

DEPARTMENT OF ENERGY**Office of Energy Efficiency and Renewable Energy****10 CFR Part 430**

RIN No. 1904-AA93

Energy Conservation Program for Consumer Products: Proposed Rule Adding Test Procedures for Externally Vented Refrigerators and Refrigerator-Freezers

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

ACTION: Proposed rule.

SUMMARY: The Department of Energy (Department or DOE) proposes test procedures for measuring the energy consumption of an externally vented refrigerator and externally vented refrigerator-freezer, a technological innovation which is not accommodated by the existing test procedures. Today's proposal would not change in any way the test procedures applicable to refrigerator and refrigerator-freezer designs without venting.

DATES: Written comments in response to this notice must be received by May 8, 1997. The Department requests 10 copies of the comments and, if possible, a computer disk. The Department is currently using WordPerfect™ 6.1.

ADDRESSES: Written comments are to be submitted to: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, EE-43, Room 1J-018, "Test Procedures for Refrigerators and Refrigerator-Freezers," Docket No. EE-RM-97-118, Forrestal Building, 1000 Independence Avenue, SW, Washington, DC 20585-0121. Telephone: (202) 586-7574. Comments may be hand delivered between the hours of 8:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays. Comments should be labeled, "Test Procedures for Refrigerators and Refrigerator-Freezers" (Docket No. EE-RM-97-118), both on the document or computer disk and on the envelope. Copies of public comments received may be read and/or photocopied at the Department of Energy Freedom of Information Reading Room, U.S. Department of Energy, Forrestal Building, Room 1E-190, 1000 Independence Avenue, SW, Washington, D.C. 20585-0121, telephone (202) 586-6020, between the hours of 9:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT:

Michael G. Raymond, U.S. Department of Energy, Energy Efficiency and Renewable Energy, Mail Station EE-43, Forrestal Building, 1000 Independence Avenue, SW, Washington, D.C., 20585-0121, (202) 586-9611

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SUPPLEMENTARY INFORMATION:**I. Introduction***A. Authority*

Part B of Title III of the Energy Policy and Conservation Act of 1975, Public Law 94-163, as amended by the National Energy Conservation Policy Act, Public Law 95-619, the National Appliance Energy Conservation Act of 1987, Public Law 100-12, the National Appliance Energy Conservation Amendments of 1988, Public Law 100-357, and the Energy Policy Act of 1992, Public Law 102-486, created the Energy Conservation Program for Consumer Products other than Automobiles (Program).¹ The products currently subject to this Program (often referred to hereafter as "covered products") include electric refrigerators and electric refrigerator-freezers.

Under the Act, the Program consists essentially of three parts: testing, labeling, and the Federal energy conservation standards. This proposed rule concerns the testing aspect of this program. The Department, with assistance from the National Institute of Standards and Technology, may amend or establish new test procedures, as appropriate, for any covered product. EPCA, § 323. The purpose of the test procedures is to produce test results that measure energy efficiency, energy use, water use (in the case of showerheads, faucets, water closets and urinals), or estimated annual operating cost of a covered product during a representative average use cycle or period of use. The test procedures shall not be unduly burdensome to conduct. EPCA, § 323(b)(3). One hundred and eighty days after a test procedure for a product is adopted, no manufacturer may make representations with respect to energy use, efficiency or water use of such product, or the cost of energy consumed by such product, except as reflected in

¹ Part B of Title III of Energy Policy and Conservation Act, as amended, is referred to in this proposed rule as "EPCA" or the "Act." Part B of Title III is codified at 42 U.S.C. 6291-6309.

tests conducted according to the DOE procedure. EPCA, § 323(c)(2).

Test procedures promulgated by DOE appear at 10 CFR Part 430, Subpart B. The "Uniform Test Method for Measuring the Energy Consumption of Electric Refrigerators and Electric Refrigerator-Freezers" appears at Appendix A1 to Subpart B.

