in the test procedure for dual compressor products. However, as discussed above, neither does the AHAM-proposed approach. Additionally, as far as DOE is aware, the AHAM procedure has not been subject to the review of interested parties. It is a fairly complex procedure and its adoption into DOE's regulations would require review and comment by the public. In light of DOE's statutory obligation to finalize the refrigeration product energy conservation standard rulemaking by the end of this year, a complete evaluation of AHAM's procedure is not possible within the context of this rulemaking. Hence, DOE has retained in Appendices A1 and A, the dual-compressor system test procedure with the modifications proposed in the NOPR. DOE may consider further revising this part of the procedure in a future rulemaking to address the measurement issues discussed in this section and may reconsider AHAM's proposal at that time.

Freezer Variable Defrost

This section discusses an issue independently raised by stakeholders and is not directly related to any of the specific NOPR proposals. In the test procedures set out for variable defrost-equipped freezers, AHAM pointed out that the energy use equations are missing the freezer correction factor k. (AHAM, No. 16.1 at p. 11) The factor k adjusts the measured energy use for freezers for consistency with consumer usage patterns of these products. Its value is 0.85 for upright freezers and 0.7 for chest freezers. Applying these values means that the calculated energy use of upright freezers is 15% lower than the measured energy use. Correspondingly, the calculated energy use of chest freezers is 30% lower than the measured energy use.

DOE notes that the other energy use equations of the current version of Appendix B1 (sections 5.2.1.1 and 5.2.1.2), which collectively address products that are not equipped with variable defrost, include the factor k. Variable defrost was introduced into the test procedures for refrigerators, refrigerator-freezers, and freezers in the 1989 final rule. 54 FR 36238. That final rule did not address the omission of the freezer correction factor in the equations for energy use of freezers with variable defrost. From the absence of any discussion of this issue in the preamble, there is nothing to suggest that DOE intended to treat variable defrost freezers differently from freezers not having this type of control. Hence, today's final rule corrects this oversight.

12. Including in Certification Reports Basic Information Clarifying Energy Measurements

This section describes amendments for reporting that were proposed in the NOPR but will be adopted in the CCE rulemaking. 75 FR 56819. DOE proposed to modify its regulation to require that certification reports explain how products with advanced controls features (e.g. variable defrost control or variable anti-sweat heater control) or with temperature sensor locations different from the standard locations are tested. 75 FR 29841–42. The energy use of such products cannot be measured properly without knowing specific information regarding these control systems or how 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 proposed that information clarifying these test details be included in certification reports. *Id.*

DOE proposed that manufacturers identify in their certification reports whether the product has (1) variable defrost control, and if so, the values of $CT_L$ and $CT_M$ used in the energy use calculation, (2) variable anti-sweat heater control, and (3) internal design details requiring adjustment during testing of temperature sensor locations from their standard locations. The NOPR proposed modifying 10 CFR 430.62(a)(4)(xii) to implement these changes. This section of the CFR lists the information specific to refrigeration products that must be provided in certification reports. The NOPR proposed that the relocation of temperature sensors from standard locations be allowed without petitioning for a waiver only if the new locations are no more than 2 inches from the standard locations. *Id.*

DOE sought comment and suggestions on its proposal. AHAM and Whirlpool supported adding the proposed data to the certification report reporting requirements if parallel changes are made to DOE's online data submission template. (AHAM, No. 16.1 at p. 11; Whirlpool, No. 12.1 at p. 8) However, AHAM added that the temperature sensor locations would need to remain confidential until the certification reports are submitted to DOE. (AHAM, Public Meeting Transcript, No. 10 at p. 48) As described in section III.D.3, stakeholders opposed using the waiver process for reporting any deviation from the standard locations. DOE has decided not to include a requirement for waivers in case of temperature sensor relocation since it will be receiving this information as part of a certification report.

Stakeholders also encouraged DOE to add a requirement to report the wattage values used in the variable anti-sweat heating energy use calculation. See Section III.D.9, above. Based on these comments and the absence of any objections, DOE is modifying this proposal within the context of the CCE rulemaking to require manufacturers to report the wattages used in the variable anti-sweat heating energy use calculation for products having this type of control system.

Any such changes that DOE may make to these reporting requirements would be made through the ongoing CCE rulemaking and would be set out in a new 10 CFR part 429. 75 FR 56819. DOE will also make any necessary updates to its online data submission template as appropriate.

13. Rounding Off Energy Test Results

DOE requested comment on whether it needed to clarify the test procedure to specify the required precision in reporting refrigeration product energy use. 75 FR 29847.

AHAM and Whirlpool both supported rounding annual energy use to the nearest kilowatt-hour. (AHAM, No. 16.1 at p. 10–11; AHAM, Public Meeting Transcript, No. 10 at p. 162; Whirlpool, No. 12.1 at p. 7) No commenters objected to this approach. Hence, with this final rule, DOE will implement this requirement in 10 CFR 430.23(a), for refrigerators and refrigerator-freezers, and in 10 CFR 430.23(b), 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. Hence, DOE also proposed that the maximum allowable energy use under the energy conservation standard be rounded to the nearest kilowatt-hour as part of the energy conservation standard rulemaking. 75 FR 59570.

Because this change is primarily clerical and does not represent a change in the measured energy use of these products, DOE is not delaying the implementation of this provision as part of the new standards that are under consideration for 2014. Accordingly, this provision will be inserted into 10 CFR part 430, subpart C, section 32(a).

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

This section discusses additional proposed changes that would apply to manufacturers when demonstrating compliance with any standard levels that DOE sets as part of its parallel rulemaking for amended energy conservation standards, scheduled to take effect in 2014. DOE had initially proposed that two of these changes be required for testing products prior to the compliance date of the new energy conservation standards, but, due to stakeholders comments, DOE has shifted these so that they will be required for testing starting on the compliance date of the new energy standards. These two changes include (1) modifying the test procedures for products with long-time or variable defrost functions to capture precooling energy use and (2) establishing test procedures for products with multiple defrost cycle types. (Sections III.E.1 and III.E.2 below discuss these amendments.) DOE further notes that some of the amendments that it had proposed have been modified to mitigate their potential impacts. These include the proposed amendments affecting convertible and special compartments and test procedures for products with variable anti-sweat heater control, discussed in sections III.D.5 and III.D.9 above. These changes were made to help ensure that manufacturers obtain test results that are representative of average consumer use.

Responding to the NOPR, stakeholders commented that DOE should adjust the new energy conservation standard to address the potential changes in measured energy use associated with several of the proposed test procedure amendments. AHAM and ACEEE jointly commented that if DOE adopts the energy standards jointly proposed by industry and energy advocates, the standards should be revised to ensure that there is no change in the stringency of the allowable energy use before and after the changes to the test procedures. (Joint Comments, No. 20.1 at p. 3) The standard levels proposed in the energy conservation standard NOPR (see 75 FR 59471–59472) were set taking into consideration the impacts of the compartment temperature changes and the modified volume calculation method. These test procedure amendments are described below in sections III.E.4 and III.E.5. Commenters indicated that additional adjustment of the new energy conservation standards might be necessary. These issues are discussed in other sections of this notice. However, DOE notes that the adjustment of the energy conservation standard is not within the scope of today's notice and does not provide a final resolution of these issues.

1. Modification of Long-Time and Variable Defrost Test Method To Capture Precooling and Temperature-Recovery Energy

DOE proposed to revise the test procedures for products with long-time or variable defrost to capture precooling energy. 75 FR 29837–29839. Long-time defrost is defrost control in which compressor run time between defrosts exceeds 14 hours. Variable defrost is a type of defrost control in which the time interval between defrosts is adjusted based on need, i.e. when a sufficient amount of moisture has collected on the evaporator as frost to reduce refrigeration performance.

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. This technique may be employed in certain systems to limit maximum freezer compartment temperature during defrost cycles. A precooling control system initiates an extra long compressor run 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. An extra long compressor run is one where the compressor on-cycle continues for at least 10% longer than 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.

Although precooling consumes energy in refrigeration products used by consumers, the current test procedure does not include this energy use. The current long-time defrost test (used also for products with variable defrost) 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 the energy use contribution associated with the defrost cycle. The second part of the test starts when the last compressor cycle before the defrost stops. Appendix A1, section 4.1.2.1. If this last compressor cycle is a precooling cycle, representing more average energy use than is measured during part 1 of the test, the test cannot measure all of the energy use associated with the defrost cycle. This situation presents a potential loophole in the current test procedure that the amendment described in this section is closing.

The DOE test procedure for products with automatic defrost in which defrost cycles are separated by less than 14 hours of compressor run time specify that the test period 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). This change, made to reduce test burden, was made at a time when control systems capable of precooling were not in general use—hence, the time period defined for the test did not include precooling compressor cycles. The change does not imply that DOE had intended that part of the energy use associated with defrost does not need to be measured.

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).

DOE proposed to make the following modifications to address precooling energy use:

• Modifying the long-time defrost test procedure description to read as follows.

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. 75 FR 29838–39.

• Modifying Figure 1, which shows the long-time defrost test period to reflect the proposed language discussed above and adding a second illustration showing the appropriate measurement technique when there is precooling. *Id.*

ACEEE, NRDC, and the IOUs supported the proposed language for the long-time automatic defrost test method (ACEEE, No. 19.1 at p. 3; NRDC, No. 21.1 at p. 4; IOUs, No. 14.1 at p. 5) Whirlpool supported modifying the test procedure to clarify that the second part of the test starts when the compartment temperatures are at steady state operation, adding parenthetically that this could be interpreted to mean within 0.5 °F. (Whirlpool, No. 12.1 at p. 6) GE supported the inclusion of a means to measure precooling energy use in the test procedure. (GE, Public Meeting Transcript, No. 10 at p. 97)

AHAM suggested that the test procedure specify that the average temperatures be the averages calculated from the first part of the long-time defrost test. AHAM also commented that the test procedure should rely on temperature control cycles instead of compressor time in order to address variable speed compressors. (AHAM, No. 16.1 at p. 8; AHAM, Public Meeting Transcript, No. 10 at p. 105)

Fisher & Paykel supported starting (and stopping) the defrost and recovery measurements in steady state conditions. (Fisher & Paykel, No. 24.2 at p. 2)

Electrolux expressed two key concerns regarding the proposed test procedure language. It noted that (1) the procedure must be able to address both cycling and variable-speed compressors and (2) the proposed test procedure does not sufficiently clarify how to determine when the test starts, i.e. what temperature criteria are used. (Electrolux, No. 17.2 at p. 1, cell H74)

AHAM, Whirlpool, GE, Electrolux, PRC, and NIST noted that the proposed modification to the test procedure for pre-cooling energy would affect tested energy use. (AHAM, Public Meeting Transcript, No. 10 at p. 104; AHAM, No. 16.1 at p. 8; Whirlpool, No. 12.1 at p. 6; GE, Public Meeting Transcript, No. 10 at pp. 96–97; Electrolux, No. 17.2 at p. 1, cell H74; PRC, No. 15.1 at p. 4; NIST, Public Meeting Transcript, No. 10 at pp. 103–104) AHAM, Whirlpool, GE, and NIST also indicated that this impact should be considered as part of the new energy conservation standard and that the test procedure amendment should not be implemented prior to 2014. *Id.*

DOE notes the contrast between statements of Fisher-Paykel indicating that the proposed language ("steady state conditions") is sufficient to describe the starting point for the second part of the test and those of Electrolux indicating that the start time is ambiguous. (Fisher-Paykel, No. 24.2 at p. 2; Electrolux, No. 17.2 at p. 1, cell H74) Whirlpool suggested that DOE quantify the temperature criterion for the start time of the second part of the test, i.e. 0.5 °F (Whirlpool, No. 12.1 at p. 6) DOE received later clarification that this statement meant that the second part of the test should start when the compartment temperature is within 0.5 °F of the average temperature of the first part of the test. (Clarification of Written Comments Submitted by Whirlpool Corporation, No. 35 at p. 2) DOE recognizes the value of providing a set specification, and the interim final rule addresses this concern.

As described below, DOE considered what criterion could be used to specify start of the second part of the test.

DOE notes that specifying a start time for the second part of the test when the compartment temperature is within 0.5 °F of its first-part average is not generally appropriate, because this requirement would conflict with the typical start time of the second part under the current test procedure for a product with a cycling compressor—at the end of a compressor on-cycle, when the compartment temperature should be near the minimum temperature measured during the first part of the test. However, DOE notes that selecting a start time for the second part when the compartment temperature is within 0.5 °F of its minimum temperature measured during the first part is also inappropriate, since a manufacturer could program a control to provide one temperature minimum during the first part at a low extreme and repeat this low extreme just prior to the defrost. The added energy use associated with the extended compressor operation to achieve this low extreme during the first part of the test might be mitigated in the energy use calculation because (a) an extended compressor shutdown as the compartment temperature rises again would lower measured energy use, (b) the relatively long duration of the first part of the test reduces the average power impact of the single extended compressor run, and (c) the average compartment temperature during this extended compressor run and its subsequent off period would be lower than during steady state operation, thus reducing the temperature measured for the first part of the test, which reduces the energy use calculated as described in Appendix A1, section 6.2. Such a control approach (initiating one extended compressor run during the first part of the test) could eliminate precooling energy from the energy use measurement without a significant energy use penalty (i.e. without a significant increase in the energy use measured during the first part of the test as a result of the single extended compressor run).

DOE considered a start for the second part of the test when the compartment temperature is within 0.5 °F of the average of the minimum temperatures achieved at the ends of each of the compressor runs during the first part. However, such a requirement would be complicated and potentially burdensome to calculate.

DOE will instead provide a specification based on the averaging of compartment temperatures over a full compressor cycle to clarify what it means to be at the end of such a period of steady state operation. The clauses describing the starting time for cycling compressor systems during the second part of the test is as follows: "* * * the second part starts at the termination of the last regular compressor "on" cycle. The average temperature of the compartment measured from the termination of the previous compressor "on" cycle to the termination of the last regular compressor "on" cycle must be within 0.5 °F of the average temperature of the compartment measured for the first part of the test." This change responds to stakeholders' desires for a specification based on temperature measurement.

In response to the concerns expressed by AHAM and Electrolux regarding the treatment of products with variable-speed compressors, DOE's proposed language specifies how to start the test for such products. To cover these systems, the proposal included the following language: "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." 75 FR 29839. However, DOE agrees with AHAM that the reference to steady state operation for this part of the test procedure should clarify that the reference is to the steady state operation of the first part of the test. Hence, DOE will modify this text to read, "the second part starts at a time before defrost during stable operation when the compartment temperature is within 0.5 °F of the average temperature of the compartment measured for the first part of the test." The clause uses "stable operation" rather than "steady state" to distinguish from the definition of steady state in Appendix A1 section 2.5.

Responding to comments that the proposed test procedure amendment to address precooling would alter the measured energy use, DOE has decided to remove this proposed language from Appendices A1 and B1 and to retain them for Appendices A and B. In DOE's view, 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). To ensure that its procedures sufficiently measure the energy consumption of these regulated products, DOE believes it is necessary to capture the energy consumption of precooling systems.

Amendments To Address Partial Recovery

DOE also requested comment on whether DOE should consider an amendment in the long-time and variable defrost test procedure to capture energy use associated with temperature recovery after the end of the second part of the test currently contained in the test procedure. (the "partial recovery" issue) 75 FR 29839.

The energy use associated with the defrost cycle includes energy used by the refrigeration system to remove the heat added to the compartment by the defrost heater and the thermal load added to the compartment while the compressor was not operating. The compressor runs for an extra long period after defrost to remove this heat and bring the compartment temperature down to the levels typical for steady state. For a cycling compressor system, this generally means that the temperature at the end of this long run would be close to the typical temperature measured during the first part of the test after each regular compressor on-cycle. The second part of the test ends when the compressor starts the second time after defrost (see Appendix A1 section 4.1.2.1). If the compartment temperature at the end of the first long compressor run after defrost is still significantly warmer than the typical first part compressor-stop temperature, a portion of the post-defrost cooldown is not captured by the second part of the test, and part of the energy used during consumer use is not measured by the test. As with precooling, this is a loophole in the test procedure that the amendments described in this section are closing.

DOE did not propose a specific method to address partial recovery. Instead, DOE raised three possible options for stakeholders to consider, including (1) providing a temperature recovery specification for the compartment to define the end of the second part of the test, (2) extending the test by a specific amount of time after the defrost to assure temperature recovery, or (3) considering the average compartment temperature measured during the second part of the test when determining the average temperature that is used in the energy use calculation interpolation. 75 FR 29839.

Stakeholders generally supported amending the procedure to capture the energy use associated with temperature recovery. NIST suggested that test procedure changes should be made to address partial recovery. It noted Working Group 12 of Technical Committee 59 of the IEC, which is developing IEC 62552, an international standard for testing refrigeration products, is considering incorporating the temperature of the second part of the test when calculating energy use. (NIST, Public Meeting Transcript, No. 10 at p. 104) Fisher & Paykel commented that the second part of the test should both start and end during steady state conditions. (Fisher & Paykel, No. 24.2 at p. 2) ACEEE and the IOUs supported DOE's proposal to address partial temperature recovery. However, the IOUs noted that SCE found through its own testing of several products that the impact of partial recovery on energy use was small. (ACEEE, No. 19.1 at p. 3; IOUs, No. 14.1 at p. 5) ACEEE recommended that DOE specify that the automatic defrost test continue until average freezer temperature is within 0.5 °F of the average lowest temperature attained during steady-state operation. (ACEEE, No. 19.1 at p. 3)

AHAM requested that DOE use a holistic approach in modifying the test procedure to address both precooling and partial recovery. (AHAM, No. 16.1 at p. 8)

DOE considered different approaches to address partial recovery in the second part of the test, as described below.

