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Energy Conservation Program: Test Procedures for Walk-In Coolers and Walk-In Freezers; Final Rule

DEPARTMENT OF ENERGY

10 CFR Part 431

[Docket No. EERE–2008–BT–TP–0014]

RIN 1904–AB85

Energy Conservation Program: Test Procedures for Walk-In Coolers and Walk-In Freezers

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

ACTION: Final rule.

SUMMARY: On January 4, 2010, the U.S. Department of Energy (DOE) issued a notice of proposed rulemaking (January 2010 NOPR) to establish new test procedures for walk-in coolers and walk-in freezers (WICF or walk-ins). On September 9, 2010, DOE issued a supplemental notice of proposed rulemaking (September 2010 SNOPR) to propose changes to the test procedures that it proposed in the NOPR. Those proposed rulemakings serve as the basis for today's action. DOE is issuing a final rule that establishes new test procedures for measuring the energy efficiency of certain walk-in cooler and walk-in freezer components including panels, doors, and refrigeration systems. These test procedures will be mandatory for product testing to demonstrate compliance with energy standards that DOE is establishing in a separate, but concurrent rulemaking, and for representations starting 180 days after publication. This final rule incorporates by reference industry test procedures that, along with calculations established in the rule, can be used to measure the energy consumption or performance characteristics of certain components of walk-in coolers and walk-in freezers. Additionally, the final rule clarifies the definitions of "Display door," "Display panel," "Door," "Envelope," "K-factor," "Panel," "Refrigerated," "Refrigeration system," "U-factor," "Automatic door opener/closer," "Core region," "Edge region," "Surface area," "Rating condition," and "Percent time off" as applicable to walk-in coolers and walk-in freezers.

DATES: The effective date of this rule is May 16, 2011. The final rule changes will be mandatory for product testing starting October 12, 2011.

The incorporation by reference of certain publications listed in this rule was approved by the Director of the Federal Register on May 16, 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 contact Ms. Brenda Edwards at the above telephone number, or by e-mail at *Brenda_Edwards@ee.doe.gov,* for additional information regarding visiting the Resource Room.

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

A link to the docket web page can be found at: *http://www1.eere.energy.gov/buildings/appliance_standards/commercial/wicf.html.* This web page will contain a link to the docket for this notice on the regulations.gov site. The regulations.gov web page will contain simple instructions on how to access all documents, including public comments, in the docket.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION: This final rule incorporates by reference into subpart R of Title 10, Code of Federal Regulations, part 431 (10 CFR part 431), the following industry standards:

(1) AHRI 1250 (I–P)–2009, "2009 Standard for Performance Rating of Walk-In Coolers and Freezers," approved 2009.

(2) ASTM C1363–05, "Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus," approved May 1, 2005.

(3) DIN EN 13164:2009–02, "Thermal insulation products for buildings—Factory made products of extruded polystyrene foam (XPS)—Specification," approved February 2009.

(4) DIN EN 13165:2009–02, "Thermal insulation products for buildings—Factory made rigid polyurethane foam (PUR) products—Specification," approved February 2009.

(5) NFRC 100–2010[E0A1], "Procedure for Determining Fenestration Product U-factors," approved 2010.

Copies of ASTM standards can be obtained from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428–2959, (610) 832–9585, or *http://www.astm.org.*

Copies of AHRI standards can be obtained from *AHRI.* Air-Conditioning, Heating and Refrigeration Institute, 2111 Wilson Boulevard, Suite 500, Arlington, VA 22201, (703) 600–0366, or *http://www.ahrinet.org.*

Copies of DIN EN standards can be obtained from *CEN.* European Committee for Standardization (French: Norme or German: Norm), Avenue Marnix 17, B–1000 Brussels, Belgium, *Tel:* + 32 2 550 08 11, *Fax:* + 32 2 550 08 19 or *http://www.cen.eu.*

Copies of NFRC standards can be obtained from *NFRC.* National Fenestration Rating Council, 6305 Ivy Lane, Ste. 140, Greenbelt, MD 20770, (301) 589–1776, or *http://www.nfrc.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. Authority and Background