Section 323(e) of the Act requires DOE to determine to what extent, if any, a proposed test procedure would alter the measured energy efficiency, measured energy use or measured water use of any covered product as determined under the existing test procedure. If DOE determines that an amended test procedure would alter the measured efficiency or measured use of a covered product, DOE is required to amend the applicable energy conservation standard accordingly. In determining the amended energy conservation standard, DOE is required to measure the energy efficiency or energy use of a representative sample of covered products that minimally comply with the existing standard. The average energy use of this representative sample, determined under the amended test procedure, constitutes the amended standard. EPCA, § 323(e)(2).

B. Background

Today's notice proposes to add test procedure amendments that are specific to a new product design—externally vented refrigerators and externally vented refrigerator-freezers. These test procedure amendments will apply only to this product design and will not apply to existing product designs of refrigerators and refrigerator-freezers without this feature. Existing test procedures for non-externally vented refrigerators and refrigerator-freezers will remain unchanged. The energy conservation standards for refrigerators and refrigerator-freezers will be unaffected by the adoption or use of the proposed new test procedures.

The Department does not believe that any of the proposed changes to the test procedures would alter the measurement of energy consumption of electric refrigerators and refrigerator-freezers currently on the market. Accordingly, adoption of the proposed amended test procedures would not require any change in energy conservation standards for refrigerators and refrigerator-freezers currently in place. In addition, the Department believes that the proposed test procedure amendments would have no effect on the pending rulemaking considering revised minimum energy conservation standards for electric

refrigerators, refrigerator-freezers and freezers. (Docket No. EE-RM-93-801).

On March 14, 1995, Edward Schulk Equities, Inc. ("ESE") submitted a letter to the Department regarding the inapplicability of existing test procedures in Appendix A1 to externally vented refrigerators. ESE submitted a description of an externally vented refrigerator from a recently granted patent. ESE claimed that allowing cooler outside air to be passed over the condenser/compressor of a refrigerator would reduce energy consumption of the refrigerator. ESE explained that the existing test procedures address only a closed system without the possibility of transfer of exterior air cooler than the ambient room temperature. Based on the information submitted, the Department agrees that the existing test procedures do not permit the measurement of energy consumption of an externally vented refrigerator.

While ESE's letter was submitted as a petition for waiver, the Department concluded that its waiver process was not appropriate because waivers apply to "basic models," and no models are currently being manufactured incorporating this invention, nor is the invention being produced for retrofitting. Therefore, the Department published ESE's letter and issued a Notice of Inquiry inviting public comment on several issues relating to the energy consumption, manufacturability, and retrofitting of externally vented refrigerators. 60 FR 37603 (July 21, 1995). The Department also invited comments on methods of testing externally vented refrigerators and refrigerator-freezers to determine energy savings. Notice of Inquiry at 60 FR 37604. No public comments were received in response to this Notice of Inquiry.

On November 13, 1995, acting upon the Department's suggestion, ESE submitted a draft of proposed amendments to the test procedures for refrigerators and refrigerator-freezers. The Department referred this submittal to the National Institute of Standards and Technology (NIST). NIST, the Department and ESE representatives extensively discussed the requirements for test procedures for externally vented refrigerators and refrigerator-freezers. NIST conducted an analysis of test procedures for externally vented refrigerators and refrigerator-freezers. The notice published today by the Department reflects these extensive discussions and subsequent NIST recommendations for test procedure amendments.

Today's notice proposes revising the test procedures for electric refrigerators and electric refrigerator-freezers appearing in 10 CFR Part 430, Subpart B, Appendix A1 by: (1) Adding a definition of externally vented refrigerators and refrigerator-freezers to which the revisions are applicable, (2) prescribing test conditions for externally vented refrigerators and refrigerator-freezers, (3) specifying energy consumption measurement tests for externally vented refrigerators and refrigerator-freezers, and (4) including calculation methods for deriving results from test measurements.