DOE first considered the approach suggested by NIST in treating partial recovery. DOE concluded that such an approach would increase the measured energy use of refrigeration products, whether or not they exhibit partial recovery, since the energy use interpolation would be based on a measurement associated with a higher temperature. This result would occur because the energy use is calculated as an interpolation, which is a weighted average of the two measurements made at the two different temperature control settings. (See, e.g., Appendix A1, section 6.2.2.2) The first equation in this section is $E = ET1 + ((ET2 - ET1) \times (45.0 - TR1)/(TR2 - TR1))$, where E is the energy use, ET1 and ET2 are the energy use measurements for the first and second tests, respectively, and TR1 and TR2 are the fresh food compartment temperatures for the first and second tests, respectively. In those cases where T2 is warmer than T1, ET2 would be less than ET1 (less energy would be measured when the compartments are warmer). The equation can be rearranged to read:

$$ET = ET1\left(\frac{T2 - 45}{T2 - T1}\right) + ET2\left(\frac{45 - T1}{T2 - T1}\right)$$

If both T1 and T2 were raised by a fixed increment, associated with including the temperature measured during the second part of the test in the compartment temperature measurement, the value used to multiply ET1 in the equation would increase, and the value used to multiply ET2 would decrease. This result would increase the weighting of ET1, the higher energy use measurement, in the calculation for ET. In order to maintain better consistency with the current test procedure and avoid an energy standard adjustment to be applied to all products with long-time or variable anti-sweat heater control, DOE rejected applying the compartment temperature measured during the second part of the test to this equation.

DOE next considered the approach suggested by ACEEE to require the second part of the test to continue until the compartment temperature is within 0.5 °F of the average lowest temperature attained during steady state operation. DOE points out two issues with this approach, as follows.

First, the current test procedure requires the second part of the test to stop when the compressor cycles on the second time after the defrost. 10 CFR part 430, subpart B, appendix A1, section 4.1.2.1. The test stop time suggested by ACEEE, when the compartment temperature is within 0.5 °F of a minimum temperature measured in the first part of the test, is a time at the end of a period of compressor operation, since the compressor must operate to bring the temperature down to this minimum, and the compartment temperature starts to increase again shortly after the compressor stops. Using a stop time for the second part of the test when the compressor stops would make a significant impact on the measured energy use, as reported in the NOPR public meeting presentation. (Public Meeting Presentation, No. 9 at p. 53)

Second, the "average lowest temperature" is the average of the series of minimum temperatures associated with the ends of compressor on-cycles during the first part of the test. Such an average would be burdensome to calculate, as described above in the discussion of precooling.

DOE agrees, however, with using a temperature specification rather than a compressor event to determine the stop time for the second part of the test. DOE feels this is appropriate because the temperature is an indicator of the thermal state of the product, while the control system could start and stop the compressor at any time, whether or not stable conditions have been reached. Consistent with the amendment described above associated with the start time of the test, the new amendment will provide a means to indicate for systems with cycling compressors whether a given system has re-entered steady state operation. This amendment will provide that "[t]he test period for the second part of the test ends at the initiation of the first regular compressor cycle after the compartment temperatures have fully recovered to their stable conditions." Additionally, "[t]he average temperature of the compartment measured from this initiation of the first regular compressor "on" cycle until the initiation of the next regular compressor "on" cycle must be within 0.5 °F of the average temperature of the compartment measured for the first part of the test." These changes will appear in Appendices A and B in a new section 4.2.1.1.

For products with variable speed compressors, specifying a stop time for the second part of the test is similar to the specification of start time. In this instance, "[t]he second part stops at a time after defrost during stable operation when the compartment temperature is within 0.5 °F of the average temperature of the compartment measured for the first part of the test." This is a simple requirement, consistent with the requirement for start of the second part of the test, and consistent with the recommendations of AHAM to address variable speed compressors.

The selection of stop times for the second part of the test, as described above addresses both cycling and variable speed compressors. It also uses compartment temperature rather than compressor cycling to define the test—both of these test characteristics were specifically requested by stakeholders. See the discussion above in this section. For non-cycling compressors, this amendment also reduces test time by allowing for the second part of the test to terminate prior to the four hours currently required by the test procedure. The current procedure specifies that the second part "terminates at the second turn "on" of the compressor or four hours from the initiation of the defrost heater, whichever comes first." 10 CFR part 430, subpart B, appendix A1, section 4.1.2.1. DOE will, however, retain the 4-hour limit for the second part of the test, to limit test duration in case of extremely slow recovery.

The modified procedure for the second part of the test that DOE is adopting today for incorporation as section 4.2.1 reads as follows: [8]

*4.2.1 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 a stable period of compressor operation that includes no portions of the defrost cycle, such as precooling or recovery, that is otherwise the same as the test for a unit having no defrost provisions (section 4.1). The second part is designed to capture the energy consumed during all of the events occurring with the defrost control sequence that are outside of stable operation.

*4.2.1.1 Cycling Compressor System*

For a system with a cycling compressor, the second part starts at the termination of the last regular compressor "on" cycle. The average temperature of the compartment measured from the termination of the previous compressor "on" cycle to the termination of the last regular compressor "on" cycle must be within 0.5 °F of the average temperature of the compartment measured for the first part of the test. If any compressor cycles occur prior to the defrost heater being energized that cause the average temperature in the compartment to deviate from the first part temperature by more than 0.5 °F, these compressor cycles are not considered regular compressor cycles and must be included in the second part of the test. As an example, a "precool" cycle, which is an extended compressor cycle that lowers the compartment temperature prior to energizing the defrost heater, must be included in the second part of the test. The test period for the second part of the test ends at the initiation of the first regular compressor cycle after the compartment temperatures have fully recovered to their stable conditions. The average temperature of the compartment measured from this initiation of the first regular compressor "on" cycle until the initiation of the next regular compressor "on" cycle must be within 0.5 °F of the average temperature of the compartment measured for the first part of the test. The second part of the test may be terminated after 4 hours if the above conditions cannot be met. See Figure 1.

*4.2.1.2 Non-cycling Compressor System*

For a system with a non-cycling compressor, the second part starts at a time before defrost during stable operation when the compartment temperature is within 0.5 °F

[8] DOE is also simplifying the numbering of section 4, which currently includes a section 4.1, but no section 4.2. The "1." representing the second level of the numbering system will be removed from all of the current section numbers.

of the average temperature of the compartment measured for the first part of the test. The second part stops at a time after defrost during stable operation when the compartment temperature is within 0.5 °F of the average temperature of the compartment measured for the first part of the test. The second part of the test may be terminated after 4 hours if the above conditions cannot be met. See Figure 2.

To help clarify these procedures, DOE is modifying the already existing Figure 1 by adding both power input and compartment temperature information. Accordingly, Figure 1 will show the relationship between compressor power input and compartment temperature. DOE has also provided a figure illustrating the second part test period for a non-cycling compressor system as a new Figure 2.

Additional Test Period and Temperature Measurement Procedure Changes

DOE determined that some additional test procedure changes are needed because of the compartment-temperature-based determination of start and stop times for the second part of the test. These changes include (1) further emphasis that the first part of the test does not include any portion of the defrost cycle such as precooling or temperature recovery, (2) use of the same test period for both energy and temperature measurements, and (3) clarification that if the defrosting of evaporators in both the freezer and fresh food compartments occurs simultaneously, the freezer compartment temperature shall serve as the basis of the second part start and stop. The first two changes are discussed in this section, while the third change is discussed in section III.E.2, below.

The current specifications for the first part of the test for products with long-time or variable defrost prescribe that "[a] first part would be the same as the test for a unit having no defrost provisions (current section 4.1.1)." (Appendix A1, section 4.1.2.1) Current section 4.1.1 specifies a test period at least three hours long and consisting of two or more whole number of compressor cycles; for non-cycling compressors, a three-hour test period is specified. (Appendix A1, section 4.1.1) This definition of the first part of the test does not clearly indicate that it may not include any portion of a precooling period or a recovery period. The inclusion of such periods would add to the energy measurement for the first part of the test some of the defrost cycle energy use, which is intended to be included only in the measurement for the second part of the test.

However, because of the current specification for determining the compartment temperature, including precooling and/or recovery periods within the first part of the test could also weaken the temperature-based definition for the start and stop of the second part of the test. Appendix A1, section 5.1.2.1, which applies to products with cycling compressors, specifies that the temperature measurement includes a number of complete compressor cycles equal to the number of minutes between temperature measurements rounded up to the nearest whole number. It also specifies that the last complete compressor cycle of the test period should be included in this measurement.

DOE believes that all testing is currently conducted using modern computer-based data acquisition systems[9] that provide much greater measurement capabilities at much lower cost than systems that were in use when the test procedures were first written. DOE believes that the time interval between measurements does not generally exceed 1 minute, which allows a technician to use the last complete compressor cycle of the test period of the first part of the test to determine the compartment temperature. If a test period is chosen that occurs just before a defrost cycle and includes a precooling cycle, the criterion for the start of the second part of the test may be the comparison of the average temperature for this precooling compressor cycle to itself, which is a meaningless comparison. Even if the last compressor cycle in the test period is not a precooling cycle, but is the last regular compressor cycle during stable operation, the criterion for the second part of the test could still be the comparison of the temperature measured for this period to itself, because (1) this last regular compressor cycle could be the basis of the temperature measurement for the first part of the test if it is the last compressor cycle in the test period, and (2) the new approach for determining start of the second part of the test compares the temperature average for this last regular compressor cycle to the temperature measurement for the first part of the test.

To remedy this situation, DOE is first modifying the current section 4.1.2.1 (to be renumbered section 4.2.1) to specify that the first part of the test includes only the stable system operation between defrosts that do not include any portions of the defrost cycle, "such as precooling or recovery". Second, DOE is modifying the temperature measurement procedures by requiring that temperature measurements be averages for the full test period specified in section 4. This will ensure examination of at least two compressor cycles to obtain the temperature measurement for the first part of the test, thus avoiding the meaningless comparison of a temperature to itself to determine start of the second part of the test. For non-cycling and incomplete-cycling systems, requiring examination of the same test period for energy use measurement and temperature measurement also strengthens the temperature-based determination of start and stop times for the second part of the test, because it avoids the current focus of the temperature measurement on the end of the test period used for energy measurement. (The current temperature measurement for non-cycling systems is for the last 32 minutes of the 3-hour test period (see Appendix A1 sections 4.1.1 and 5.1.2.2) and for incomplete-cycling systems it is for the last 3 hours of the 24-hour test period (see Appendix A1 sections 4.1.1 and 5.1.2.3)). In any case in which the control system reduces temperature (i.e. engages precooling) for the short temperature-measurement period, the new temperature-based determination of second-part start can be shifted to a time after this precooling has occurred. Hence, DOE is extending the temperature measurement to cover the entire test period for all of these system types.

These changes to sections 4 and 5 have been made in Appendices A and B.

2. Establishing Test Procedures for Multiple Defrost Cycle Types

DOE proposed adding procedures to address products with one compressor and two or more evaporators in which each evaporator undergoes active defrost cycles that use electric defrost heaters to melt frost. Also, DOE proposed adding a definition for "defrost cycle type" by defining this term as "a distinct sequence of control whose function is to remove frost and/ or ice from a refrigerated surface." 75 FR 29839. DOE noted in this proposed definition that there may be variations in the defrost control sequence, such as the number of defrost heaters energized, and that each of these variations establishes a separate distinct defrost cycle type. DOE also noted that defrost achieved regularly during the compressor off-cycles by warming of the evaporator without active heat addition

[9] See, for example, the data acquisition products offered by National Instruments, *http://www.ni.com/*.

is not a defrost cycle type. See generally 75 FR 29839.

Products with one compressor and multiple evaporators with active defrost may use multiple defrost cycle types. This amendment would not address products that are equipped with two or more evaporators that defrost simultaneously. In this case, there is only one defrost cycle type, which includes the defrosting of all of the evaporators. The procedure would also not address a product equipped with a freezer evaporator that undergoes conventional automatic defrost and a fresh food evaporator that undergoes off-cycle defrost (in which frost is melted between compressor cycles by the fresh food compartment air, which is above freezing temperature). Such a product also would have just one defrost cycle type, which consists of defrosting only the freezer evaporator.

DOE proposed these amendments to address primarily those products equipped with long-time or variable defrost. *Id.* Long-time defrost refers to defrost control in which defrost cycles are separated by 14 or more hours of compressor operation. Variable defrost refers to defrost control in which the compressor operation time between defrosts varies (and generally exceeds 14 hours). The proposal also clarified how to determine which defrost cycle test procedure should be used for products with multiple defrost cycle types—i.e. long-time, variable, or the simplified automatic defrost control procedure. (See, e.g. 10 CFR part 430, subpart B, appendix A1, section 4.1.2) This proposed clarification indicated that, assuming the defrost control is not variable, the test technician would consider the number of hours of compressor operation between defrosts for each of the defrost cycle types. If the largest of these numbers of hours is less than 14 hours, the current procedure from Appendix A1 section 4.1.2 (automatic defrost) would apply. Otherwise, the proposed test procedure for these products would apply. 75 FR 29839.

The point of the amended test procedure is to ensure that the energy use from each defrost cycle type, using the appropriate factors representing its frequency, is included in the total energy use calculation. Currently, the energy use for products with long-time or variable defrost (for conventional products having a single defrost cycle type) is calculated by adding the energy use from the measured steady-state operation between defrosts (the first part of the test) to the energy use from the defrost cycle (the second part of the test). See 10 CFR part 430, subpart B, appendix A1, sections 5.2.1.2 (long-time defrost) and 5.2.1.3 (variable defrost). The energy use per defrost cycle is adjusted in this energy use equation to account for defrost frequency. DOE proposed an energy use equation for products with multiple defrost cycle types that adds the energy use separately for each defrost cycle type and adjusts for the different defrost cycle frequencies that may be present. 75 FR 29839. The energy use equation provided in the proposal was generic, allowing for any number of defrost cycle types by using summation notation indicating that the defrost energy use contribution would be summed for all defrost cycle types. *Id.* at 29863.

Whirlpool supported the proposed changes that would address products with multiple defrost cycle types. (Whirlpool, No. 12.1 at p. 6) However, Whirlpool also indicated that this proposed amendment was one of several in the NOPR that would have a significant impact on a product's measured energy use, manufacturer cost, facilities, testing capability and/or lead time, and requested that it not take effect until 2014. (Whirlpool, No. 12.1 at p. 2) AHAM generally supported the proposal, but expressed several concerns. (AHAM, Public Meeting Transcript, No. 10 at pp. 108–109; AHAM, No. 16.1 at p. 9) These concerns included (a) the proposed time between defrosts of the freezer section may not apply to the fresh food section, (b) the presence of off-cycle defrost in the fresh food compartment should not make the proposed procedure applicable to a particular product, (c) DOE should clarify that the optional third part of the test to determine typical intervals between defrosts is not required, and (d) the proposed amendment would affect measured energy use and should be considered when DOE sets its new energy conservation standards for refrigeration products. AHAM also agreed with DOE's conclusion that the defrost cycle type with the longest compressor run time between defrosts should be the basis upon which to determine whether the long-time defrost test method would be applicable, and with DOE's decision not to include this amendment in test procedures for freezers. *Id.* However, AHAM indicated that it would prefer that DOE adopt the procedure proposed by AHAM for multiple compressor systems, intending that it apply to both multiple compressor products and products with single compressors and multiple active evaporator defrosts. (AHAM, No. 16.1 at p. 7; Clarification of Written Comments Submitted by AHAM, No. 34 at p. 2) Electrolux also supported the need to capture all defrost energy use in the test procedure, but expressed concern about the near-term introduction of this amendment, arguing that it should be delayed until 2014, when the new energy conservation standards take effect. (Electrolux, No. 17.2 at p. 1, cell H89)

Based on the stakeholder comments indicating that this test procedure amendment would impact measured energy use, DOE has decided to apply this amendment to Appendix A, thus, making it mandatory for manufacturers to use during product testing once the standards that DOE promulgates for 2014 must be met. This slight delay in implementation will also provide manufacturers with time to adjust to this new requirement. Consistent with the proposal, this amendment does not apply to freezers.

In DOE's view, the current energy test procedure does not include test procedures for products with multiple defrost cycle types. For this reason, there is no basis for manufacturers' claims that the amendment would impact energy use measurements. DOE has no documentation regarding the test procedures manufacturers are using to certify these products, and has received no petitions for waivers suggesting the need for any such test procedures. Hence, DOE has no information on which to form a decision on how to adjust the new energy conservation standard to account for these amendments. Until these amendments are required in conjunction with the 2014 standards, manufacturers introducing products equipped with multiple defrost cycle types should, consistent with 10 CFR 430.27, petition for a waiver since the modified version of Appendix A1 set out in today's notice will not include a specified method for capturing this energy usage. Manufacturers who attempt to measure the energy use of such products without a waiver would be unable to certify these products.

As for AHAM's comment regarding the need to consider the different time intervals between defrosts of the fresh food and freezer compartments, DOE agrees that such a need exists. This is the reason that DOE proposed this amendment. The procedure adds the energy use of the defrost cycles in accordance with their frequencies of occurrence (i.e. their different time intervals). However, the test procedure is designed to address defrost cycle types separately rather than fresh food and freezer compartment defrosts separately, as suggested by the AHAM comment. DOE proposed this approach because if the fresh food and freezer compartments are defrosted at the same time, it is impossible to measure the energy use associated with these defrost cycles separately. Even if the energy consumption of the two defrost heaters were separately measured, it is impossible to allocate the energy use of the single compressor separately to the two compartments. The entire defrost cycle type involving defrost of both compartments can be considered individually.