Title III of the Energy Policy and Conservation Act (42 U.S.C. 6291–6317; "EPCA" or, "the Act") sets forth a variety of provisions designed to improve energy efficiency. (All references to EPCA refer to the statute as amended through the Energy Independence and Security Act of 2007 (EISA 2007), Public Law 110–140 (Dec. 19, 2007)). Part C of Title III (42 U.S.C. 6311–6317), which was subsequently redesignated as Part A–1 for editorial reasons, establishes an energy conservation program for certain industrial equipment. This includes walk-in coolers and walk-in freezers, the subject of today's notice. (42 U.S.C. 6311(1), (20), 6313(f), and 6314(a)(9))

Under EPCA, 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 or equipment must use (1) as the basis for certifying compliance 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.

Section 312 of the Energy Independence and Security Act of 2007 ("EISA 2007") amended EPCA by adding certain equipment to this energy conservation program, including walk-in coolers and walk-in freezers (collectively "walk-in equipment," "walk-ins," or "WICF."). (42 U.S.C. 6311(1), (20), 6313(f), and 6314(a)(9)) As amended by EISA 2007, EPCA requires DOE to establish new test procedures to measure the energy use of walk-in coolers and walk-in freezers. (42 U.S.C. 6314(a)(9)(B)(i)) The new test procedures for WICF equipment are the subject of this rulemaking. EPCA also directs DOE to publish performance-based standards and promulgate labeling requirements (42 U.S.C. 6313(f)(4)(A) and 42 U.S.C. 6315(e), respectively). These actions will be covered in separate rulemakings.

In the notice of proposed rulemaking published January 4, 2010 (January 2010 NOPR or, in context, NOPR), DOE proposed to establish test procedures to measure the energy efficiency of walk-in coolers and freezers. 75 FR 186. DOE identified several issues in its proposal based on the public comments submitted in response to the January 2010 NOPR and further research. These issues included: (1) The proposed definition of a walk-in cooler or freezer with regards to the upper temperature limit; (2) the proposal to create test procedures for the envelope and refrigeration system of a walk-in cooler or freezer; (3) the proposal to group walk-in envelopes and refrigeration systems with essentially identical construction methods, materials, and components into a single basic model; and (4) the proposed calculation methodology for determining the energy consumption of units within the same basic model. 75 FR 186, (Jan. 4, 2010). On March 1, 2010, DOE held a public meeting to receive comments, data, and information on the January 2010 NOPR. Through their comments, interested parties raised significant issues and suggested changes to the proposed test procedures. DOE determined that some of these comments warranted further consideration and published a supplemental notice of proposed rulemaking on September 9, 2010 (September 2010 SNOPR or, in context, SNOPR). 75 FR 55068. DOE received 22 written comments on the September 2010 SNOPR. This final rule addresses comments from the January 2010 NOPR that were not addressed in the September 2010 SNOPR and comments received on the September 2010 SNOPR.

General Test Procedure Rulemaking Process

Under 42 U.S.C. 6314, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered equipment. EPCA provides that test procedures "shall be reasonably designed to produce test results which reflect energy efficiency, energy use and estimated annual operating costs of a type of industrial equipment (or class thereof) during a representative average use cycle as determined by the Secretary [of Energy], and shall not be unduly burdensome to conduct." (42 U.S.C. 6314(a)(2))

Additionally, EPCA notes that if the procedure determines estimated annual operating costs, the procedure "shall provide that such costs shall be calculated from measurements of energy use in a representative average use cycle (as determined by the Secretary), and from representative average-unit costs of the energy needed to operate such equipment during such cycle." (42 U.S.C. 63114(a)(3)) Further, the statute provides that DOE "shall provide information to manufacturers of covered equipment respecting representative average unit costs of energy." *Id.*

With respect to today's rulemaking, the test procedure DOE is prescribing today is a new test procedure. Today's rule establishes a comprehensive testing regime to ensure minimum levels of performance by applying the component-based approach detailed in EISA 2007. The separate but concurrent energy conservation standards rulemaking for walk-in coolers and walk-in freezers will be based on the performance of walk-in coolers and walk-in freezers as measured by the test procedure set forth in this final rule.