II. Discussion

The current test procedures for refrigerators and refrigerator-freezers, found at 10 CFR Part 430, Appendix A1 of Subpart B, does not address testing of externally vented refrigerators and refrigerator-freezers. The existing test procedures apply to a refrigerator system to which cool outside air cannot be conducted for purposes of heat transfer. Externally vented refrigerators would be designed to permit outside air to be introduced across the refrigerator's condenser and compressor and, in some cases, throughout the walls of the refrigerator. The introduction of outside air at temperatures lower than the ambient room air temperature permits more efficient heat transfer, potentially resulting in energy savings.

The Department therefore proposes to revise the test procedures to include provisions tailored to measuring the energy consumption of externally vented refrigerators and refrigerator-freezers. These provisions will add to, rather than replace, the existing test procedures, which remain fully applicable to both externally vented and non-vented refrigerators and refrigerator-freezers. The Department emphasizes that the proposed amendments to the test procedures do not affect in any way the test procedures applicable to existing refrigerator designs. The amendments provide a method for accurately measuring the energy consumption of an enclosed, externally vented refrigerator or refrigerator-freezer unit and take account of design features (e.g., enclosed condenser, outside air conduits, dampers) peculiar to an externally vented refrigerator or refrigerator-freezer that circulates outside air around its condenser. The amendments do not apply to refrigerators or refrigerator-freezers that use outside air through the refrigerator walls. With these amendments, the test procedures will provide a basis for making comparable measurements of

energy consumption for externally vented and unvented refrigerators and refrigerator-freezers.

The Department also emphasizes that recognition of a design option of externally vented refrigerators and refrigerator-freezers does not affect in any way the Department's consideration of design options in connection with its consideration of proposed revisions to energy consumption standards for refrigerators and refrigerator-freezers. This design option was not included in the standards rulemaking record and therefore cannot be considered in the current standards rulemaking.

The Department invites comments on any aspect of the proposed test procedure amendments for externally vented refrigerators and refrigerator-freezers.

The Department today proposes to amend the test procedures applicable to electric refrigerators and electric refrigerator-freezers (10 CFR Part 430, Subpart B, Appendix A1), as follows:

1. *Definitions and applicability of amended test procedures.* The Department proposes to define "externally vented refrigerator or refrigerator-freezer" as a refrigerator or refrigerator-freezer with an enclosed condenser or an enclosed condenser/compressor compartment, and a set of air ducts for transferring exterior air from outside the building envelope into, through, and out of the refrigerator or refrigerator-freezer cabinet (section 1.12). Energy consumption savings from an externally vented refrigerator or refrigerator-freezer should be achievable for outside air temperatures between 60 °F and 80 °F. Above 80 °F, outside air may be warmer than ambient room air, making heat transfer in the wrong direction for energy savings. Below 60 °F, outside air may be too cool for optimal operation of the unit. The proposed amendments to the test procedures are generally predicated upon a unit's design that permits the exclusion and/or mixing of outside air that is either above 80 °F or below 60 °F. Accordingly, the amendments to the test procedures will apply only under conditions where the externally vented refrigerator or refrigerator-freezer design is capable of mixing the exterior air drawn in from outside the building envelope with the ambient room air. The modification includes thermostatically controlled dampers or controls that: 1) enable the proper mixing of outside and ambient room air when the outside air temperature is lower than 60 °F, and 2) exclude outside air warmer than 80 °F, or warmer than room air temperature (section 1.12). Externally vented units could have

temperature controls that exclude outside air either at a pre-set temperature no lower than 80 °F or when the outside air temperature exceeds the ambient room air temperature (section 1.12). The test procedures require that prior to conducting energy consumption tests, the operability of thermostatic controls be verified (section 5.4.1). All tests must generally be conducted with the thermostatic controls operable. A special rule is provided for testing energy consumption when mixing controls do not operate properly (section 5.4.2.4). The test procedures will take account of the energy consumption of any exterior air fan that draws air to the refrigerator cabinet.

2. *Exterior air source.* The Department recognizes that actual testing should take place under conditions of variable exterior air temperatures and, therefore, proposes to require that prescribed test conditions include the provision of an external air source that provides air at adjustable temperature and pressure capabilities (section 2.6). The test procedures prescribe the location of temperature sensors for measuring the air temperature at the inlet to the condenser/compressor compartment (section 2.6.2). Air temperature will also be measured at the exterior air source. Temperature measurements are to be made at prescribed intervals.