However, DOE recognizes that additional clarification must be provided for the defrost test period for defrost cycle types involving the defrosting of more than one compartment. Applying the compartment-temperature-based specifications for the start and stop times of the second part of the test as described in section III.E.1, rather than the current procedure's use of compressor start/stop times, raises the question of which compartment's temperatures serve as the basis of the specification. DOE believes that the temperature of the freezer compartment would provide a better indication of appropriate start of the second part of the test (prior to any precooling operation of the compressor), and would also provide a better indication of when steady state operation has been achieved after completion of the defrost cycle. This is because the melting temperature to which the evaporators must be heated to melt frost is a much greater deviation from normal compartment temperature for the freezer compartment than it is for the fresh food compartment. Hence, the amended procedure clarifies that the start and stop times for the second part of the test for defrost cycle types involving defrost of both fresh food and freezer compartments are determined by the freezer compartment temperatures. DOE notes that this clarification would apply even if there is only one defrost cycle type.

DOE also agrees with AHAM's comment that off-cycle defrost does not represent a defrost cycle type, and has modified the definition of defrost cycle type to make this clarification.

Regarding the optional third part of the test, DOE has eliminated this test from its test procedures, making further clarification unnecessary. (see section III.D.10).

Finally, DOE considered an additional complication associated with applying the proposed test procedure to refrigeration products. In particular, it is possible that there may be more than one interval in the compressor run time between the occurrences of a particular defrost cycle type. For instance, a product may employ a control system that initiates a defrost of both the fresh food and freezer compartment every 18 hours of compressor run time, and initiates defrost of only the fresh food compartment at intervals of 6 hours and 12 hours of compressor run time after the dual-compartment defrost. For such a product, the compressor run time interval between instances of the fresh-food-only defrost cycle type is both 6 hours and 12 hours.[10] For such instances, selection of the appropriate value for $CT_i$ for use in the energy use equation (see proposed section 5.2.1.6 of Appendix A (75 FR 29863)) is unclear. Determining the appropriate value for $CT_i$ should be based on the fact that the $12/CT_i$ ratio is intended to represent the frequency of occurrence of defrost cycle type "i" in a 24-hour period, subject to the assumption that compressor run time averages 50%.

DOE is unaware of any refrigeration products on the market to which this issue applies. However, in order to clarify the test procedure and to cover this possibility, DOE has inserted additional language as follows, in the section describing energy use calculation for systems with multiple defrost cycle types: "For cases in which there are more than one fixed CT value (for long-time defrost models) or more than one $CT_M$ and/or $CT_L$ value (for variable defrost models) for a given defrost cycle type, an average fixed CT value or average $CT_M$ and $CT_L$ values shall be selected for this cycle type so that 12 divided by this value or values is the frequency of occurrence of the defrost cycle type in a 24 hour period, assuming 50% compressor run time."

In summary, the interim final rule makes four changes to the proposal affecting products with multiple defrost cycle types. First, manufacturers need to comply with these amendments once the new standards for refrigeration products apply, rather than sooner. Second, it clarifies the definition for "defrost cycle type" by excluding off-cycle defrost. Third, it clarifies how to determine CT values in those products equipped with multiple defrost types if there is more than one compressor run time interval between instances of a particular defrost cycle type. And fourth, it clarifies that for defrost cycle types in which both fresh food and freezer compartments are defrosted, that the freezer compartment temperature is the basis of the start and stop times of the second part of the test.

[10] Let the "compressor operation time", COT of successive dual-compartment defrosts be 0 hours, 18 hours, 36 hours, etc. The COTs of the fresh-food-only defrosts are 6 hours, 12 hours, 24 hours, 30 hours, etc. The difference in COTs between successive fresh-food-only defrosts is 6 hours or 12 hours, depending on which pair of such defrosts is considered.

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

DOE proposed to incorporate references to AHAM Standard HRF–1–2008 in new Appendices A and B. 75 FR 29842.

The current DOE test procedures for refrigeration products 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. DOE proposed to adopt the most recent version of this industry procedure, HRF–1–2008, for products subject to the new energy conservation standards that DOE is currently considering for 2014. *Id.* HRF–1–2008 incorporates many changes, including new compartment temperatures and new volume calculation methods, which are discussed further in sections III.E.4 and III.E.5. Adopting the provisions in HRF–1–2008 for new compartment temperatures will alter the measured energy use of these products, as described in the NOPR. *Id.* The temperature and volume calculation method changes will change the adjusted volume (which is integral to the calculated energy use) because (1) the temperature changes affect the volume adjustment factors (adjusted volume is equal to the fresh food compartment volume plus the volume adjustment factor multiplied by the freezer compartment volume), and (2) the volume measurements themselves will change. Because the energy standards for refrigeration products express energy use as a function of adjusted volume, the temperature and volume changes necessitate a change in the energy conservation standard. DOE proposed that these amendments referencing HRF–1–2008 would take effect once any new energy conservation standards that DOE decides to adopt as part of its current standards rulemaking become required. *Id.*

Besides updating the existing test procedure references to HRF–1–2008, DOE also proposed including a reference to the definitions section of HRF–1–2008. *Id.*

In addition, DOE proposed including language explaining that in cases where the referenced sections of HRF–1–2008 and the regulatory language of 10 CFR part 430 conflict, the regulatory language takes precedence. *Id.*

AHAM and Whirlpool generally agreed with this proposal, mentioning that it would incorporate the most up-to-date industry standards and practices. (AHAM, No. 16.1 at p. 4; Whirlpool, No. 12.1 at p. 2) General Electric asked whether DOE would adopt updates of HRF–1 beyond HRF–1–2008 when they are established. (General Electric, Public Meeting Transcript, No. 10 at p. 124) DOE is open to considering these updates for inclusion if and when they are finalized.

Because no concerns were raised by stakeholders regarding these proposals, the interim final rule includes the amendments as proposed. The new Appendices A and B, referencing HRF–1–2008, will be required for testing to determine compliance with energy standards when manufacturers are required to comply with the new energy conservation standards.

4. Establishing New Compartment Temperatures

DOE proposed to adopt the new compartment temperatures described in section 5.6.2 of HRF–1–2008 and their associated volume adjustment factors found in section 6.3 of HRF–1–2008 into the DOE test procedures. 75 FR 29842–29843. These amendments will improve the test procedure's consistency with the actual use of refrigeration products in the field. The amendment will also help facilitate the international harmonization of appliance test procedures with IEC 62552. Reducing the energy test compartment temperatures for refrigerators (excluding all-refrigerators) and refrigerator-freezers will result in higher measured energy use because of the higher thermal load associated with the increased temperature difference between ambient conditions and the compartments. These compartment temperature changes also led AHAM to change the volume adjustment factors, which depend on compartment temperatures. Consistent with HRF–1–2008, DOE also proposed to make similar changes to its volume adjustment factors. DOE had proposed to implement these changes by adding appropriate regulatory text into Appendices A and B, rather than simply referencing HRF–1–2008. *Id.*

DOE invited interested parties to comment on this proposed change. ACEEE, AHAM, the IOUs, and Whirlpool generally supported the proposal to adopt the new compartment temperatures. (ACEEE, No. 19.1 at p. 2; AHAM, No. 16.1 at p. 8; IOUs, No. 14.1 at p. 4–5; Whirlpool, No. 16.1 at p. 5) GE and Whirlpool added that establishing new compartment temperatures will impact the energy conservation standard. (GE, Public Meeting Transcript, No. 10 at pp. 130–131; Whirlpool, Public Meeting Transcript, No. 10 at pp. 128–129) After considering these comments and considering the potential impacts that this change would be likely to have, DOE has decided to implement these changes as part of the amended test procedure that will be required with the new standards that DOE is considering. 75 FR 59470.

Specifically, ACEEE and the IOUs also expressed concerns related to DOE's examination of the potential changes in measured energy use stemming from the proposed amendments. These commenters suggested that DOE investigate the nonlinearity of energy use for products with smaller volumes. (ACEEE, No. 19.1 at p. 2; IOUs, No. 14.1 at p. 4–5) The preliminary TSD that DOE had published previously suggested the possibility of this nonlinearity. See Preliminary TSD, section 5.4.2.3 (Engineering Analysis [11]). DOE has not, however, received sufficient data to either confirm this nonlinearity or to permit it to develop a nonlinear energy use equation for these products. Accordingly, DOE could not account for this possibility within the context of the test procedure.

Under today's interim final rule, these new compartment temperatures and their associated volume adjustment factors will be incorporated into new Appendices A and B.

5. Establishing New Volume Calculation Method

DOE proposed to add the volume calculation procedure used in HRF–1–2008 to new Appendices A and B that would apply to all compliance testing for products required to meet the new 2014 standards that DOE is currently considering. 75 FR 29843. The proposed volume calculation method is simpler than the one contained in the current procedure and removes the subjective nature of the current method that test technicians use when estimating volume.

The NOPR invited interested parties to comment on this proposed change. ACEEE, AHAM, and Whirlpool supported the DOE decision to adopt new volume calculation methods. (ACEEE, No. 19.1 at p. 3; AHAM, No. 16.1 at p. 8; Whirlpool, No. 12.1 at p. 5)

In light of this support, and the absence of any comments objecting to its adoption, DOE is adopting this new method as part of the new test procedures contained in Appendices A and B. Adopting this new method offers a critical advantage over the current method. First, the use of this new method will improve the accuracy of volume reporting. Second, because the energy use equation that serves as the basis for each standard depends on the calculated adjusted volume for each product class, a more accurate volume calculation will also improve the accuracy of the calculation of the energy standard. As a result, the amendment will help improve compliance with the standard.

Additionally, DOE noted that HRF–1–2008 does not explicitly address how to treat automatic icemakers and ice storage bins within the context of the volume calculation method. (See section 4, "Method for Computing Refrigerated Volume of Refrigerators, Refrigerator-Freezers, Wine Chillers, and Freezers" of HRF–1–2008.) To address this shortcoming, DOE proposed that these elements be considered part of the internal volume for refrigerators and refrigerator-freezers (covered in Appendix A). DOE also proposed to apply this clarification to freezers (covered in Appendix B), since freezers could also be equipped with automatic icemakers. DOE sought comment on this approach. 75 FR 29843.

AHAM supported DOE's proposed clarification for automatic icemakers and ice storage bins, including its application to freezers. (AHAM, No. 16.1 at p. 8; AHAM, Public Meeting Transcript, No. 10 at p. 133) There were no comments objecting to this proposed amendment. In light of the additional clarity that this change would provide manufacturers when testing their products and the absence of any objections, DOE is amending its procedure to cover these icemaking-related components as part of the internal volume of refrigeration products as applicable. These clarifications will appear in both Appendices A and B.

Fisher & Paykel also raised an issue regarding the proposed volume calculation method. It noted that some manufacturers have tested products that have TTD ice service with their ice delivery chutes filled or covered. By testing products in this way, manufacturers would be able to reduce that product's measured energy use. The adjusted volume measurement may also be reduced (as would the calculated

[11] *Preliminary Technical Support Document:* U.S. Department of Energy–Office of Energy Efficiency and Renewable Energy. Energy Efficiency Program For Consumer Products: Refrigerators, Refrigerator-Freezers, and Freezers. November 2009. Washington, DC. *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/ref_frz_prenopr_prelim_tsd.pdf.*

energy standard for the product), but only slightly, because the volume reduction multiplied by the energy standard equation slope is generally less than the energy use reduction, thus providing the manufacturer an advantage with respect to compliance with the energy standard. Fisher & Paykel asserted that using such an approach may constitute circumvention of the test procedures. To address this potential problem, Fisher & Paykel suggested that DOE add an additional clarification to the proposed changes to the volume calculation method by requiring that "all chutes and throats required for the delivery of ice shall be free of packing, covers or other blockages that may be fitted for shipping or when the icemaker is not in use."

After considering Fisher & Paykel's concern and its proposed solution, DOE is adopting this clarification. DOE wants to ensure that the procedure that it adopts today provides sufficient clarity without leaving potential room for circumvention. To achieve this goal, DOE is inserting this additional requirement into section 2 of new Appendices A and B, as well as amended Appendices A1 and B1, to help clarify the test preparation process. DOE also believes that, as a practical matter, consumers will remove any such packing material or temporary covers during actual use of these products since they are likely to use these features (e.g., TTD ice service) rather than opt to let them remain dormant. Consequently, removing such packing material and/or covers is more consistent with consumer use of the product than permitting this material to remain in place during testing.

As with the incorporation of new compartment temperatures, DOE will incorporate the proposed volume calculation changes as part of the procedures that manufacturers must use when certifying compliance to the new energy standards that will be required for refrigeration products to meet in 2014.

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

Section III.D.4 above discusses two temperature control amendments that manufacturers must use prior to the promulgation of the new energy conservation standards that will apply in 2014. These amendments include (a) addressing products equipped with electronic controls for which exact median settings cannot be selected, and (b) modifying the DOE test procedure to include two standardized temperatures for products with both fresh food and freezer compartments. This latter change would help achieve some consistency with the test approach already used by manufacturers when selecting temperature settings for the second test that must be run.

The remaining amendments that will be required when determining compliance with the standards under consideration for products manufactured in 2014 are discussed in this section.

Refrigerator-Freezers and Refrigerators With Freezer Compartments

The NOPR discussed gaps present in the current procedure regarding refrigerator-freezers and refrigerators with freezer compartments. In particular, in certain cases, depending on the results of the first test, the current instructions in section 3.2 of Appendix A1 do not address: (1) Control settings for the second test and/or third test, and (2) which energy test results to use in the energy use calculations. The NOPR presented a chart illustrating the logic behind the temperature setting requirements according to the current test procedure for refrigerator-freezers and refrigerators with freezer compartments. The table is reproduced below as Table III.3.

The logic in the chart was presented to be consistent with the typical test practice of using the warm/warm setting only if both compartment temperatures are lower than the standardized temperatures in the first test. While this practice is inconsistent with the current DOE test procedure, as described above in section III.D.4, it is consistent with current manufacturer test practices. As discussed in the NOPR, the current procedure does not clearly address the temperature setting requirements for the second test, nor does it clearly indicate which test results to use when calculating total energy use, for Cases 2, 5, and 6 shown in Table III.3. DOE proposed to amend the test procedure to address this deficiency. 75 FR 29844–29845.

TABLE III.3—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 | 2 |
| | | | Fzr High FF Low | None | First and Second Tests. | 3 |
| | | | Fzr High FF High | None | First and Second Tests. | 4 |
| | Fzr Low FF High | Fzr Cold FF Cold | Fzr Low FF High | None | Not Clear | 5 |
| | | | Fzr Low FF Low | None | Not Clear | 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 |
| | | | 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.

In particular, DOE proposed to include a modified temperature setting logic chart in the test procedure in section 3.2 of Appendix A to clarify the temperature setting instructions. DOE pointed out that, under some scenarios, one or both of the compartments might not achieve the required standardized temperature when the temperature controls are in their coldest settings. *Id.* DOE requested comment on the proposed amendments but also asked stakeholders to consider whether disallowing an energy rating would be a more appropriate solution in those cases where a particular product's compartment temperatures cannot achieve the required standardized temperatures. In other words, what should happen to products that have compartments that are set to the coldest temperature setting but are warmer than the standardized temperatures prescribed in the test procedure?

As DOE explained in the NOPR, the inability to achieve the standardized temperatures may create a potential conflict with the product definitions. DOE offered a few examples to illustrate this situation. For example, if a refrigerator's fresh food compartment exceeds the standardized temperature for fresh food compartments during an energy test, the product might be considered not to meet the current refrigerator definition, which specifies the use of "temperatures above 32 °F and below 39 °F". (10 CFR 430.2) Thus, the questions presented to DOE are (1) whether such products can still be refrigerators, refrigerator-freezers, or freezers even if they are unable to attain the required standardized temperatures during testing and (2) whether these products should even be rated.

DOE received no specific comments on either the proposed temperature setting logic or the temperature setting instructions proposed for the currently undefined cases described above. Comments were received, however, regarding DOE's suggestion to prevent certification of products that do not reach the standardized temperatures when tested with their coldest temperature settings. ACEEE, AHAM, the IOUs, Earthjustice, Fisher & Paykel, NRDC, and Whirlpool all supported this approach. (ACEEE, No. 19.1 at p. 4–5; AHAM, No. 16.1 at p. 10; IOUs, No. 14.1 at p. 5–6; Earthjustice, No. 22.1 at p. 2; Fisher & Paykel, No. 24.2 at p. 3; Whirlpool, No. 12.1 at p. 7) In response to these comments, DOE will adopt the proposed revisions in temperature setting requirements, but with modifications to indicate that products that are incapable of meeting required test conditions (i.e., achieving the standardized temperatures when all controls are at their coldest settings) are not considered compliant with the applicable standards. These changes will be adopted in Appendices A and B.

The definitions for refrigerator, refrigerator-freezer, and freezer and the changes DOE is making to these definitions are discussed in sections III.A and III.B. Products that meet any of these definitions are considered to be covered products that are subject to DOE regulations. The new definitions all include temperature ranges for the products' compartments to help classify product types. However, as mentioned in section III.B, these temperature ranges are not strictly defined to apply solely to energy test conditions. Hence, if a refrigerator cannot maintain 39 °F compartment temperature with temperature controls in the coldest setting during an energy test, this does not mean the product is not a refrigerator and exempt from coverage. The new definitions specify that the product is designed to be capable of attaining the 39 °F temperature without specifying the ambient or other conditions. The implication is that a product designed to be a refrigerator that fails to meet 39 °F compartment temperature during energy testing cannot be certified. However, since it is a covered product, it cannot be sold as a product other than a refrigerator. Similar restrictions apply to the other products, i.e., the refrigerator-freezer and freezer.

DOE's temperature setting modifications will take effect once any new standards affecting products manufactured in 2014 become required. These amendments will appear in new Appendices A and B. The instructions will include the amendment, discussed above in section III.D.4, that modifies the test procedure for consistency with current industry practice (i.e., consideration of standardized temperatures for both compartments and use of the warm/warm setting only if both compartments are lower than their standardized temperatures in the first test). The procedure will also indicate that a product cannot be certified if it fails to achieve the required compartment standardized temperatures. Also, DOE will add to the test procedure a modified version of the test setting logic chart for basic refrigerators and refrigerator-freezers that is consistent with the new requirements. This modified table is presented as Table III.4 below.