II. Summary of the Final Rule

Today's final rule establishes a new test procedure for measuring the energy efficiency of walk-in cooler and walk-in freezer equipment. The test procedure is essentially composed of tests for the principal components that make up a walk-in: Panels, doors, and refrigeration. Testing individual components of walk-in coolers and walk-in freezers is simpler and less burdensome to manufacturers than testing an entire walk-in. In this test procedure, DOE also provides a method for calculating the energy use of an entire envelope, or the efficiency of a refrigeration system, based on the results of the component tests.

The test procedure incorporates by reference the industry test procedures ASTM C1363–05, "Standard Test

Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus,"DIN EN 13164:2009–02, "Thermal insulation products for buildings—Factory made products of extruded polystyrene foam (XPS)—Specification," DIN EN 13165:2009–02, "Thermal insulation products for buildings—Factory made rigid polyurethane foam (PUR) products—Specification," NFRC 100–2010[E0A1], "Procedure for Determining Fenestration Product U-factors," and AHRI 1250 (I–P)–2009, "2009 Standard for Performance Rating of Walk-In Coolers and Freezers."

Concurrently, DOE is undertaking an energy conservation standards rulemaking to address the statutory requirement to establish performance standards for walk-in equipment by 2012. (42 U.S.C. 6313(f)(4)(A)) DOE will use this test procedure in the concurrent process of evaluating potential performance standards for the equipment. After the compliance date of the performance standards, this walk-in cooler and walk-in freezer test procedure, along with any future statistical sampling plans that may be adopted, must be used by manufacturers to determine compliance with the standards, and by DOE to ascertain compliance with the standards in any enforcement action. Moreover, once any final test procedure is effective, any representation of the energy use of walk-in equipment or components must reflect the results of testing that equipment using the test procedure.

III. Discussion

In this section, DOE describes the overall approach it followed in developing today's test procedure for walk-in cooler and freezer equipment, including envelope components and refrigeration systems. The following section also addresses issues raised by interested parties, which consisted of the following entities:

- *Manufacturers:* American Panel, Craig Industries, CrownTonka, Heatcraft Refrigeration Products (Heatcraft), Hill Phoenix, International Cold Storage (ICS), Kysor Panel Systems (Kysor Panel), Manitowoc, Master-Bilt, Owens Corning, Nor-Lake, ThermalRite, Thermo-Kool, and Zero Zone;
- *Material suppliers:* Carpenter Company (Carpenter);
- *Trade associations:* AHRI, Center for the Polyurethanes Industry (CPI);
- *Utility companies:* Pacific Gas & Electric Company (PG&E), Southern California Edison (SCE), Sacramento Municipal Utility District (SMUD), and San Diego Gas and Electric (SDG&E);
- *Advocacy groups:* Appliance Standards Awareness Project (ASAP), Alliance to Save Energy (ASE), American Council for an Energy-Efficient Economy (ACEEE), Natural Resources Defense Council (NRDC), Northeast Energy Efficiency Partnerships (NEEP), and Northwest Energy Efficiency Alliance (NEEA);
- *Other parties:* Oak Ridge National Laboratory (ORNL), and the Small Business Administration (SBA).

A. Overall Approach: Component-Based Testing

In the framework document, DOE contemplated developing a single test for an entire walk-in cooler or freezer. *See http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/wicf_framework_doc.pdf.* However, feedback from interested parties indicated that a single test procedure for the entire WICF would not be practical because many walk-ins are assembled on site with components from different manufacturers, which would make on-site testing infeasible. DOE then proposed in the January 2010 NOPR and September 2010 SNOPR to develop separate tests for the envelope and refrigeration system of a walk-in, which in aggregate would represent the performance of the entire walk-in (75 FR 186, 191 (Jan. 4, 2010) and 75 FR 55068, 55070 (Sept. 9, 2010)). DOE proposed to have one metric for the refrigeration system, which would be an efficiency metric, and one metric for the envelope, which would be an energy use metric. The envelope metric would account for electrical use of envelope components, as well as any energy used by the refrigeration system to reject the heat contributed by conduction, infiltration, and other heat sources. In this way, DOE intended to capture the energy impact of components, such as panels, that do not themselves consume electricity.