3. *Air ducts.* Externally vented refrigerators and refrigerator/freezers depend upon air ducts to transfer exterior air to the refrigerator cabinet. Rather than specifying the length, diameter, shape and material of the duct, the Department proposes to specify air pressure requirements as a uniform test condition (section 2.6.3). Specifically, the proposed test procedures require exterior air pressure at the inlet to the refrigerator unit to be maintained at a negative pressure of $0.20'' \pm 0.05''$ water column (62 Pa \pm 12.5 Pa). The test procedures also specify location distances for the pressure sensors, relative to the exterior air source (i.e., the inlet to the building envelope) and to the condenser inlet.

4. *Applicability of general test method conditions.* The proposed amendments to the test procedures are not intended to supplant existing test methods applicable to all other refrigerators and refrigerator-freezers. Accordingly, the proposed amendments provide that, except as expressly modified, the test conditions and specifications included in the existing test procedures shall also apply to externally vented refrigerators and refrigerator-freezers (section 5.4).

5. *Energy consumption correction factor for test measurements.* The

Department proposes a series of formulas for determining energy consumption from test measurements. First, the Department recognizes that energy consumption of any refrigerator will be different with and without door openings. Under the existing test procedure, refrigerators are tested at 90 °F without door openings to simulate the energy consumption they would have at normal room temperature with door openings. Normal room temperature for the refrigerator test procedure is considered to be 80 °F, the typical temperature of the ambient air surrounding the refrigerator's condenser. An externally vented refrigerator will show an artificially low energy consumption compared to an unvented refrigerator when tested at 90 °F room air temperature, because 90 °F is warmer than normal room temperature. The Department proposes to require calculation of a correction factor for each basic model of externally vented refrigerator. The correction factor is the ratio of the energy consumption of an externally vented refrigerator (with external venting disabled) at 90 °F inlet air temperature to the energy consumption of the unit at 80 °F inlet air temperature (sections 5.4.2.1 and 6.3.1).

6. *Energy consumption test measurements and calculations.* Based on analysis by NIST and its derivation of an algebraic equation for determining energy consumption over a range of outside air temperatures, the Department has determined that test measurements of energy consumption need be taken at only two outside air temperatures, 90 °F and 60 °F (sections 5.4.2.2 and 5.4.2.3). If the outside air temperature is not in this range, mixing controls and dampers will keep the condenser inlet temperature within the range. Accordingly, the Department proposes an energy profile equation that will allow for the interpolation of energy consumption at outside air temperatures within this range (section 6.3.4). The parameters of the energy profile equation are determined for each basic model of externally vented refrigerator that is tested, based on the measured energy consumption during testing at 90 °F and 60 °F.

Once the parameters of the energy profile equation are determined, the test procedures provide a basis for calculating energy consumption at various temperatures. Because temperatures vary across the country, throughout a day, and throughout the year, the proposed test procedures specify an energy consumption formula that determines a unit's total energy consumption based on weighted

averaging of the unit's energy consumption at different exterior air temperatures. The test procedures provide weighting factors for a national average energy consumption (section 6.3.6) and weighting factors for four different regions of the country, which are identified on a map. This procedure was based on the test procedure for heat pumps, for which energy savings are also a function of climate. The regional map is the same as that used in the heat pump test procedure, except Regions I and II from the heat pump test procedure are combined and called Region I. Externally vented refrigerators need only be tested at 90 °F and 60 °F, and from such measurements, application of the correction factor, and application of the energy profile equation, the unit's average per cycle energy consumption can be determined for the nation as a whole and for each of the four regions of the country. The Department recognizes the Federal Trade Commission (FTC) has authority to prescribe labeling requirements for all types of refrigerators and other covered products and may require fact sheets containing regional performance information. The proposed energy consumption measurement formulas would satisfy the FTC's requirements.