TABLE III.4—INTERIM FINAL TEMPERATURE SETTING CHART FOR REFRIGERATORS AND REFRIGERATOR-FREEZERS

| First test | | Second test | | Energy calculation based on: |
|---|---|---|---|---|
| Settings | Results | Settings | Results | |
| Fzr Mid<br>FF Mid | Fzr Low<br>FF Low | Fzr Warm<br>FF Warm | Fzr Low<br>FF Low | Second Test Only. |
| | | | Fzr Low<br>FF High | First and Second Tests. |
| | | | Fzr High<br>FF Low | First and Second Tests. |
| | | | Fzr High<br>FF High | First and Second Tests. |
| | Fzr Low<br>FF High | Fzr Cold<br>FF Cold | Fzr Low<br>FF High | No Energy Use Rating. |
| | | | Fzr Low<br>FF Low | First and Second Tests. |
| | Fzr High<br>FF Low | Fzr Cold<br>FF Cold | Fzr High<br>FF Low | No Energy Use Rating. |
| | | | Fzr Low<br>FF Low | First and Second Tests. |
| | Fzr High<br>FF High | Fzr Cold<br>FF Cold | Fzr Low<br>FF Low | First and Second Tests. |

TABLE III.4—INTERIM FINAL TEMPERATURE SETTING CHART FOR REFRIGERATORS AND REFRIGERATOR-FREEZERS—Continued

| First test | | Second test | | Energy calculation based on: |
|---|---|---|---|---|
| Settings | Results | Settings | Results | |
| | | | Fzr Low<br>FF High | No Energy Use Rating. |
| | | | Fzr High<br>FF Low | No Energy Use Rating. |
| | | | Fzr High<br>FF High | No Energy Use Rating. |

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

All-Refrigerators and Freezers

DOE also proposed that a logic chart for single-compartment products be provided for all-refrigerators and freezers. 75 FR 29846.

Based on stakeholder comments, the test instructions for these products have been modified to prevent the rating of any product that fails to achieve the standardized temperature during testing with controls set at the coldest position. The logic chart for these products has also been modified accordingly. The modified chart is shown below as Table III.5.

TABLE III.5—TEMPERATURE SETTING CHART FOR ALL-REFRIGERATORS AND FREEZERS

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

DOE believes the test instructions listed in Table III.4 and Table III.5 should adequately address all test result possibilities for their respective products. First, for single-compartment products, the measured temperature for each test could either be higher or lower than the standardized temperature for each compartment. This scenario represents two possibilities for each of two tests, indicating a total of two multiplied by two, or four possibilities. Second, for two-compartment products, the temperature of each of the two compartments could be higher or lower than their standardized temperatures. This scenario represents four possibilities for each test. Hence, the maximum number of possible outcomes for such products is sixteen (fours tests multiplied by four possible outcomes). However, four of these possibilities are very unlikely. For example, if the freezer temperature is lower than the standardized temperature for the first test, which is conducted with the settings at the median position, and the next test is conducted with the settings in the coldest position, it is unlikely that the freezer temperature will rise above its first-test measurement during the second test to exceed the standardized temperature. Four of the sixteen possible outcomes are eliminated based on similar considerations. All of these test procedure changes will become mandatory for testing on the compliance date of any new energy conservation standards that DOE decides to adopt for products manufactured in 2014.

7. Icemakers and Icemaking

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). As stated in the NOPR, DOE estimates that the energy use associated with automatic icemaking is in the range of 64 to 73 kWh and represents 10 percent to 15 percent of the rated energy use of typical refrigeration products. 75 FR 29846–29847. Because of the potential magnitude of this energy use, DOE is considering developing a test procedure to account for the energy consumed by automatic icemaking systems. However, as the NOPR discussed, developing a robust and repeatable test procedure will take longer than the current rulemaking cycle will allow. Hence, instead of proposing to amend the test procedure to include a measurement of icemaking energy use, DOE proposed to modify the test procedure to incorporate a fixed placeholder value to represent icemaking energy use. DOE intends to continue working on the development of an icemaking test procedure with the intent of eventually integrating it into the test procedure in place of the fixed placeholder as soon as possible.

DOE selected a fixed placeholder value for icemaking energy use based on "AHAM Update to DOE on Status of Ice Maker Energy Test Procedure." (No. 5.1 at p. 11) That document specifies a daily production rate of 1.8 pounds of ice. The average energy usage measurement from this test was 128 Watt-hours per pound. 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. DOE proposed to implement this value in the test procedure 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. 75 FR 29846–29847.

Most stakeholders agreed with this approach. The Joint Comments, ACEEE, AHAM, the IOUs, NDRC, NIST, Sub-Zero and Whirlpool all accepted the proposed approach to address icemaking and also the temporary placeholder value. (Joint Comments, No. 20.1 at p. 5; ACEEE, No. 19.1 at p. 3–4; AHAM, No. 16.1 at p. 10; IOUs, No. 14.1 at p. 1–2; NDRC, No. 21.1 at p. 5; NIST, Public Meeting Transcript, No. 10 at p. 148; Sub Zero, No. 10 at p. 150–151; Whirlpool, No. 12.1 at p. 6–7) The value of 0.23 kWh per day was of concern to Electrolux, who asserted that the value is too low and does not truly represent the icemaking energy across all refrigerators-freezers. (Electrolux, No. 17.2 at p. 1, cell H155) Electrolux provided in their comments the same data that AHAM submitted to DOE in November 2009 (Electrolux, No. 17.2 at p. 3) These same data were used by DOE in developing these placeholder values. Since no new data were provided, nor did Electrolux state specific arguments as to why the AHAM data might be flawed, DOE does not believe there is sufficient evidence or guidance to either raise or lower the proposed value.

There was interest from the IOUs, NDRC, and NIST to define the daily ice production factor in kWh/pound rather than kWh/year, to allow flexibility for variation in icemaking capacity. (IOUs, No. 14.1 at p. 3; NIST, Public Meeting Transcript, No. 10 at p. 147; NRDC, No. 21.1 at p. 5–6) A production factor in kWh/pound, when coupled with a standardized ice production rate of lbs/day, would enable a metric in units of kWh/year to be calculated. This metric could then be added to the total energy use of the product. The IOUs additionally suggested differentiating the placeholder value energy use depending on the functional differences between refrigerators and freezers with automatic icemakers. However, the available data provides an insufficient basis on which to establish such variation in the placeholder value based on product characteristics. Also, since DOE is instituting a fixed placeholder value for automatic icemaker energy use, DOE perceives no value in representing the energy use on a kWh per pound basis at this time. Hence, the placeholder value will be represented in kWh per year and added to the measured energy use to provide a single metric for refrigeration product performance.

GE suggested that adding the energy use of automatic icemakers into the energy use calculation, but not providing a similar placeholder for manual icemaking, misleads consumers because it implies that there is no energy associated with manual icemaking. (GE, Public Meeting Transcript, No. 10 at p. 156–157) Currently, DOE has data only on automatic icemaking and none on manual icemaking that would permit DOE to create a comparable placeholder value for this task. The available information, as described by the IOUs, suggests that much of the automatic icemaking energy use is associated with the electric heater used to free the ice from the mold. (IOUs, No. 14.1 at p. 2) In comparison, manual icemaking involves the additional energy use associated with opening the freezer door to insert the ice, which is likely to be small when compared to the heater impact from automatic icemaking systems.

Taking these factors into account, DOE will incorporate a single, temporary placeholder value that will apply to products that have automatic icemakers. This value would apply to products equipped either with or without TTD ice service. Because automatic icemaking is possible in both refrigerator-freezers and freezers, the modifications will be made in both Appendices A and B.

Development of a Test Method

DOE sought comment on developing a test method to determine icemaking energy use. DOE expects to work with AHAM to develop such a procedure.

Electrolux voiced concern that the proper development of a robust and reproducible icemaking test procedure will take longer than the time permitted under this rulemaking. (Electrolux, No. 17.2 at p. 1, cell H159) The Joint Comments provided a draft timeline for development of a procedure including (1) development of a test procedure by January 1, 2012, (2) a test procedure rulemaking to modify the DOE test procedure to adopt this procedure starting on January 1, 2012, and culminating in a final rule by December 31, 2012, (3) an energy conservation standard rulemaking culminating in a final rule by July 1, 2013, that would adjust the energy conservation standards to address any differences between the current placeholder value and the average automatic icemaker energy use measured using the new procedure, and (4) an effective date for the adjusted standards three years after the energy standard rulemaking final rule. (Joint Comment, No. 20.1 at p. 5–6) This schedule extends beyond the final rule of this rulemaking, as suggested by Electrolux. DOE intends to support the development of a test method for measurement of icemaking energy use, and will act to amend the test procedure and energy standard accordingly, once a test method has been developed.

Other comments addressed how the test method should report the results to the consumer. The IOUs and Electrolux believe that the kWh per year value for icemaking from the future test method should be communicated to the consumer on the product as a visible separate value from the kWh per year value. (IOUs, No. 14.1 at p. 1–2; Electrolux, No. 17.2 at p. 1, cell H157) The development of EnergyGuide requirements is under the jurisdiction of the Federal Trade Commission (FTC) rather than DOE. Hence, FTC will ultimately decide on the content of the label.

Ice in the Bin During Testing

DOE requested comment on whether the test procedure should provide instructions regarding whether ice bins should contain ice during testing. AHAM, GE, and Whirlpool asserted that no ice should be present because the amount of ice in the bin could vary from unit to unit and its presence introduces a thermal load that can affect temperature measurements. (AHAM, No. 16.1 at p. 10; GE, Public Meeting Transcript, No. 10 at p. 143–145; Whirlpool, No. 12.1 at p. 7) DOE acknowledges that adding ice during testing would affect the thermal loading—and overall measured energy consumption—of a refrigerator-freezer equipped with automatic defrost. Whirlpool also asserted that there may be significant impacts on measured energy use, manufacturer cost, facilities, testing capability, lead time, or any combination of these if this amendment is introduced prior to the compliance date for the new energy conservation standards. (Whirlpool, No. 12.1 at p. 2)

Under the current procedure (Appendix A1, section 2.3), refrigerator-freezers with automatic defrost are tested with no thermal load in their freezer compartments. Hence, the thermal load associated with a full ice bin could represent a significant additional thermal mass, which would lengthen the compressor on-cycles during testing, and may reduce the measured energy use by reducing off-cycle losses. To avoid this result, in DOE's view, refrigerator-freezers with automatic defrost should be tested with empty ice bins. To ensure consistency among test procedures of different products, DOE is requiring that all ice bins remain empty for all products during testing. To address concerns regarding potential changes in measured energy use, this change will apply to new Appendices A and B.

*F. Other Issues*

This section discusses comments made by stakeholders regarding items for which DOE has not made corresponding changes in the test procedure.

1. Electric Heaters

Refrigeration products use electric heaters for a variety of functions. The NOPR discussed these functions, described current approaches to heater operation during energy testing, and highlighted possible modifications to the current test requirements for heaters. Five types of heaters were discussed—anti-sweat, defrost, temperature control, automatic icemaker, and exterior heaters. The NOPR asked whether these heaters serve any other functions and whether other types of electric resistance heaters are present in refrigeration products. DOE sought to understand any additional heater applications, how they contribute to energy use in normal operating conditions and during testing under the current DOE energy test, and whether the current procedure requires any amending to more accurately reflect their actual energy usage in the field. 75 FR 29848–29849.

Whirlpool commented that they were unaware of additional uses for electric resistance heaters in refrigeration products. (Whirlpool, No. 12.1 at p. 7) NDRC commented generally, stating that better insulation in many cases could be used to ameliorate the need for resistance heating. (NDRC, No. 21.1 at p. 6) Because stakeholders identified no new functions for electric heaters, DOE has made no additional test procedure amendments to address their energy use at this time.

2. Vacuum Insulation Panel Performance

DOE did not propose any test procedure changes specifically associated with vacuum insulation panel (VIP) performance in the NOPR.

Nanopore commented that the test procedure should include a lifetime performance test to evaluate the long-term efficiency of products. Nanopore made this recommendation to address some low quality vacuum panels that can lose as much as 80 percent of their thermal resistance over the timeframe of a few months. Suggested procedures to measure long-term performance included (1) requiring a measurement 6 or 12 months after manufacture, (2) aging of vacuum insulation panels in an 80 °C environment for a period of time and then testing them, and (3) aging of the entire product and subsequently testing it. (Nanopore, No. 11.1 at p. 1).

Additionally, ThermoCor provided details of an accelerated life test (ALT) developed by Panasonic, a vacuum panel manufacturer. ThermoCor proposed that this test could be conducted for the entire refrigeration cabinet to assess long-term performance, and that a different test could be developed to assess the long-term performance of the compressor. The ALT uses cycling between 80 °C and −30 °C. A first test is conducted prior to the accelerated aging. Subsequently, the test is repeated three times after three separate periods of 9 days of temperature cycling. (ThermoCor, No. 18.1 at pp. 1–3)

Testing of the long-term efficiency of products has not yet been introduced in DOE test procedures, although it has been proposed for refrigerated walk-in enclosures. See 75 FR 55068, 55074 (September 9, 2010). DOE recognizes the importance of such a test, particularly for a component that may have a degraded lifetime performance as suggested by Nanopore. However, applying such lifetime performance tests to entire refrigeration products (i.e., rather than to individual vacuum panels) has, to DOE's knowledge, not been evaluated to confirm the accuracy of this approach. DOE further notes that this type of test could represent a significant additional test burden. In light of these concerns, the adoption of such a procedure into DOE's regulations would require additional input from the public. Consequently, DOE is not adopting a lifetime performance test at this time.

3. Metric Units

DOE did not propose in the NOPR any test procedure changes specifically addressing the use of metric units. See generally, 75 FR 29824.

Fisher & Paykel commented that all dimensions detailed in the test procedures should be expressed in rounded metric units and that Imperial (i.e., English) units should be provided in parentheses. In Fisher & Paykel's view, such a change would be justified since all other international markets other than the U.S. use the metric system. The company added that making this change would also remove potential sources of error. (Fisher & Paykel, No. 24.2 at p. 1) DOE notes that the Imperial system, using inches, feet, and Fahrenheit for some of the key measurements made for refrigeration products, is the primary system used by U.S. consumers. Since some of the measurements, such as product volumes, are used in marketing literature as well as in the test procedure and test reports, converting to metric would potentially affect consumers. Fisher & Paykel did not identify any particular instances of test procedure values being in round Imperial units that introduce errors in testing, nor did they indicate whether converting to round metric units could cause any change in measured energy use, making it difficult for DOE to fully evaluate this recommendation. Further, prior to making such a change, DOE would, ideally, obtain comments from other stakeholders involved in testing and reporting product performance to determine if this concern is widely shared. Hence, DOE is declining to adopt the change suggested by Fisher & Paykel. DOE may revisit this issue in a future rulemaking.

*G. Compliance With Other EPCA Requirements*

In addition, DOE examined its other obligations under EPCA in developing this final rule and interim final rule. 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 concluded that the amendments being adopted today satisfy this requirement.

The 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 amendments require no changes in the current requirements for equipment and instrumentation for testing or the time required for testing.

With respect to the test method for variable anti-sweat heaters, the procedure DOE is adopting today applies the test procedure found in the GE waiver (see discussion in section III.D.9 above) rather than the more complicated approach proposed in the NOPR that would have required the use of a humidity-controlled test chamber and the conducting of three tests to measure energy use for steady-state cycling operation of a refrigerator-freezer. By adopting this modified approach, the new procedure reduces the number of tests required for products with anti-sweat heater switches and relies on a calculated value to represent the anti-sweat heater energy use contribution when calculating the total energy usage of a given product. This change considerably reduces the testing burden manufacturers would have faced under the proposal while providing a definitive method to account for anti-sweat heater energy use.

Regarding heated-temperature-control special compartments, the procedure in the interim final rule requires the averaging of tests conducted with the temperature control settings in the coldest and warmest positions. This approach doubles the test time for products with such special compartments. However, as described in section III.D.5, few products have such compartments. DOE estimates that these products represent less than 5% of standard-size refrigerator-freezers, based on (1) estimates that 20% of such products have special compartments (see the discussion in section III.D.5 reviewing major manufacturers' product details), and (2) the observation that of the two refrigerator-freezers examined for reverse engineering as part of the refrigeration product energy conservation standard rulemaking that had special compartments, neither utilized heating to achieve temperature control. The averaging of two tests potentially represents a smaller test burden than the proposed approach of requiring the highest energy use position. Under the proposed approach, AHAM indicated that manufacturers would have to run tests at each setting to determine which represents the highest energy use. (AHAM, No. 16.1 at p. 5) DOE notes that the averaging of such tests that is being adopted today is justified because it provides better consistency with a representative average use cycle, as required by EPCA. (42 U.S.C. 6293(b)(3))

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 procedure that DOE is adopting today already satisfies these requirements. 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 modified in this final rule and interim final rule) address these modes.

3. Addressing Changes in Measured Energy Use

Section 323(e)(1) of EPCA requires that DOE consider whether a new test procedure alters the measured energy use of any covered product. (42 U.S.C. 6293(e)(1)) Further, section 323(e)(2) of EPCA requires DOE to amend the applicable standards if DOE determines that a new test procedure would alter the measured energy use of a covered product. The amended standard would be based on the average measurements made for a representative sample of minimally compliant products. (42 U.S.C. 6293(e)(2))

As discussed above, DOE has made a number of changes to account for the concerns raised by industry regarding the timing of certain provisions that DOE had proposed to make effective 30 days after the publication of the final rule. These changes include providing manufacturers with additional time (2014) to use certain procedures when conducting the test procedure. As a result, the interim final rule sets out the procedures manufacturers must follow starting in 2014 with respect to special compartments with heated temperature control, long-time or variable defrost in order to capture pre-cooling and partial recovery energy use, and multiple defrost cycles. The interim final rule also addresses compartment temperature changes and volume calculations.