DOE received comments on the September 2010 SNOPR from interested parties stating that the walk-in cooler and walk-in freezer main components could be further broken down into their own constituent components: panels and doors of envelopes and unit coolers and condensing units of refrigeration systems. Commenters explained that all of these components could be produced by separate manufacturers and then assembled into a complete walk-in. Because of this situation, it would be difficult to determine who should test the walk-in envelope, the refrigeration system, or both. It would also be difficult to determine who would be best positioned to ensure the walk-in cooler or freezer complied with an energy conservation standard. DOE acknowledges these and similar concerns from the stakeholders.

Based on the information provided by commenters and DOE's own research, DOE has determined that a component-based approach would address the unique challenges posed in regulating the energy efficiency performance of walk-in envelopes. As noted above, these challenges include the fact that walk-in units are frequently assembled using components made by multiple manufacturers, and walk-in installers may not be equipped to test all the components that comprise a walk-in. These factors indicate that a component-based approach would not only help ensure compliance with whatever energy conservation standards that DOE sets, but also reduce the overall testing burden on the manufacturers, including small businesses who are involved in producing walk-in units, either in full or in part.

Moreover, DOE notes that the adoption of such an approach is consistent with the component-based approach that Congress took when it enacted EISA 2007. Thus, DOE is adopting a component-level approach for this rule and discusses the specific component metrics in greater detail in section III.A.1.

1. Test Metrics

As stated previously, DOE initially proposed separate test procedures for envelopes and refrigeration systems of walk-ins along with different test metrics for each. The metric for the refrigeration system would be an efficiency metric, and the metric for the envelope would be an energy use metric that would account for the electrical use of envelope components and the energy used by the refrigeration system to reject the heat contributed by conduction, infiltration, and other heat sources. To account for different sizes of envelopes, DOE further proposed that the result of the envelope test procedure should be a normalized energy use metric—the total energy use divided by the external surface area of the envelope (energy use per square foot).

Several interested parties disagreed with the proposed metrics. NEEA stated that regulating walk-in coolers and walk-in freezers on the basis of annual energy use would not accurately estimate actual energy use, and therefore such estimates would be misleading for almost all installed systems. NEEA suggested using an overall U-value for the entire envelope and a spreadsheet that calculates the overall U-factor of a walk-in by weighted area. (NEEA, No. 0061.1 at

p. 1 and 9; NEEA, No. 0061.2 at p. 1) (In this and subsequent citations, the document number refers to the number of the comment in the Docket for the DOE rulemaking on test procedures for walk-in coolers and freezers, Docket No. EERE–2008–BT–TP–0014; and the page references refer to the place in the document where the statement preceding appears.) NRDC also disagreed with the annual energy use metric because of the number of assumptions that would be required and the potential to confuse customers. (NRDC, No. 0064.1 at p. 7) NRDC further stated that normalizing energy use to the surface area would be unusual and may not be useful. (NRDC, No. 0064.1 at p. 2) NEEA suggested that the envelope metric should be a U-factor (which is a characterization of the heat loss performance). (NEEA, No. 0061.1 at p. 7) A comment submitted jointly by SCE, SDG&E, PG&E, and SMUD, hereafter referred to as the Joint Utilities, suggested an area-based conductance metric for the envelope that would consider both opaque and transparent surfaces. (The Joint Utilities, No. 0059.1 at p. 2) NRDC also suggested a metric for refrigeration systems that would encompass the total equivalent warming impact and measure the heat loads from refrigeration systems impacting a building's heating, ventilation, and air conditioning (HVAC) system. (NRDC, No. 0064.1 at p. 8) A comment submitted jointly by ACEEE, ASAP, ASE, NRDC, NEEP, and NEEA on the September 2010 SNOPR (hereafter referred to as The Joint SNOPR comment) stated that the energy conservation standard for envelopes should be the overall heat gain (U-overall) with separate standards for walk-in coolers and walk-in freezers. (Joint SNOPR Comment, No. 0074.1 at p. 2)