7. *Reporting requirements.* The Department is proposing to add a reporting requirement for externally vented refrigerators and refrigerator-freezers. The energy savings due to externally venting a refrigerator or refrigerator-freezer is a function of the outdoor air temperature, therefore, externally vented refrigerators and refrigerator-freezer's energy use will depend on climate. The Department proposes to require that a manufacturer's certification report include the national average annual energy use for externally vented refrigerators and refrigerator-freezers. Separate reporting of regional per cycle energy consumption would not be required.

III. Review Under the National Environmental Policy Act of 1969

In this rule, the Department proposes amendments to the test procedures for refrigerators and refrigerator-freezers to include externally vented refrigerators and refrigerator-freezers. The Department has determined that this rule is covered under the Categorical Exclusion found at paragraph A.6 of appendix A to Subpart D, 10 CFR Part 1021, which applies to the establishment of procedural rulemakings. This Proposed Rule is also a procedural rulemaking and its implementation will not affect the

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.

IV. Regulatory Review

Today's regulatory proposal has been determined not to be a "significant regulatory action" under Executive Order 12866, "Regulatory Planning and Review," (58 FR 51735, October 4, 1993). Accordingly, today's action was not subject to review under the Executive Order by the Office of Information and Regulatory Affairs.

V. Regulatory Flexibility Review

The proposed rule has been reviewed under the Regulatory Flexibility Act, Pub. L. 96-354 (42 U.S.C. 601-612) which requires preparation of a regulatory flexibility analysis for any regulation that will have a significant economic impact on a substantial number of small entities, i.e., small businesses and small government jurisdictions. The proposed rule would not have significant economic impact on manufacturers of externally vented refrigerators and refrigerator-freezers. The rule, if promulgated, would modify the testing methods that currently apply. DOE accordingly certifies that the proposed rule would not, if promulgated, have a significant economic impact on a substantial number of small entities and that preparation of a regulatory flexibility analysis is not warranted.

VI. "Takings" Assessment Review

It has been determined pursuant to Executive Order 12630 (52 FR 8859, March 18, 1988) that this proposed regulation, if adopted, would not result in any takings which might require compensation under the Fifth Amendment to the United States Constitution.

VII. Federalism Review

Executive Order 12612 (52 FR 41685, October 30, 1987) requires that regulations or rules be reviewed for any substantial direct effects on States, on the relationship between the Federal Government and the States, or on the distribution of power and responsibilities among various levels of Government. If there are sufficient substantial direct effects, the Executive Order 12612 requires the preparation of a Federalism assessment to be used in decisions by senior policy makers in promulgating or implementing the regulation.

The proposed rule published today would not alter the distribution of authority and responsibility to regulate in this area. The proposed rule would only revise a currently applicable DOE test procedure to accommodate a technological development in the manufacture of refrigerators and refrigerator-freezers. Accordingly, DOE has determined that preparation of a federalism assessment is unnecessary.

VIII. Paperwork Reduction Act Review

This proposed rule contains no new collections of information under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.*

IX. Review Under Unfunded Mandates Reform Act of 1995

Section 202 of the Unfunded Mandates Reform Act of 1995 ("Unfunded Mandates Act") requires that the Department prepare a budgetary impact statement before promulgating a rule that includes a Federal mandate that may result in expenditure by state, local, and tribal governments, in the aggregate, or by the private sector, of \$100 million or more in any one year. The budgetary impact statement must include: (i) Identification of the Federal law under which the rule is promulgated; (ii) a qualitative and quantitative assessment of anticipated costs and benefits of the Federal mandate and an analysis of the extent to which such costs to state, local, and tribal governments may be paid with Federal financial assistance; (iii) if feasible, estimates of the future compliance costs and of any disproportionate budgetary effects the mandate has on particular regions, communities, non-Federal units of government, or sectors of the economy; (iv) if feasible, estimates of the effect on the national economy; and (v) a description of the Department's prior consultation with elected representatives of state, local, and tribal governments and a summary and evaluation of the comments and concerns presented.