Also as discussed above, industry and efficiency advocates negotiated a consensus agreement, dated July 30, 2010, that sets forth a series of standard levels for refrigeration products. DOE's parallel standards rulemaking proposed levels that are based on the levels submitted as part of that agreement. The industry has since raised concerns about the interplay between these proposed standards and the test procedure that DOE ultimately adopts. These concerns revolve around the following issues: (1) Modification of the set-up procedures for special compartments with heated temperature control; (2) modification of the long-time defrost test procedure to capture pre-cooling energy use; and (3) establishment of test procedures for products with multiple defrost cycle types.

DOE notes that its test procedure NOPR was published on May 27, 2010, over two months before the date of the consensus agreement. Given this fact, DOE believes that industry negotiators had an ample opportunity to consider the potential impacts of the proposed test procedure amendments prior to finalizing the consensus agreement standards. The industry has not asserted that it has had an insufficient amount of time to consider the NOPR's provisions in developing the consensus standard levels. Accordingly, DOE believes that the standards set forth in that agreement were based on a serious and thoughtful consideration of the new changes to the test procedure that DOE proposed in May 2010.

In spite of these facts, DOE is modifying its scheduled implementation of certain provisions to provide manufacturers with additional time to adjust to the new procedures. By implementing these particular changes through the interim final rule, DOE seeks to mitigate the potential burdens on industry while ensuring that the test procedure is sufficiently robust and comprehensive to capture the energy use from refrigeration products. Additionally, by following this approach, DOE invites the submission of additional input from the public regarding the procedures to address special compartments with heated temperature control, long-time or variable defrost in order to capture pre-cooling and partial recovery energy use, and multiple defrost cycles. DOE will consider these comments and, to the extent necessary, consider any needed adjustments.

## IV. Procedural Requirements

### *A. Review Under Executive Order 12866*

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

*B. Review Under the Regulatory Flexibility Act*

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

DOE reviewed the test procedures in today's final rule and interim final rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. This final rule and interim final rule prescribe test procedures that will 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 had tentatively concluded that the final rule and interim final rule will not have a significant impact on small manufacturers under the provisions of the Regulatory Flexibility Act. DOE received no comments objecting to this conclusion. Accordingly, the final rule and the interim final rule amend DOE's energy test procedures for refrigeration products. These 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 will not be significantly more difficult or time-consuming to conduct than current DOE energy test procedures.

For these reasons, DOE 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 has transmitted the certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the SBA for review under 5 U.S.C. 605(b).

*C. Review Under the Paperwork Reduction Act of 1995*

Manufacturers of refrigeration products must certify to DOE that their products comply with any applicable energy conservation standard. In certifying compliance, manufacturers must test their products according to the DOE test procedure for refrigeration products, including any amendments adopted for that test procedure. DOE has proposed regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including the refrigeration products addressed by today's final rule and interim final rule. 75 FR 56796 (Sept. 16, 2010). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been submitted to OMB for approval. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Public comment is sought regarding: whether this proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information shall have practical utility; the accuracy of the burden estimate; ways to enhance the quality, utility, and clarity of the information to be collected; and ways to minimize the burden of the collection of information, including through the use of automated collection techniques or other forms of information technology. Send comments on these or any other aspects of the collection of information to Subid Wagley (*see* **ADDRESSES**) and by e-mail to *Christine_J._Kymn@omb.eop.gov.*

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

*D. Review Under the National Environmental Policy Act of 1969*

In this notice, DOE amends its test procedure for refrigerators, refrigerator-freezers, and freezers. These amendments will 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 amendments also will be used to develop and implement future energy conservation standards for refrigeration products. DOE has determined that this final rule and interim final rule fall 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 establishes revisions to existing test procedures that will not affect the amount, quality, or distribution of energy usage, and, therefore, will not result in any environmental impacts. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

*E. Review Under Executive Order 13132*

Executive Order 13132, "Federalism," imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. 64 FR 43255 (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 final rule and interim final rule and determined that it will not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's final rule and interim final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) 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 final rule and interim final rule meet the relevant standards of Executive Order 12988.

*G. Review Under the Unfunded Mandates Reform Act of 1995*

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) (Pub. L. 104–4; 2 U.S.C. 1501 *et seq.*) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. For a regulatory action resulting in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish estimates of the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a)–(b)) UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed "significant intergovernmental mandate," and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect such governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. (The policy is also available at *http://www.gc.doe.gov*). Today's final rule and interim final rule contain 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 final rule and interim final rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

*I. Review Under Executive Order 12630*

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

*J. Review Under 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 rule under OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

*K. Review Under Executive Order 13211*

Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use," 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA a Statement of Energy Effects for any significant energy action. A "significant energy action" is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule and that (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use if the regulation is implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use. Today's 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 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 has consulted with both the Attorney General and the Chairman of the FTC about the impact on competition of using the methods contained in these standards and has received no comments objecting to their use.

*M. Congressional Notification*

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

**V. Approval of the Office of the Secretary**

The Secretary of Energy has approved publication of these final rules.

**List of Subjects in 10 CFR part 430**

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

Issued in Washington, DC, on November 18, 2010.

**Cathy Zoi,**

*Assistant Secretary, Energy Efficiency and Renewable Energy.*

■ For the reasons stated in the preamble, DOE amends 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 definitions for "electric refrigerator" and "electric refrigerator-freezer" to read as follows:

### § 430.2 Definitions.

* * * * *

*Electric refrigerator* means a cabinet designed for the refrigerated storage of food, designed to be capable of achieving storage temperatures above 32 °F (0 °C) and below 39 °F (3.9 °C), 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 (0 °C), but does not provide a separate low temperature compartment designed for the freezing and storage of food at temperatures below 8 °F (−13.3 °C).

*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 and designed to be capable of achieving storage temperatures above 32 °F (0 °C) and below 39 °F (3.9 °C), and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8 °F (−13.3 °C) which may be adjusted by the user to a temperature of 0 °F (−17.8 °C) or below. 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, (Revision of ANSI B38.1–1970), ("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 and Internal Volume of Refrigerating Appliances (2008), including Errata to Energy and Internal Volume of Refrigerating Appliances, Correction Sheet issued November 17, 2009, IBR approved for Appendices A and B to Subpart B.

* * * * *

■ 3. Section 430.23 is amended by

■ a. Adding an introductory paragraph before paragraph (a); and

■ b. Revising paragraphs (a) and (b).

The additions and revisions read as follows:

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

When the test procedures of this section call for rounding off of test results, and the results fall equally between two values of the nearest dollar, kilowatt-hour, or other specified nearest value, the result shall be rounded up to the nearest higher value.

(a) *Refrigerators and refrigerator-freezers.* (1) The estimated annual operating cost for electric refrigerators and electric refrigerator-freezers without an anti-sweat heater switch shall be the product of the following three factors, the resulting product then being rounded off to the nearest dollar per year:

(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.

(2) The estimated annual operating cost for electric refrigerators and electric refrigerator-freezers with an anti-sweat heater switch shall be the product of the following three factors, the resulting product then being rounded off to the nearest dollar per year:

(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.

(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, the resulting product then being rounded off to the nearest dollar per year:

(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.

(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 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, 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 the following, rounded to the nearest kilowatt-hour per year:

(i) For electric refrigerators and electric refrigerator-freezers 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, the representative average use cycle of 365 cycles per year multiplied by 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 without an anti-sweat heater switch shall be the product of the following three factors, the resulting product then being rounded off to the nearest dollar per year:

(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.

(8) The estimated regional annual operating cost for externally vented electric refrigerators and externally vented electric refrigerator-freezers with an anti-sweat heater switch shall be the product of the following three factors, the resulting product then being rounded off to the nearest dollar per year:

(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.

(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, the resulting product then being rounded off to the nearest dollar per year:

(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.

(10) The following principles of interpretation should be applied to the test procedure. The intent of the energy test procedure is to simulate typical room conditions (approximately 70 °F (21 °C)) with door openings, by testing at 90 °F (32.2 °C) without door openings. Except for operating characteristics that are affected by ambient temperature (for example, compressor percent run time), the unit, when tested under this test procedure, shall operate in a manner equivalent to the unit in typical room conditions. The energy used by the unit shall be calculated when a calculation is provided by the test procedure. Energy consuming components that operate in typical room conditions (including as a result of door openings, or a function of humidity), and that are not exempted by this test procedure, shall operate in an equivalent manner during energy testing under this test procedure, or be accounted for by all calculations as provided for in the test procedure. If:

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

(ii) 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), a manufacturer must obtain a waiver in accordance with the relevant provisions of 10 CFR part 430. Examples:

A. Energy saving features that are designed to be activated by a lack of door openings shall not be functional during the energy test.

B. The defrost heater should not either function or turn off differently during the energy test than it would when operating in typical room conditions.

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

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

(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, the resulting product then being rounded off to the nearest dollar per year:

(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.

(2) The estimated annual operating cost for freezers with an anti-sweat heater switch shall be the product of the following three factors, the resulting product then being rounded off to the nearest dollar per year:

(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.

(3) The estimated annual operating cost for any other specified cycle type for freezers shall be the product of the following three factors, the resulting product then being rounded off to the nearest dollar per year:

(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.

(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 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 the following, rounded to the nearest kilowatt-hour per year:

(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 multiplied by 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 and Appendix B of this subpart after Appendix B becomes mandatory (see the note at the beginning of Appendix B).

(7) The following principles of interpretation should be applied to the test procedure. The intent of the energy test procedure is to simulate typical room conditions (approximately 70 °F (21 °C)) with door openings, by testing at 90 °F (32.2 °C) without door openings. Except for operating characteristics that are affected by ambient temperature (for example, compressor percent run time), the unit, when tested under this test procedure, shall operate in a manner equivalent to the unit in typical room conditions. The energy used by the unit shall be calculated when a calculation is provided by the test procedure. Energy consuming components that operate in typical room conditions (including as a result of door openings, or a function of humidity), and that are not exempted by this test procedure, shall operate in an equivalent manner during energy testing under this test procedure, or be accounted for by all calculations as provided for in the test procedure. If:

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

(ii) 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), a manufacturer must obtain a waiver in accordance with the relevant provisions of 10 CFR part 430. Examples:

A. Energy saving features that are designed to be activated by a lack of door openings hall not be functional during the energy test.

B. The defrost heater should not either function or turn off differently during the energy test than it would when in typical room conditions.

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

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

* * * * *

■ 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) applies 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-foot 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 to maintain the standardized temperatures (see section 3.2).

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 defrost control sequence such as the number of defrost heaters energized. Each such variation establishes a separate distinct defrost cycle type. However, defrost achieved regularly during the compressor off-cycles by warming of the evaporator without active heat addition is not a 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; may include thermostatically controlled dampers or controls that mix the exterior and room air at low outdoor temperatures and exclude exterior air when the outdoor air temperature is above 80 °F (26.7 °C) or the room air temperature; and may have a thermostatically actuated exterior air fan.

1.11 "HRF–1–2008" means AHAM Standard HRF–1–2008, Association of Home Appliance Manufacturers, Energy and Internal Volume of Refrigerating Appliances (2008), including Errata to Energy and Internal Volume of Refrigerating Appliances, Correction Sheet issued November 17, 2009. 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). Separate auxiliary freezer compartments may not be larger than the first freezer compartment and separate auxiliary fresh food compartments may not be larger than the first fresh food compartment, but such size restrictions do not apply to separate auxiliary convertible compartments.

1.14 "Special compartment" means any compartment other than a butter conditioner, without doors directly accessible from the exterior, and with separate temperature control (such as crispers convertible to meat keepers) that is not convertible from fresh food temperature range to freezer temperature range.

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

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

1.17 "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).

1.18 "Variable defrost control" means an automatic defrost system in which 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 performing this function. A control scheme that changes the defrost interval from a fixed length to an extended length (without any intermediate steps) is not considered a variable defrost control. A variable defrost control feature should predict the accumulation of frost on the evaporator and react accordingly. Therefore, the times between defrost should vary with different usage patterns and include a continuum of lengths of time between defrosts as inputs vary.

*2. Test Conditions*

2.1 Ambient Temperature. The ambient temperature shall be 90.0 ± 1 °F (32.2 ± 0.6 °C) during the stabilization period and the test period.

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). Exceptions and clarifications to the cited sections of HRF–1–2008 are noted in sections 2.3 through 2.8, and 5.1 of this test procedure.

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

2.4 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 of this appendix;

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

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

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

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

(g) Ice storage bins shall be emptied of ice.

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. Special compartments shall be tested with controls set to provide the coldest temperature. However, for special compartments in which temperature control is achieved using the addition of heat (including resistive electric heating, refrigeration system waste heat, or heat from any other source, but excluding the transfer of air from another part of the interior of the product) for any part of the controllable temperature range of that compartment, the product energy use shall be determined by averaging two sets of tests. The first set of tests shall be conducted with such special compartments at their coldest settings, and the second set of tests shall be conducted with such special compartments at their warmest settings. The requirements for the warmest or coldest temperature settings of this section do not apply to features or functions associated with temperature control (such as fast chill compartments) that are initiated manually and terminated automatically within 168 hours.

2.8 The space between the back of the cabinet and a vertical surface (the test room wall or simulated wall) shall be the minimum distance in accordance with the manufacturer's instructions. However, the clearance shall not be greater than 2 inches (51 mm) from the plane of the cabinet's back panel to the vertical surface. If permanent rear spacers extend further than this distance, the appliance shall be located with the spacers in contact with the vertical surface.

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 (25.8 square cm) 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.

For the purposes of comparing compartment temperatures with standardized temperatures, as described in sections 3.2.1 and 3.2.2, the freezer compartment temperature shall be as specified in section 5.1.4, and the fresh food compartment temperature shall be as specified in section 5.1.3.

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 which test results to use in the energy consumption calculation. If any compartment is warmer than its standardized temperature for a test with all controls at their coldest position, the tested unit fails the test and cannot be rated.

TABLE 1—TEMPERATURE SETTINGS FOR ALL-REFRIGERATORS

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

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

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

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 this condition is not met, then the unit shall be tested in accordance with 3.2.1.

3.2.3 Temperature Settings for Separate Auxiliary Convertible Compartments. For separate auxiliary convertible compartments tested as freezer compartments, the median setting shall be within 2 °F (1.1 °C) of the standardized temperature, and the warmest setting shall be above 5 °F (−15 °C). For separate auxiliary convertible compartments tested as fresh food compartments, the median setting shall be within 2 °F (1.1 °C) of the standardized temperature, and the coldest setting shall be below 34 °F (1.1 °C). For compartments where control settings are not expressed as particular temperatures, the measured temperature of the convertible compartment rather than the settings shall meet the specified criteria.

*4. Test Period*

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

4.1 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.

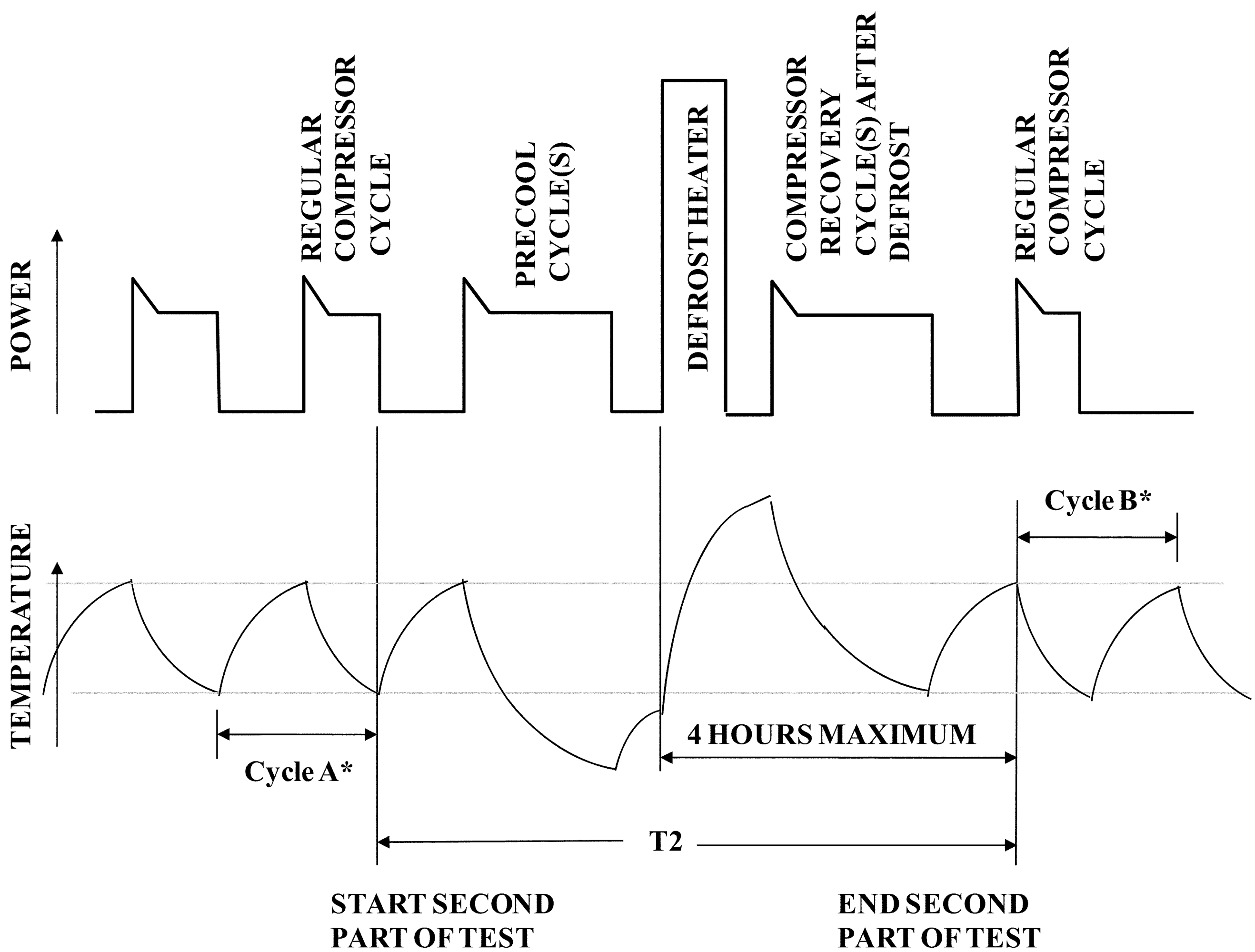
4.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test time period shall start after steady-state conditions have been achieved and be from one point during a defrost period to the same point during the next defrost period. If the model being tested has a long-time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

4.2.1 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 a stable period of compressor operation that includes no portions of the defrost cycle, such as precooling or recovery, that is otherwise the same as the test for a unit having no defrost provisions (section 4.1). The second part is designed to capture the energy consumed during all of the events occurring with the defrost control sequence that are outside of stable operation.