While other interested parties suggested specific metrics for walk-in components, manufacturers also offered suggestions for overall walk-in metrics. Craig Industries recommended combining the envelope and refrigeration calculations to calculate the overall efficiency of the complete walk-in system and labeling each walk-in with that efficiency metric. (Craig, No. 0068.1 at p. 6) Zero Zone stated that the test procedure should include performance testing to verify adequate temperatures inside the walk-in. (Zero Zone, No. 0077.1 at p. 1)

In view of the component-level approach being adopted today, DOE is not establishing an overall energy use metric for the envelope in this test procedure. Instead, DOE is establishing separate metrics for the individual components of the walk-in: the wall and ceiling panels (hereafter referred to as non-floor panels); floor panels; the display and non-display doors; and the refrigeration system. Regarding Zero Zone's suggestion that the procedure verify that adequate internal temperatures are used in evaluating a walk-in unit's efficiency, DOE does not believe that such a requirement is necessary in light of the component-based approach being adopted today.

The panel metric determined by the test procedure accounts for the conductance and is in terms of U-factor (that is, the thermal transmittance) measured in Btu/h-ft^2-°F, as NEEA, the Joint SNOPR Comment, and the Joint Utilities recommended. The metric for display and non-display doors accounts for the thermal transmittance through the door and the electricity use of any electrical components associated with the door, and is in terms of energy use, measured in kWh/day. DOE believes that requiring separate metrics for specific individual walk-in components does not constitute a substantive change from what was proposed in the September 2010 SNOPR because this Final Rule only requires tests that were proposed for components in the September 2010 SNOPR. Also, the September 2010 SNOPR and this final rule contain similar calculation methodologies.

2. Responsibility for Testing and Compliance

DOE proposed to adopt separate tests for the envelope and refrigeration system of a walk-in and require the manufacturers of each to test and certify the part they manufacture. 75 FR 186, 191 (Jan. 4, 2010) and 75 FR 55068, 55070 (Sept. 9, 2010). In response to this proposed approach, DOE received multiple comments regarding who should assume testing, certification, and compliance responsibilities. The Joint SNOPR Comment recommended that DOE focus on factory-produced products (*i.e.* kits) instead of walk-ins that are assembled on-site from components from different manufacturers. (Joint SNOPR Comment, No. 0074.1 at p. 1) The Joint SNOPR Comment further suggested that panel, refrigeration system, and door manufacturers each be responsible for compliance and certification responsibilities for their own products. (Joint SNOPR Comment, No. 0074.1 at pp. 2–3) Thermo-Kool agreed with this approach and submitted a copy of a regulatory framework proposed by NEEA, in which envelope, door, and refrigeration manufacturers would be responsible for testing and complying with the standards for the components they manufacture. (Thermo-Kool, No. 0072.1 at p. 1)

DOE received several other comments which it summarized in the certification, compliance, and enforcement (CCE) final rule, published on March 7, 2011. 76 FR 12422, 12444. In brief, some of those comments agreed with the approach suggested by the Joint SNOPR Comment and Thermo-Kool that individual component manufacturers should test, certify, and ensure compliance of their respective components. Other commenters recommended that the manufacturer, the assembler, or the system designer of the overall walk-in should be responsible for the compliance of the walk-in with the standards. 76 FR 12442–12446.

In the CCE final rule, DOE addressed these comments by defining the manufacturer of a walk-in at 10 CFR 431.302. 76 FR 12504.

The definition extends the compliance responsibility to both the component manufacturer and the assembler. In the CCE final rule, DOE clarified that component manufacturers would be the entity responsible for certifying compliance of the components they manufacture for walk-in applications and ensuring compliance with the applicable Federal standards of those components. Assemblers of the complete walk-in system are required to use only components that are certified to meet the applicable Federal standards. DOE also adopted a flexible enforcement framework in which it will determine who is responsible for noncompliance on a case-by-case basis. 76 FR 12444.