The Department has determined that the action proposed today does not include a Federal mandate that may result in estimated costs of \$100 million or more to state, local or to tribal governments in the aggregate or to the private sector. Therefore, the requirements of Sections 203 and 204 of the Unfunded Mandates Act do not apply to this action.

X. Review Under Executive Order 12988, "Civil Justice Reform"

With respect to the review of existing regulations and the promulgation of

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

XI. Public Comment Procedures

A. Written Comment Procedures

Interested persons are invited to participate in the rulemaking by submitting data, comments, or information with respect to the proposed test procedures set forth in this notice to the address indicated at the beginning of the notice.

Comments should be identified both on the envelope and on the documents as "Test Procedures for Refrigerators and Refrigerator-Freezers," Docket No. EE-RM-97-118. Ten (10) copies are requested to be submitted. In addition, the Department requests that an electronic copy (3½" diskette) of the comments on WordPerfect™ 6.1 be provided. All submittals received by the date specified at the beginning of this notice will be considered by the Department of Energy before final action is taken on the proposed amendments.

Pursuant to the provisions of 10 CFR 1004.11, any person submitting information that he or she believes to be

confidential and exempt by law from public disclosure should submit one complete copy of the document and ten (10) copies, if possible, from which the information believed to be confidential has been deleted. The Department of Energy will make its own determination with regard to the confidential status of the information and treat it according to its determination.

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

B. Issues for Public Comment

The Department of Energy is interested in receiving comments and data concerning the suitability and workability of these test procedures. Also, the Department welcomes comment on improvements or alternatives to these approaches. In particular, DOE is interested in gathering comments on the following:

- The appropriateness of providing test procedures for externally vented refrigerators and refrigerator-freezers.
- The definition of externally vented refrigerators and refrigerator-freezers and the applicability of the proposed revisions of the test procedures.
- The interaction of the externally vented refrigerator and refrigerator/freezer and its associated air conduits and building envelope penetration with the building heating and cooling loads.
- The effects on energy conservation if externally vented refrigerators and refrigerator-freezers are installed without the outside air connection, and methods for adjusting the test results to account for the likely failure of some consumers to make use of this feature.
- The appropriate test conditions for externally vented refrigerators and refrigerator-freezers, including the selection of outside air temperatures at which testing should occur.
- The appropriateness of the correction factor to account for the

externally vented refrigerator and refrigerator-freezer's testing advantage resulting from the 90°F test temperature.

- The appropriateness of the energy profile equations and the derivation of formulas for computing energy consumption from test results.
- The appropriateness and means of measuring national and regional average per cycle energy consumption.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Energy conservation, Household appliances.

Issued in Washington, DC, March 24, 1997.

Christine A. Ervin,

Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, Part 430 of Chapter II of Title 10, Code of Federal Regulations is proposed to be amended as follows:

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.

2. Section 430.23 (a) is amended in the following respects:

Subpart B—Test Procedures

§ 430.23 Test procedures for measures of energy consumption.

(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:

- (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 or 6.3.6 of appendix A1 of this subpart for the non-externally vented or externally vented units, respectively, and
- (iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

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

- (i) The representative average-use cycle of 365 cycles per year,
- (ii) Half the sum of the average per-cycle energy consumption for the

standard cycle and the average per-cycle energy consumption for a test cycle type with the anti-sweat heater switch in the position set at the factory just prior to shipping, each in kilowatt-hours per cycle, determined according to 6.2 or 6.3.6 of appendix A1 of this subpart for the non-externally vented or externally vented units, respectively, and

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

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

- (i) The representative average-use cycle of 365 cycles per year,
- (ii) The average per-cycle energy consumption for the specified cycle type, in kilowatt-hours per cycle, determined according to 6.2 or 6.3.6 of appendix A1 of this subpart for the non-externally vented or externally vented units, respectively, and
- (iii) The representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

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

(i) For electric refrigerators and electric refrigerator-freezers not 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, divided by

(B) The average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 or 6.3.6 of appendix A1 of this subpart for the non-externally vented or externally vented units, respectively, 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, 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 prior to

shipping, each in kilowatt-hours per cycle, determined according to 6.2 or 6.3.6 of appendix A1 of this subpart for the non-externally vented or externally vented units, respectively, the resulting quotient then being rounded off to the second decimal place.