4.2.1.1 Cycling Compressor System. For a system with a cycling compressor, the second part starts at the termination of the last regular compressor "on" cycle. The average temperature of the compartment measured from the termination of the previous compressor "on" cycle to the termination of the last regular compressor "on" cycle must be within 0.5 °F (0.3 °C) of the average temperature of the compartment measured for the first part of the test. If any compressor cycles occur prior to the defrost heater being energized that cause the average temperature in the compartment to deviate from the first part temperature by more than 0.5 °F (0.3 °C), these compressor cycles are not considered regular compressor cycles and must be included in the second part of the test. As an example, a "precool" cycle, which is an extended compressor cycle that lowers the compartment temperature prior to energizing the defrost heater, must be included in the second part of the test. The test period for the second part of the test ends at the initiation of the first regular compressor cycle after the compartment temperatures have fully recovered to their stable conditions. The average temperature of the compartment measured from this initiation of the first regular compressor "on" cycle until the initiation of the next regular compressor "on" cycle must be within 0.5 °F (0.3 °C) of the average temperature of the compartment measured for the first part of the test. The second part of the test may be terminated after 4 hours if the above conditions cannot be met. See Figure 1.

Figure 1

Long-time Automatic Defrost Diagram for Cycling Compressors

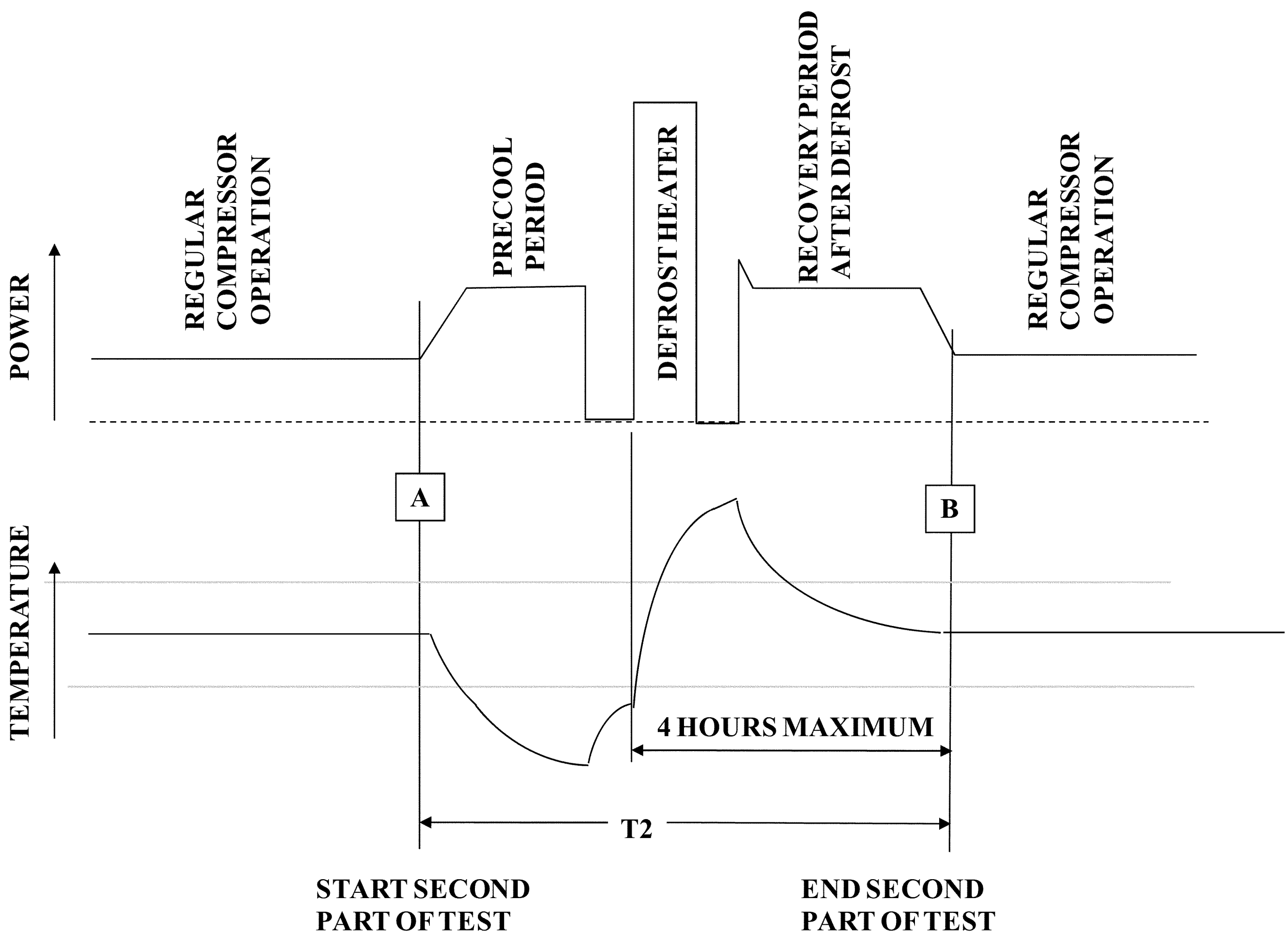



***Average compartment temperature during cycles A & B must be within 0.5 ˚F of the average temperature for the first part of the test. This requirement does not apply for cycle B if the 4 hour limit is reached.**

4.2.1.2 Non-cycling Compressor System. For a system with a non-cycling compressor, the second part starts at a time before defrost during stable operation when the compartment temperature is within 0.5 °F (0.3 °C) of the average temperature of the compartment measured for the first part of the test. The second part stops at a time after defrost during stable operation when the compartment temperature is within 0.5 °F (0.3 °C) of the average temperature of the compartment measured for the first part of the test. The second part of the test may be terminated after 4 hours if the above conditions cannot be met. *See* Figure 2.

Figure 2

Long-time Automatic Defrost Diagram for Non-Cycling Compressors




***Average compartment temperature at times A & B must be within 0.5 ˚F of the average temperature for the first part of the test. This requirement does not apply for time B if the 4 hour limit is reached.**

4.2.2 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 4.2.1).

4.2.3 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 4.2.1 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.

4.2.4 Systems with Multiple Defrost Frequencies. This section applies 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 4.2.1 shall be used. The second part of the method will be conducted separately for each distinct defrost cycle type. For defrost cycle types involving the defrosting of both fresh food and freezer compartments, the freezer compartment temperature shall be used to determine test period start and stop times.

*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 5.1 and 5.2 of HRF–1–2008, the product may be tested by relocating the temperature sensors from the locations specified in the figures 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, and the certification report shall indicate that non-standard sensor locations were used.

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 the test period as defined in section 4. For long-time automatic defrost models, compartment temperatures shall be those measured in the first part of the test period specified in section 4.2.1. For models with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.2.2.

5.1.3 Fresh Food Compartment Temperature. The fresh food compartment temperature shall be calculated as:

$$TR = \frac{\sum_{i=1}^{R}(TR_i) \times (VR_i)}{\sum_{i=1}^{R}(VR_i)}$$

Where:

R is the total number of applicable fresh food compartments, which include the first fresh food compartment and any number of separate auxiliary fresh food compartments (including separate auxiliary convertible compartments tested as fresh food compartments in accordance with section 2.7);

$TR_i$ is the compartment temperature of fresh food compartment "i" determined in accordance with section 5.1.2; and

$VR_i$ is the volume of fresh food compartment "i".

5.1.4 Freezer Compartment Temperature. The freezer compartment temperature shall be calculated as:

$$TF = \frac{\sum_{i=1}^{F}(TF_i) \times (VF_i)}{\sum_{i=1}^{F}(VF_i)}$$

Where:

F is the total number of applicable freezer compartments, which include the first freezer compartment and any number of separate auxiliary freezer compartments (including separate auxiliary convertible compartments tested as freezer compartments in accordance with section 2.7);

$TF_i$ is the compartment temperature of freezer compartment "i" determined in accordance with section 5.1.2; and

$VF_i$ is the volume of freezer compartment "i".

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 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 or compressor run time between defrosts in hours required to cause it to go through a complete cycle, rounded to the nearest tenth of an hour; 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 compressor run 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 compressor run time between defrosts in hours rounded to the nearest tenth of an hour (greater than $CT_L$ but not more than 96 hours);

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

For variable defrost models with no values for $CT_L$ and $CT_M$ in the algorithm, the default values of 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 4.2.4 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 run time between freezer defrosts (in hours rounded to the nearest tenth of an hour); and

$CT_R$ = compressor run time between refrigerator defrosts (in hours rounded to the nearest tenth of an hour).

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

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

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 in hours rounded to the nearest tenth of an hour, and for variable defrost control equal to $(CT_{Li} \times CT_{Mi})/(F \times (CT_{Mi} - CT_{Li}) + CT_{Li})$;

$CT_{Li}$ = least or shortest compressor run time between instances of defrost cycle type i in hours rounded to the nearest tenth of an hour ($CT_L$ for the defrost cycle type with the longest compressor run time between defrosts must be greater than or equal to 6 but less than or equal to 12 hours);

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

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

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

For variable defrost models with no values for $CT_{Li}$ and $CT_{Mi}$ in the algorithm, the default values of 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 × 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 × 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.

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

The 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 5.1.3 in degrees F;
The 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
The number 1 indicates the test period during which the highest freezer compartment temperature was measured.

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

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

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

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

$E_{std}$ = 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 switch in the "off" position or, for a product without an anti-sweat heater switch, the anti-sweat heater in its lowest energy use state.
Correction Factor = (Anti-sweat Heater Power × System-loss Factor) × (24 hrs/1 day) × (1 kW/1000 W)

Where:

Anti-sweat Heater Power = 0.034 * (Heater Watts at 5%RH)
+ 0.211 * (Heater Watts at 15%RH)
+ 0.204 * (Heater Watts at 25%RH)
+ 0.166 * (Heater Watts at 35%RH)
+ 0.126 * (Heater Watts at 45%RH)
+ 0.119 * (Heater Watts at 55%RH)
+ 0.069 * (Heater Watts at 65%RH)
+ 0.047 * (Heater Watts at 75%RH)
+ 0.008 * (Heater Watts at 85%RH)
+ 0.015 * (Heater Watts at 95%RH)
Heater Watts at a specific relative humidity = the nominal watts used by all heaters at that specific relative humidity, 72 °F (22.2 °C) ambient, and DOE reference temperatures of fresh food (FF) average temperature of 39 °F (3.9 °C) and freezer (FZ) average temperature of 0 °F (−17.8 °C).
System-loss Factor = 1.3.

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, $\boldsymbol{\varepsilon}_{90}$, $\boldsymbol{\varepsilon}_{60}$, $\boldsymbol{\varepsilon}_{50}$, and $\boldsymbol{\varepsilon}_{30}$, 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 $\boldsymbol{\varepsilon}_{90}$, $\boldsymbol{\varepsilon}_{60}$, $\boldsymbol{\varepsilon}_{50}$, and $\boldsymbol{\varepsilon}_{30}$ calculated in 6.3.2 by multiplying the correction factor K to obtain the corrected energy consumptions per day in kWh/day:

$E_{90} = K \times \boldsymbol{\varepsilon}_{90}$,
$E_{60} = K \times \boldsymbol{\varepsilon}_{60}$,
$E_{50} = K \times \boldsymbol{\varepsilon}_{50}$, and
$E_{30} = K \times \boldsymbol{\varepsilon}_{30}$

Where:

K is determined under section 6.3.1; and $\boldsymbol{\varepsilon}_{90}$, $\boldsymbol{\varepsilon}_{60}$, $\boldsymbol{\varepsilon}_{50}$, and $\boldsymbol{\varepsilon}_{30}$ 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 (26.7 °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 in °F for the test of section 5.4.2.3;
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 3. 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

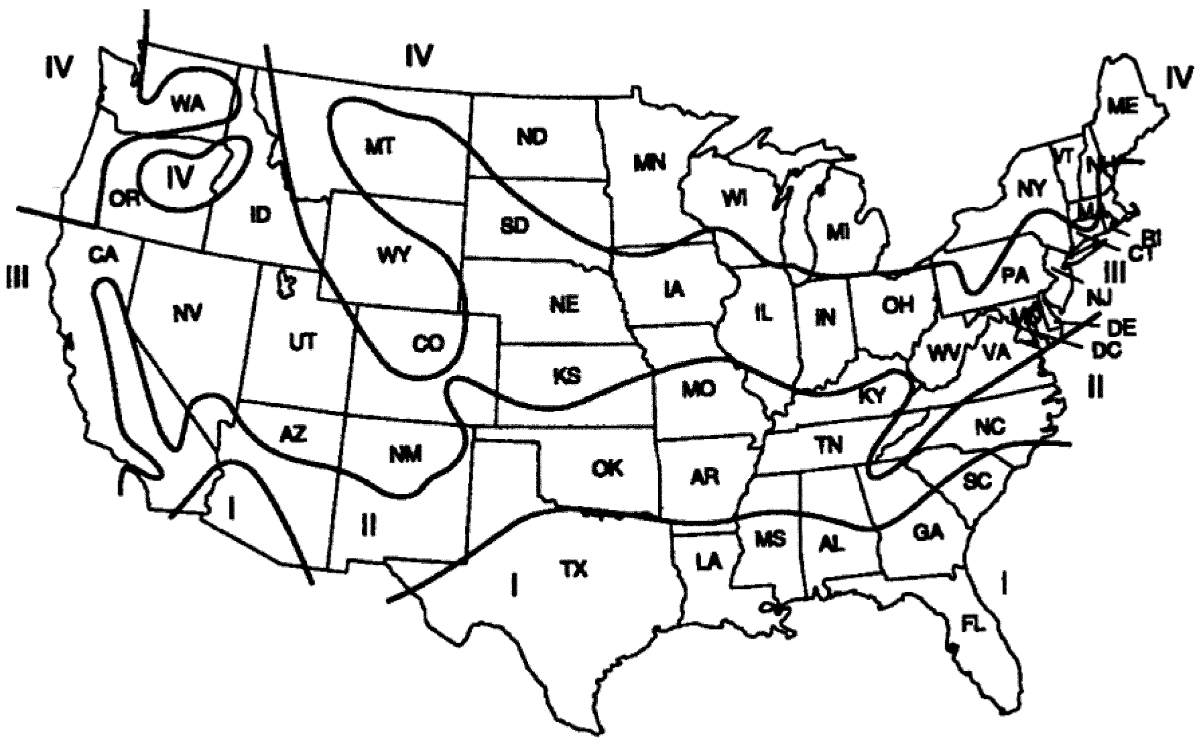
$a_1$, a, b, c, d, and e are weather-associated weighting factors for the regions, as specified in Table A.

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 3: 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. Revising section 2. Test Conditions;

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

■ 1. Revising sections 3.2 and 3.2.1 through 3.2.3;

■ 2. Adding new section 3.2.4;

■ 3. Removing section 3.3;

■ e. Revising section 4. Test Period;

■ 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, 5.2.1, 5.2.1.1, 5.2.1.2, and 5.2.1.3;

■ 2. Adding new sections 5.1.3 and 5.1.4;
■ 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;
■ g. In section 6. Calculation of Derived Results from Test Measurements, by:
■ 1. Revising sections 6.2.1.2 and 6.2.2.2;
■ 2. Adding new section 6.2.3;
■ 3. Revise the Figure at the end of section 6;
■ 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) applies 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 to maintain the standardized temperatures (see section 3.2).

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 defrost control sequence such as the number of defrost heaters energized. Each such variation establishes a separate distinct defrost cycle type. However, defrost achieved regularly during the compressor off-cycles by warming of the evaporator without active heat addition is not a 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; may include thermostatically controlled dampers or controls that mix the exterior and room air at low outdoor temperatures and exclude exterior air when the outdoor air temperature is above 80 °F (26.7 °C) 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). Separate auxiliary freezer compartments may not be larger than the first freezer compartment and separate auxiliary fresh food compartments may not be larger than the first fresh food compartment, but such size restrictions do not apply to separate auxiliary convertible compartments.

1.14 "Special compartment" means any compartment other than a butter conditioner, without doors directly accessible from the exterior, and with separate temperature control (such as crispers convertible to meat keepers) that is not convertible from fresh food temperature range to freezer temperature range.

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

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

1.17 "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).

1.18 "Variable defrost control" means an automatic defrost system in which 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 performing this function. A control scheme that changes the defrost interval from a fixed length to an extended length (without any intermediate steps) is not considered a variable defrost control. A variable defrost control feature should predict the accumulation of frost on the evaporator and react accordingly. Therefore, the times between defrost should vary with different usage patterns and include a continuum of lengths of time between defrosts as inputs vary.

*2. Test Conditions*

2.1 Ambient Temperature. The ambient temperature shall be 90.0 ± 1 °F (32.2 ± 0.6 °C) during the stabilization period and the test period.