DOE notes that the provisions and clarifications in the CCE final rule were made in the context of component manufacturers certifying their components to the existing standards in EPCA, which prescribe requirements on a component-level basis. DOE has decided to continue this approach in developing test procedures and performance-based standards for walk-in coolers and freezers. DOE believes that, within the very limited context of walk in equipment, EPCA created a means for DOE to set performance-based standards for certain walk-in component manufacturers. In particular, because Congress set requirements for specific components used in walk-in applications, it provided DOE with the implicit authority to set performance-based standards at the component level for these specific components. This unique ability stems from the manner in which Congress set standards for walk-in equipment by prescribing, among

other things, specific performance-based requirements for wall, ceiling, door, and floor insulation panels used in walk-ins. *See* 42 U.S.C. 6313(f).

Because interested parties, including entities who produce these components and are subject to today's requirements, have indicated to DOE that the energy efficiency performance of WICF components would be most readily and easily tested and certified by component manufacturers, DOE intends to take this approach for WICF test procedures and performance standards. DOE acknowledges the numerous difficulties that commenters have noted with alternative proposed approaches. By requiring individual component manufacturers to certify that their components satisfy specified performance-based standards, DOE can ease the overall burden on walk-in manufacturers relative to the alternatives that were under consideration as part of the January 2010 NOPR and September 2010 SNOPR. Therefore, in this test procedure, DOE is establishing tests for the components of a walk-in (*i.e.* panels, doors, and refrigeration systems) and anticipates that component manufacturers will test their equipment using the applicable procedure and, in the future, will certify that they comply with the appropriate standard. DOE emphasizes that until performance standards are established, manufacturers are not required to use this test procedure to certify equipment to DOE (although they must use this test procedure in making representations as to the performance of their components). However, because the prescriptive standards established by the 2007 amendments to EPCA are already in effect, manufacturers must demonstrate compliance with them using the method specified in the CCE final rule. 76 FR 12422.

3. Basic Model

DOE proposed a definition of basic model for both envelopes and refrigeration systems. 75 FR 186, 188–189 (Jan. 4, 2010) and 75 FR 55068, 55071–55073 (Sept. 9, 2010). DOE received comments from interested parties on the definition and summarized them in the CCE final rule. 76 FR 12422. Consistent with its component-level approach to certification, discussed in section III.A.2, and taking the comments from interested parties into consideration, DOE decided to define a basic model for each of the key components of a walk-in, rather than defining a basic model for the entire walk-in. DOE emphasized that although the term "basic model" is defined on the component level, it is still implemented in the same manner as it is in the rest of DOE's appliance standards program; that is, a basic model consists of equipment that is essentially the same with respect to energy consumption, efficiency, or other measure of performance. 76 FR 12444–12446.

DOE provided, in relevant part, the definition of basic model in the CCE final rule at 76 FR 12504 (providing definition of "basic model" for walk-ins) (to be codified at 10 CFR 431.302).

DOE believes applying the basic model concept at the component level will reduce the testing burden on manufacturers while ensuring that their products meet any applicable standard, because it removes the difficulty of testing and/or certifying different sized walk-ins that would have different energy consumption levels. 76 FR 12445. The CCE final rule provides that manufacturers may elect to group individual models into basic models at their discretion to the extent the models have essentially identical characteristics that affect energy efficiency or energy consumption. Manufacturers may also rate models conservatively—i.e. the tested performance of the model(s) must be at least as good as the certified rating—after applying the appropriate sampling plan. 76 FR 12429. The basic model concept is applied slightly differently to panels, doors, and refrigeration systems because of their different characteristics. These differences are explained below.

a. Basic Model of Panels

Panels are construction components that are not doors and that are used to construct the envelope of the walk-in. These components comprise the elements separating the interior refrigerated environment of the walk-in from the exterior environment. In this test procedure, panels are classified as either floor panels, non-floor panels, or display panels. A display panel is a panel that is entirely or partially comprised of glass, a transparent material, or both and is used for display purposes. Floor and non-floor panels are mostly comprised of insulating material and are not primarily used for display purposes. For all types of panels, the energy efficiency metric is the U-factor, which is a measure of conductive, convective, and radiative heat transfer and which takes into account composite panel characteristics, which may include the insulation type, structural members, any type of transparent material (*e.g.* glass), and panel thickness. See section III.B.2 for details on how the U-factor is determined. DOE considers a panel basic model to include panels which do not have any differing features or characteristics that affect the U-factor. 76 FR 12504.