(5) The annual energy use of electric refrigerators and electric refrigerator-freezers equals the representative average use cycle of 365 cycles per year times the average per-cycle energy consumption for the standard cycle in kilowatt-hours per cycle, determined according to 6.2 or 6.3.6 of appendix A1 of this subpart for the non-externally vented or externally vented units, respectively.

(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 which the Secretary determines are likely to assist consumers in making purchasing decisions which are derived from the application of appendix A1 of this subpart.

(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:

(i) The representative average 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 and

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

(8) The estimated regional annual operating cost for externally vented electric refrigerators and externally vented electric refrigerator-freezers with an anti-sweat heater switch shall be the product of the following three factors:

(i) The representative average 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 type with the anti-sweat heater switch in the position set at the factory just prior to shipping, each in kilowatt-hours per cycle, determined according to 6.3.7 of appendix A1 of this subpart, and

(iii) The representative average unit cost of electricity in dollars per

kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

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

(i) The representative average cycle of 365 cycles per year,

(ii) The regional average per-cycle energy consumption for the specified cycle type, in kilowatt-hours per cycle, determined according to 6.3.7 of appendix A1 of this subpart, and

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

* * * * *

3. Section 1 of Appendix A1 is amended by adding the following definition:

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

1. Definitions

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

4. Section 2 of Appendix A1 is amended by adding the following new sections:

2. Test Conditions

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2.6 *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).

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

2.6.2 *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.

2.6.3 *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).

5. Section 5 of Appendix A1 is amended by adding the following new sections:

5. Test measurements

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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 5.4 or other sections expressly applicable to externally vented refrigerators or refrigerator-freezers.

5.4.1 *Operability of thermostatic and mixing of air controls.* Prior to 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 must be verified. The operability of such controls shall be verified by operating the unit under ambient air temperature of 90 °F and exterior air temperature of 45 °F. If the inlet air entering the condenser or condenser/compressor compartment is maintained at 60 °F, plus or minus three degrees, energy consumption of the unit shall be measured under sections 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 °F, plus or minus three degrees, energy

consumption of the unit shall also be measured under section 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, 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, 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 section 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, i corresponds to each of the two states of the compartment temperature control positions.

6. Section 6 of Appendix A1 is amended by adding the following new sections:

6. Calculation of Derived Results from Test Measurements

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6.3 Externally vented refrigerator or refrigerator-freezers. Per-cycle energy consumption measurements for the 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. A correction factor, K, shall be calculated as:

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

Where ec_{90} and ec_{80} = the energy consumption test results as determined under 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 section 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 sections 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 are ϵ_{90} , ϵ_{60} , ϵ_{50} , and ϵ_{30} , where applicable, in kWh/day.

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

$$\begin{aligned} E_{90} &= K \times \epsilon_{90}, \\ E_{60} &= K \times \epsilon_{60}, \\ E_{50} &= K \times \epsilon_{50}, \text{ and} \\ E_{30} &= K \times \epsilon_{30} \end{aligned}$$

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

6.3.4 Energy profile equation. For a given setting of the anti-sweat heater, 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) shall be calculated by the following equation:

$$E_x = a + bT_x$$

Where,

T_x = exterior air temperature in °F;
 $a = 3E_{60} - 2E_{90}$, in kWh/day;
 $b = (E_{90} - E_{60})/30$, in kWh/day per °F.

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:

$$E_N = 0.523 \times E_{60} + 0.165 \times E_{65} + 0.181 \times E_{75} + 0.131 \times E_{80}, \text{ for unit which is not tested under section 5.4.2.4,}$$

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

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 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 1 using one of the following equations and the coefficients in the table A:

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

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

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 a_1 , a , b , c , d , 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 | a_1 | 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 |