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 of this appendix.

2.3 Anti-Sweat Heaters.

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

2.4 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–1–1979 (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 of this appendix;

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

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

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. Special compartments shall be tested with controls set to provide the coldest temperature. This requirement for the coldest temperature does not apply to features or functions associated with temperature control (such as fast chill compartments) that are initiated manually and terminated automatically within 168 hours.

2.8 The space between the back of the cabinet and a vertical surface (the test room wall or simulated wall) shall be the minimum distance in accordance with the manufacturer's instructions.

2.9 Steady State Condition. Steady state conditions exist if the temperature measurements in all measured compartments 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.

A. The average of the measurements during a two hour period if no cycling occurs or during a number of complete repetitive compressor cycles through a period of no less than two hours is compared to the average over an equivalent time period with three hours elapsed 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 through a period of no less than two hours and including the last complete cycle prior to a defrost period, or if no cycling occurs, the average of the measurements during the last two hours prior to a defrost period; are compared to the same averaging period prior to 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 35 ± 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 not 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 four 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 Pa ± 12.5 Pa) 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 not greater than 0.01″ water column (2.5 Pa).

*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, 45 °F (7.2 °C) fresh food compartment temperature;

Refrigerator-Freezer: 5 °F (−15 °C) freezer compartment temperature, 45 °F (7.2 °C) fresh food compartment temperature.

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 as specified in section 5.1.4, and the fresh food compartment temperature shall be as specified in section 5.1.3.

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. If (a) the measured temperature of any compartment with all controls set at their coldest settings is above its 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 (b) the measured temperatures of all compartments with all controls set at their warmest settings are below their standardized temperatures then the result of this test alone will be used to determine energy consumption. If neither (a) nor (b) occur, then the results of the first two tests shall be used to determine energy consumption.

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

3.2.3 Alternatively, a first test may be performed with all temperature controls set at their coldest setting. If the measured temperature of any compartment for this test is above its standardized temperature, a second 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 this condition is not met, then the unit shall be tested in accordance with 3.2.1 of this appendix.

3.2.4 Temperature Settings for Separate Auxiliary Convertible Compartments. For separate auxiliary convertible compartments tested as freezer compartments, the median setting shall be within 2 °F (1.1 °C) of the standardized temperature, and the warmest setting shall be above 10 °F (−12.2 °C). For separate auxiliary convertible compartments tested as fresh food compartments, the median setting shall be within 2 °F (1.1 °C) of the standardized temperature, and the coldest setting shall be below 40 °F (4.4 °C). For compartments where control settings are not expressed as particular temperatures, the measured temperature of the convertible compartment rather than the settings shall meet the specified criteria.

* * * * *

*4. Test Period*

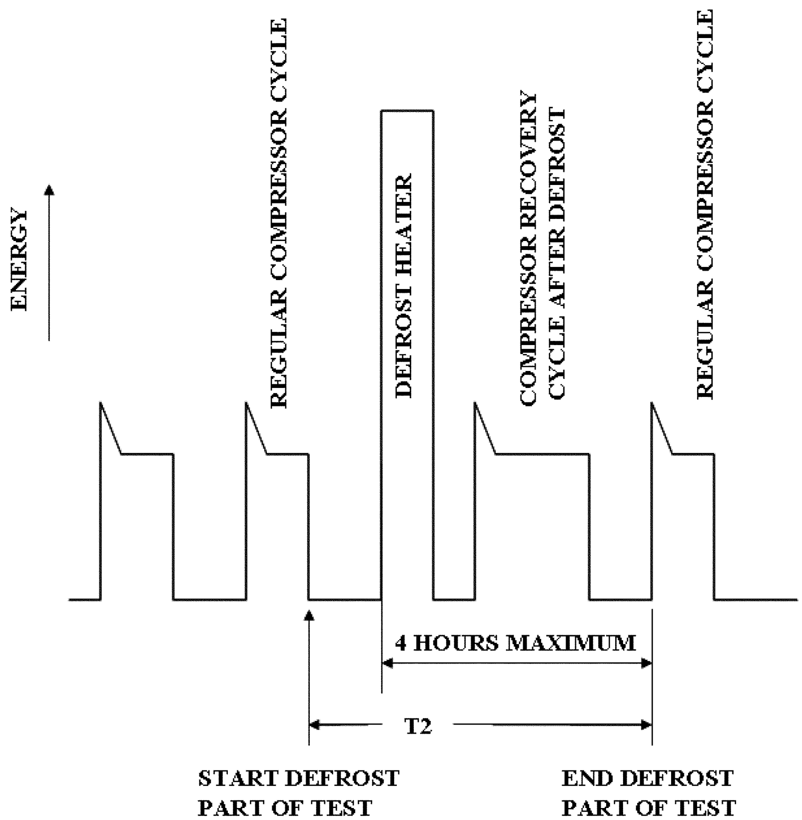
Tests shall be performed by establishing the conditions set forth in section 2, and using the control settings set forth in section 3.

4.1 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.

4.2 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 4.2.1 may be used. If the model being tested has a variable defrost control, the provisions of section 4.2.2 shall apply. If the model has a dual compressor system with automatic defrost for both systems, the provisions of 4.2.3 shall apply.

4.2.1 Long-time Automatic Defrost. If the model being tested has a long-time automatic defrost system, the test time period may consist of two parts. The first part would be the same as the test for a unit having no defrost provisions (section 4.1). The second part would start when a defrost cycle is initiated when the compressor "on" cycle is terminated prior to start of the defrost heater and terminates at the second turn "on" of the compressor or 4 hours from the initiation of the defrost heater, whichever comes first. See diagram in Figure 1 to this section.

Figure 1
Long-time Automatic Defrost Diagram




4.2.2 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 4.2.1).

4.2.3 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 4.2.1 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.

*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 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, and the certification report shall indicate that non-standard sensor locations were used.

* * * * *

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 4.2.1. For models with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.2.2.

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.

5.1.3 Fresh Food Compartment Temperature. The fresh food compartment temperature shall be calculated as:

$$TR = \frac{\sum_{i=1}^{R}(TR_i) \times (VR_i)}{\sum_{i=1}^{R}(VR_i)}$$

Where:

R is the total number of applicable fresh food compartments, which include the first fresh food compartment and any number of separate auxiliary fresh food compartments (including separate auxiliary convertible compartments tested as fresh food compartments in accordance with section 2.7);

$TR_i$ is the compartment temperature of fresh food compartment "i" determined in accordance with section 5.1.2; and

$VR_i$ is the volume of fresh food compartment "i".

5.1.4 Freezer Compartment Temperature. The freezer compartment temperature shall be calculated as:

$$TF = \frac{\sum_{i=1}^{F}(TF_i) \times (VF_i)}{\sum_{i=1}^{F}(VF_i)}$$

Where:

F is the total number of applicable freezer compartments, which include the first freezer compartment and any number of separate auxiliary freezer compartments (including separate auxiliary convertible compartments tested as freezer compartments in accordance with section 2.7);

$TF_i$ is the compartment temperature of freezer compartment "i" determined in accordance with section 5.1.2; and

$VF_i$ is the volume of freezer compartment "i".

* * * * *

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 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 or compressor run time between defrosts in hours required to cause it to go through a complete cycle, rounded to the nearest tenth of an hour; 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 compressor run 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 compressor run time between defrosts in hours rounded to the nearest tenth of an hour (greater than $CT_L$ but not more than 96 hours);

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

For variable defrost models with no values for $CT_L$ and $CT_M$ in the algorithm, the default values of 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 run time between freezer defrosts (in hours rounded to the nearest tenth of an hour); and

$CT_R$ = compressor run time between refrigerator defrosts (in hours rounded to the nearest tenth of an hour).

* * * * *

*6. Calculation of Derived Results From Test Measurements*

* * * * *

6.2.1.2 If one of the fresh food compartment temperatures measured for a test period is greater than 38.0 °F (3.3 °C), the average per-cycle energy consumption shall be equivalent to:

$E = ET1 + ((ET2 - ET1) \times (38.0 - TR1)/(TR2 - TR1))$

Where:

E is defined in 6.2.1.1;

ET is defined in 5.2.1;

TR = Fresh food compartment temperature determined according to 5.1.3 in degrees F;

The numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate; and

38.0 = Standardized fresh food compartment temperature in degrees F.

* * * * *

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:

$E = ET1 + ((ET2 - ET1) \times (45.0 - TR1)/(TR2 - TR1))$

and

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

Where:

E is defined in 6.2.1.1;

ET is defined in 5.2.1;

TR and numbers 1 and 2 are defined in 6.2.1.2;

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

45.0 is a specified fresh food compartment temperature in degrees F; and

k is a constant 15.0 for refrigerators or 5.0 for refrigerator-freezers each being standardized freezer compartment temperature in degrees F.

* * * * *

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

$E_{std}$ = 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 switch in the "off" position or, for products without anti-sweat heater switches, the anti-sweat heater in its lowest energy use state.

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

Where:

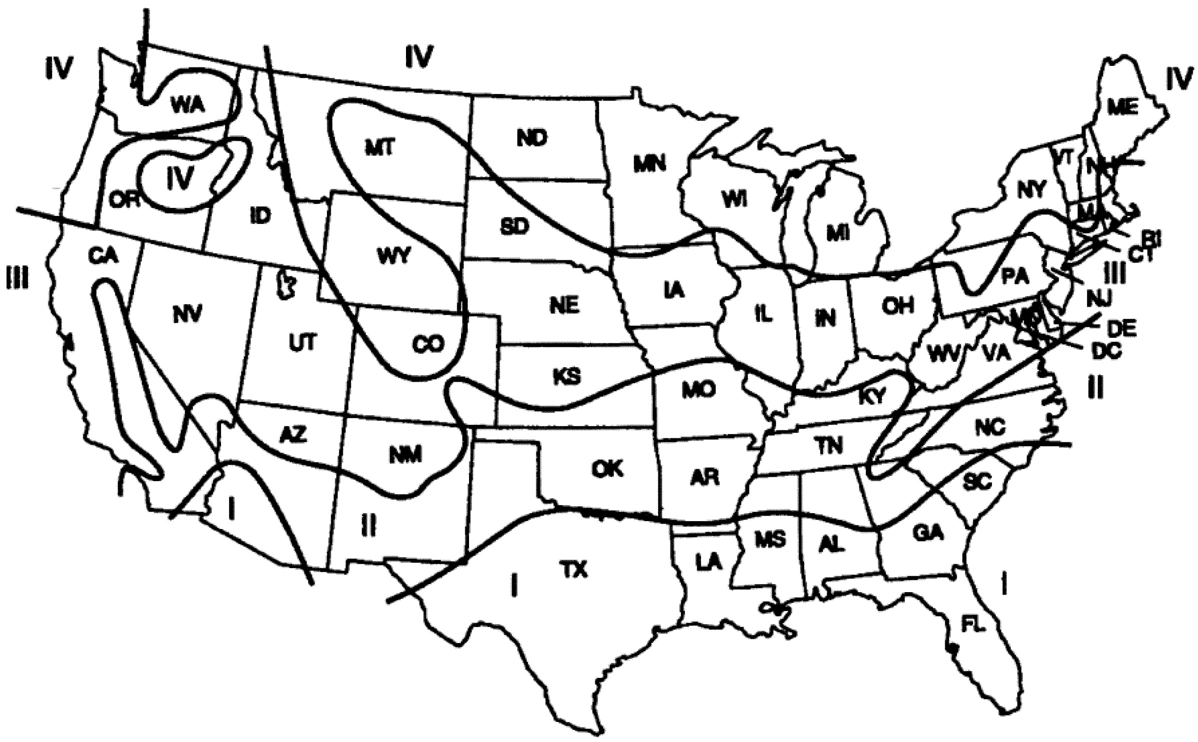
Anti-sweat Heater Power = 0.034 * (Heater Watts at 5%RH)
+ 0.211 * (Heater Watts at 15%RH)
+ 0.204 * (Heater Watts at 25%RH)
+ 0.166 * (Heater Watts at 35%RH)
+ 0.126 * (Heater Watts at 45%RH)
+ 0.119 * (Heater Watts at 55%RH)
+ 0.069 * (Heater Watts at 65%RH)
+ 0.047 * (Heater Watts at 75%RH)
+ 0.008 * (Heater Watts at 85%RH)
+ 0.015 * (Heater Watts at 95%RH)

Heater Watts at a specific relative humidity = the nominal watts used by all heaters at that specific relative humidity, 72 °F (22.2 °C) ambient, and DOE reference temperatures of fresh food (FF) average temperature of 45 °F (7.2 °C) and freezer (FZ) average temperature of 5 °F (−15 °C).

System-loss Factor = 1.3

* * * * *

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.

■ 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) applies 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 multiplied by 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.

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, 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 set to maintain the standardized temperature (see section 3.2).

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 AHAM Standard HRF–1–2008, Association of Home Appliance Manufacturers, Energy and Internal Volume of Refrigerating Appliances (2008), including Errata to Energy and Internal Volume of Refrigerating Appliances, Correction Sheet issued November 17, 2009. 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. It bypasses the thermostat control and operates continually until the feature is terminated either manually or automatically.

1.11 "Separate auxiliary compartment" means a freezer compartment other than the first freezer compartment of a freezer having more than one 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 freezer compartments may not be larger than the first freezer compartment.

1.12 "Special compartment" means any compartment without doors directly accessible from the exterior, and with separate temperature control that is not convertible from fresh food temperature range to freezer temperature range.

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

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

1.15 "Variable defrost control" means an automatic defrost system in which 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 performing this function. A control scheme that changes the defrost interval from a fixed length to an extended length (without any intermediate steps) is not considered a variable defrost control. A variable defrost control feature should predict the accumulation of frost on the evaporator and react accordingly. Therefore, the times between defrost should vary with different usage patterns and include a continuum of lengths of time between defrosts as inputs vary.

*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.

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). 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 Anti-Sweat Heaters. The anti-sweat heater switch is to be on during one test and off during a second test. In the case of an electric freezer with variable anti-sweat heater control, the standard cycle energy use shall be the result of the calculation described in 6.2.2.

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) 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 2.6 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 of this appendix. Settings for special compartments shall be as described in section 2.5 of this appendix;

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

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

(g) Ice storage bins shall be emptied of ice.

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 Special compartments shall be tested with controls set to provide the coldest temperature. However, for special compartments in which temperature control is achieved using the addition of heat (including resistive electric heating, refrigeration system waste heat, or heat from any other source, but excluding the transfer of air from another part of the interior of the product) for any part of the controllable temperature range of that compartment, the product energy use shall be determined by averaging two sets of tests. The first set of tests shall be conducted with such special compartments at their coldest settings, and the second set of tests shall be conducted with such special compartments at their warmest settings. The requirements for the warmest or coldest temperature settings of this section do not apply to features or functions associated with temperature control (such as quick freeze) that are initiated manually and terminated automatically within 168 hours.

2.6 The space between the back of the cabinet and a vertical surface (the test room wall or simulated wall) shall be the minimum distance in accordance with the manufacturer's instructions. However, the clearance shall not be greater than 2 inches (51 mm) from the plane of the cabinet's back panel to the vertical surface. If permanent rear spacers extend further than this distance, the appliance shall be located with the spacers in contact with the vertical surface.

2.7 Steady State Condition. Steady-state conditions exist if the temperature measurements 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.

*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 and 3.2.2, the freezer compartment temperature shall be as specified in section 5.1.3.

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, the tested unit fails the test and cannot be rated. If the compartment temperature measured with all controls set at their warmest setting is below the standardized temperature, then the result of this test alone will be used to determine energy consumption. Also see Table 1 below, which summarizes these requirements.

TABLE 1—TEMPERATURE SETTINGS FOR FREEZERS

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

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 this condition is not met, then the unit shall be tested in accordance with section 3.2.1.

*4. Test Period*

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

4.1 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.

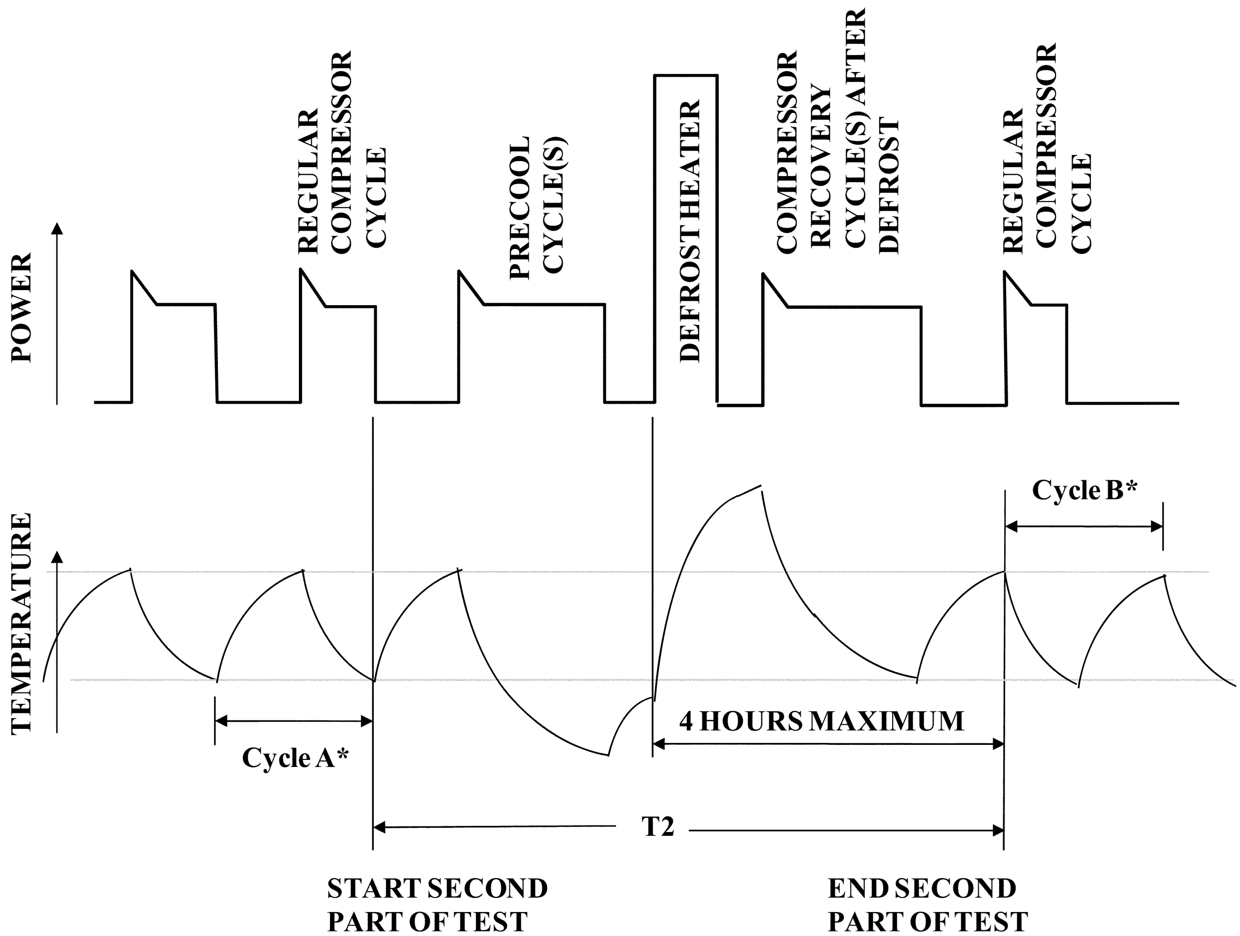
4.2 Automatic Defrost. If the model being tested has an automatic defrost system, the test time period shall start after steady-state conditions have been achieved and be from one point during a defrost period to the same point during the next defrost period. If the model being tested has a long-time automatic defrost system, the alternate provisions of 4.2.1 may be used. If the model being tested has a variable defrost control, the provisions of 4.2.2 shall apply.

4.2.1 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 a stable period of compressor operation that includes no portions of the defrost cycle, such as precooling or recovery, that is otherwise the same as the test for a unit having no defrost provisions (section 4.1). The second part is designed to capture the energy consumed during all of the events occurring with the defrost control sequence that are outside of stable operation.

4.2.1.1 Cycling Compressor System. For a system with a cycling compressor, the second part starts at the termination of the last regular compressor "on" cycle. The average temperature of the compartment measured from the termination of the previous compressor "on" cycle to the termination of the last regular compressor "on" cycle must be within 0.5 °F (0.3 °C) of the average temperature of the compartment measured for the first part of the test. If any compressor cycles occur prior to the defrost heater being energized that cause the average temperature in the compartment to deviate from the first part temperature by more than 0.5 °F (0.3 °C), these compressor cycles are not considered regular compressor cycles and must be included in the second part of the test. As an example, a "precool" cycle, which is an extended compressor cycle that lowers the compartment temperature prior to energizing the defrost heater, must be included in the second part of the test. The test period for the second part of the test ends at the initiation of the first regular compressor cycle after the compartment temperatures have fully recovered to their stable conditions. The average temperature of the compartment measured from this initiation of the first regular compressor "on" cycle until the initiation of the next regular compressor "on" cycle must be within 0.5 °F (0.3 °C) of the average temperature of the compartment measured for the first part of the test. The second part of the test may be terminated after 4 hours if the above conditions cannot be met. See Figure 1.

Figure 1

Long-time Automatic Defrost Diagram for Cycling Compressors

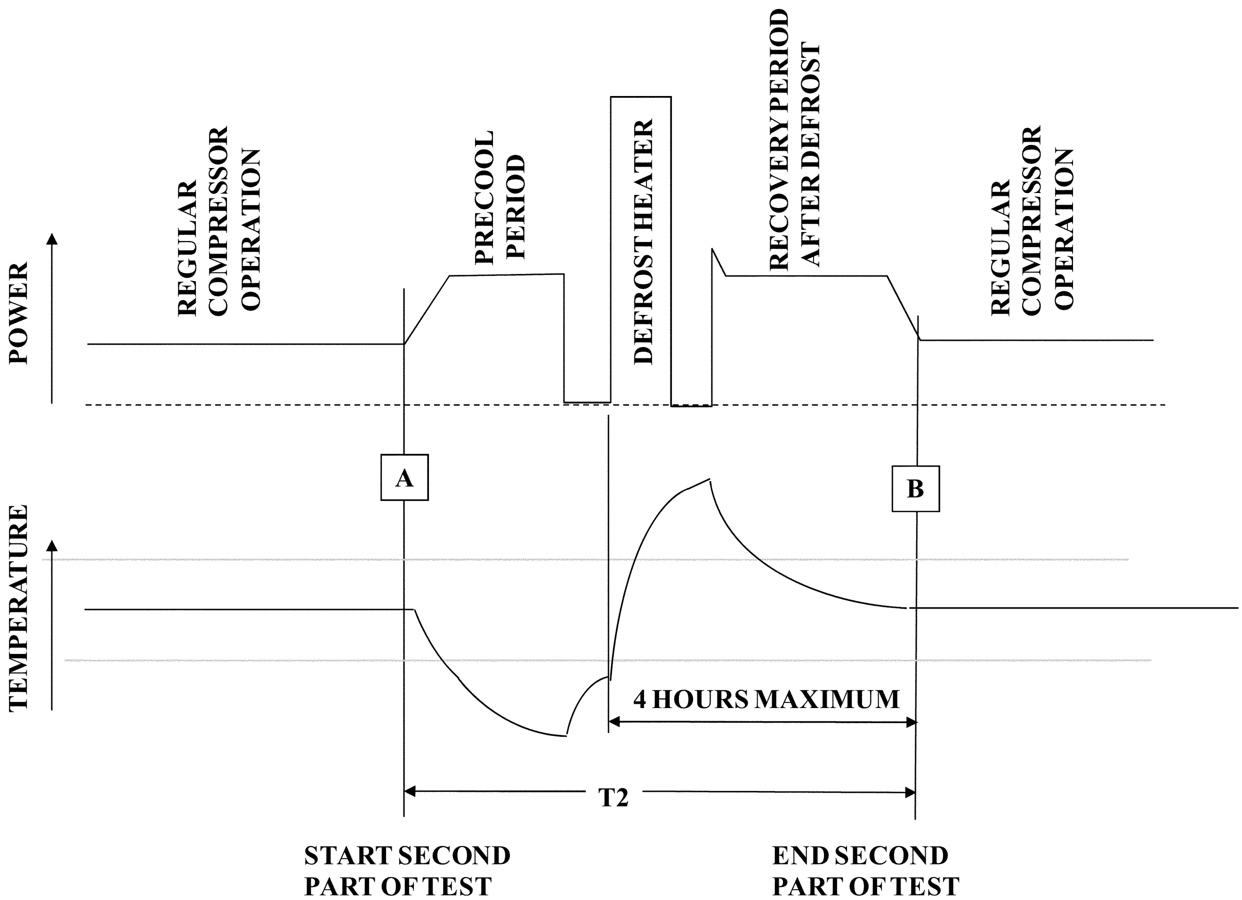



***Average compartment temperature during cycles A & B must be within 0.5 ˚F of the average temperature for the first part of the test. This requirement does not apply for cycle B if the 4 hour limit is reached.**

4.2.1.2 Non-cycling Compressor System. For a system with a non-cycling compressor, the second part starts at a time before defrost during stable operation when the compartment temperature is within 0.5 °F (0.3 °C) of the average temperature of the compartment measured for the first part of the test. The second part stops at a time after defrost during stable operation when the compartment temperature is within 0.5 °F (0.3 °C) of the average temperature of the compartment measured for the first part of the test. The second part of the test may be terminated after 4 hours if the above conditions cannot be met. See Figure 2.

Figure 2

Long-time Automatic Defrost Diagram for Non-cycling Compressors




***Average compartment temperature at times A & B must be within 0.5 ˚F of the average temperature for the first part of the test. This requirement does not apply for time B if the 4 hour limit is reached.**

4.2.2 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 4.2.1).

*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 5.2 of HRF–1–2008, the product may be tested by relocating the temperature sensors from the locations specified in the figures 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, and the certification report shall indicate that non-standard sensor locations were used.

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 the test period as defined in section 4. For long-time automatic defrost models, compartment temperature shall be that measured in the first part of the test period specified in section 4.2.1. For models with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.2.2.

5.1.3 Freezer Compartment Temperature. The freezer compartment temperature shall be calculated as:

$$TF = \frac{\sum_{i=1}^{F}(TF_i) \times (VF_i)}{\sum_{i=1}^{F}(VF_i)}$$

Where:

F is the total number of applicable freezer compartments, which include the first freezer compartment and any number of separate auxiliary freezer compartments;

$TF_i$ is the compartment temperature of freezer compartment “i” determined in accordance with section 5.1.2; and

$VF_i$ is the volume of freezer compartment “i”.

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 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 or compressor run time between defrosts in hours required to cause it to go through a complete cycle, rounded to the nearest tenth of an hour;
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:

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

Where:

ET, K, and 1440 are defined in section 5.2.1.1;
EP1, EP2, T1, T2, and 12 are defined in section 5.2.1.2;

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

Where:

$CT_L$ = least or shortest compressor run 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 compressor run time between defrosts in hours rounded to the nearest tenth of an hour (greater than $CT_L$ but not more than 96 hours);
F = ratio of per day energy consumption in excess of the least energy and the maximum difference in per-day energy consumption and is equal to 0.20.
For variable defrost models with no values for $CT_L$ and $CT_M$ in the algorithm, the default values of 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

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;
The number 1 indicates the test period during which the highest compartment temperature is measured; and
IET, expressed in kilowatt-hours per cycle, equals 0.23 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 = freezer compartment temperature determined according to 5.1.3 in degrees F;
The numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate; and
0.0 = standardized compartment temperature in degrees F.

6.2.2 Variable Anti-Sweat Heater Models. The standard cycle energy consumption of an electric freezer with a variable anti-sweat heater control ($E_{std}$), expressed in kilowatt-hours per day, shall be calculated equivalent to:

$E_{std}$ = E + (Correction Factor) where E is determined by 6.2.1.1, or 6.2.1.2, whichever is appropriate, with the anti-sweat heater switch in the "off" position or, for a product without an anti-sweat heater switch, the anti-sweat heater in its lowest energy use state.

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

Where:

Anti-sweat Heater Power = 0.034 * (Heater Watts at 5%RH)
+ 0.211 * (Heater Watts at 15%RH)
+ 0.204 * (Heater Watts at 25%RH)
+ 0.166 * (Heater Watts at 35%RH)
+ 0.126 * (Heater Watts at 45%RH)
+ 0.119 * (Heater Watts at 55%RH)
+ 0.069 * (Heater Watts at 65%RH)
+ 0.047 * (Heater Watts at 75%RH)
+ 0.008 * (Heater Watts at 85%RH)
+ 0.015 * (Heater Watts at 95%RH)
Heater Watts at a specific relative humidity = the nominal watts used by all heaters at that specific relative humidity, 72 °F ambient (22.2 °C), and DOE reference freezer (FZ) average temperature of 0 °F (−17.8 °C).
System-loss Factor = 1.3

*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 paragraph after the appendix heading;
■ b. Revising section 1. Definitions;
■ c. In section 2. Test Conditions, by:
■ 1. Revising sections 2.1 and 2.2;
■ 2. Redesignating section 2.3 as 2.7;
■ 3. Adding new sections 2.3 through 2.6;
■ 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. Revising section 4, Test Period;
■ 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, 5.2.1.2, and 5.2.1.3;
■ 2. Adding new section 5.1.3;
■ 3. Removing section 5.2.1.4;
■ g. In section 6. Calculation of Derived Results From Test Measurements, by:
■ 1. Revising section 6.2.1.2;
■ 2. Adding a new section 6.2.2
■ 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) applies to this test procedure.

1.1 Adjusted total volume" means the product of, (1) the freezer volume as defined in HRF–1–1979 in cubic feet, times (2) 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.

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 "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 set to maintain the standardized temperature (see section 3.2).

1.6 "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.

1.7 "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.

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

1.9 "Quick freeze" means an optional feature on freezers that is initiated manually. It bypasses the thermostat control and operates continually until the feature is terminated either manually or automatically.

1.10 "Separate auxiliary compartment" means a freezer compartment other than the first freezer compartment of a freezer having more than one 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 freezer compartments may not be larger than the first freezer compartment.

1.11 "Special compartment" means any compartment without doors directly accessible from the exterior, and with separate temperature control that is not convertible from fresh food temperature range to freezer temperature range.

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 an automatic defrost system in which 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 performing this function. A control scheme that changes the defrost interval from a fixed length to an extended length (without any intermediate steps) is not considered a variable defrost control. A variable defrost control feature should predict the accumulation of frost on the evaporator and react accordingly. Therefore, the times between defrost should vary with different usage patterns and include a continuum of lengths of time between defrosts as inputs vary.

* * * * *

*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.

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. 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 Anti-Sweat Heaters. The anti-sweat heater switch is to be on during one test and off during a second test. In the case of an electric freezer equipped with variable anti-sweat heater control, the standard cycle energy use shall be the result of the calculation described in 6.2.2.

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) Connection of water lines and installation of water filters are not required;

(b) Clearance requirements from surfaces of the product shall be as specified in section 2.6 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 of this appendix. Settings for special compartments shall be as described in section 2.5 of this appendix;

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

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

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 Special compartments shall be tested with controls set to provide the coldest temperature. This requirement for the coldest temperature does not apply to features or functions (such as quick freeze) that are initiated manually and terminated automatically within 168 hours.

2.6 The space between the back of the cabinet and a vertical surface (the test room wall or simulated wall) shall be the minimum distance in accordance with the manufacturer's instructions.

* * * * *

*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 as specified in section 5.1.3.

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*

Tests shall be performed by establishing the conditions set forth in section 2 and using the control settings as set forth in section 3 of this appendix.

4.1 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.

4.2 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 4.2.1 may be used. If the model being tested has a variable defrost control, the provisions of 4.2.2 shall apply.

4.2.1 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). The second part would start when a defrost is initiated when the compressor "on" cycle is terminated prior to start of the defrost heater and terminates at the second turn "on" of the compressor or 4 hours from the initiation of the defrost heater, whichever comes first.

4.2.2 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 4.2.1).

*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 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, and the certification report shall indicate that non-standard sensor locations were used.

* * * * *

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 4.2.1. For models equipped with variable defrost controls, compartment temperatures shall be those measured in the first part of the test period specified in section 4.2.2.

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.

5.1.3 Freezer Compartment Temperature. The freezer compartment temperature shall be calculated as:

$$TF = \frac{\sum_{i=1}^{F}(TF_i) \times (VF_i)}{\sum_{i=1}^{F}(VF_i)}$$

Where:

F is the total number of applicable freezer compartments, which include the first freezer compartment and any number of separate auxiliary freezer compartments;

$TF_i$ is the compartment temperature of freezer compartment "i" determined in accordance with section 5.1.2; and

$VF_i$ is the volume of freezer compartment "i".

* * * * *

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 or compressor run time between defrosts in hours required to cause it to go through a complete cycle, rounded to the nearest tenth of an hour;

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:

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

Where:

ET, K, and 1440 are defined in section 5.2.1.1 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 compressor run 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 compressor run time between defrosts in hours rounded to the nearest tenth of an hour (greater than $CT_L$ but not more than 96 hours);

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

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

* * * * *

*6. Calculation of Derived Results From Test Measurements*

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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:

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

Where:

E is defined in 6.2.1.1;

ET is defined in 5.2.1;

TF = freezer compartment temperature determined according to 5.1.3 in degrees F;

The numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate; and

0.0 = Standardized compartment temperature in degrees F.

* * * * *

6.2.2 Variable Anti-Sweat Heater Models. The standard cycle energy consumption of an electric freezer with a variable anti-sweat heater control ($E_{std}$), expressed in kilowatt-hours per day, shall be calculated equivalent to:

$E_{std}$ = E + (Correction Factor) where E is determined by 6.2.1.1, or 6.2.1.2, whichever is appropriate, with the anti-sweat heater switch in the "off" position or, for a product without an anti-sweat heater switch, the anti-sweat heater in its lowest energy use state.

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

Where:

Anti-sweat Heater Power = 0.034 * (Heater Watts at 5%RH)
+ 0.211 * (Heater Watts at 15%RH)
+ 0.204 * (Heater Watts at 25%RH)
+ 0.166 * (Heater Watts at 35%RH)
+ 0.126 * (Heater Watts at 45%RH)
+ 0.119 * (Heater Watts at 55%RH)
+ 0.069 * (Heater Watts at 65%RH)
+ 0.047 * (Heater Watts at 75%RH)
+ 0.008 * (Heater Watts at 85%RH)
+ 0.015 * (Heater Watts at 95%RH)

Heater Watts at a specific relative humidity = the nominal watts used by all heaters at that specific relative humidity, 72 °F (22.2 °C) ambient, and DOE reference freezer (FZ) average temperature of 0 °F (−17.8 °C).

System-loss Factor = 1.3.

* * * * *

*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 § 430.32, revise paragraph (a) introductory text to read as follows:

**§ 430.32 Energy and water conservation standards and their effective dates.**

* * *

(a) *Refrigerators/refrigerator-freezers/freezers.* These standards do not apply to refrigerators and refrigerator-freezers with total refrigerated volume exceeding 39 cubic foot (1104 liters) or freezers with total refrigerated volume exceeding 30 cubic foot (850 liters). The energy standards as determined by the equations of the following table shall be rounded off to the nearest kWh per year. If the equation calculation is halfway between the nearest two kWh per year values, the standard shall be rounded up to the higher of these values.

* * * * *

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