DOE notes that manufacturers who make customized panels may experience a higher certification burden than manufacturers of standardized panels. For example, under today's procedure, a panel's U-factor is a surface area-independent metric, which implies that variation in panel width and height alone would not be expected to affect the U-factor rating if all other characteristics were equal. In those instances where no changes in energy efficiency would occur, these panels could be grouped as a basic model. In contrast, smaller floor and non-floor panels may have a higher proportion of framing material to non-framing material, or other structural members, which could affect the overall panel U-factor rating if the framing material or framing geometry has different thermal conductivity performance than the neighboring insulation. Therefore, for two or more floor or non-floor panels that are equivalent in materials and other characteristics but differ in their frame to insulation proportions such that they have different U-factor ratings, the panels would be considered different basic models and would need to be certified independently to DOE, if the manufacturer chooses to claim different U-factor ratings. However, DOE emphasizes that as explained in section III.3, manufacturers may group models into basic models at their discretion as long as the tested performance of the models is at least as good as the certified rating.

DOE has also introduced additional provisions to reduce the testing and certification burden on floor and non-floor panel manufacturers. See section III.B.2.a for details.

As explained above, the energy efficiency metric for display panels is the U-factor, as for floor and non-floor panels. However, unlike a floor, ceiling, or wall panel, a display panel is essentially a window. Therefore, in this test procedure, DOE is requiring the U-factor of display panels to be tested using NFRC 100–2010[E0A1], "Procedure for Determining Fenestration Product U-factors," which DOE proposed in the SNOPR for measuring the U-factor of doors and windows, including their framing materials. 75 FR 55083. (Sept. 9, 2010) As with floor and non-floor panels, the basic model concept allows manufacturers to group display panels that are essentially identical in U-factor into one basic model, which DOE anticipates will reduce the testing burden on display

panel manufacturers. Also, NFRC 100–2010[E0A1] allows verified computer models to simulate a display panel's energy consumption, another factor that reduces the manufacturer's testing burden.

b. Basic Model of Doors

A door is an assembly installed in an opening on an interior or exterior wall that is used to allow access or close off the opening and that is movable in a sliding, pivoting, hinged, or revolving manner of movement. For walk-in coolers and walk-in freezers, a door includes the door panel, glass, framing materials, door plug, mullion, and any other elements that form the door or part of its connection to the wall. This test procedure defines two types of doors, display and non-display doors. Display doors are doors designed for product movement, display, or both, rather than the passage of persons, and non-display doors are considered to be all other types of doors. For all doors, the energy consumption metric that DOE is adopting in today's rule incorporates the U-factor and any electrical components built into the door. (See section I.A.1.a for details.) Calculating this metric requires the use of NFRC 100–2010[E0A1], "Procedure for Determining Fenestration Product U-factors," which DOE proposed in the SNOPR for measuring the U-factor of doors and windows, including their framing materials. 75 FR 55083. (Sept. 9, 2010) Applying the NFRC test yields an overall U-factor for the tested door. Then, through calculations outlined in Appendix A, the U-factor and the electrical energy consumption are combined to create a rating for the door.

As with panels, doors with essentially identical energy consumption levels may be grouped into a basic model and rated conservatively. 76 FR 12429 and 12504. The basic model concept can be used to reduce the testing and certification burdens by allowing manufacturers to group doors that are essentially identical in energy consumption but cosmetically different. The NFRC procedure also permits either a physical test or a verified computer model to be used when determining the U-factor of the door. The latter of these options would be expected to reduce testing burden because only a series of calculations would need to be run by an NFRC-approved computer modeling program. DOE also notes that the calculations for energy consumption of door components are not based on testing, which reduces the general testing burden for doors. Any results from physical tests, computer simulations, and calculations must be retained as required by the CCE final rule. 76 FR 12494.

c. Basic Model of Refrigeration Systems

The refrigeration system consists primarily of a compressor, condenser, unit cooler, valves, and piping. It is considered a component under the component level approach (*see* section III.A) that DOE is adopting in today's final rule. As with the panels and doors, and consistent with the approach promulgated in the CCE final rule, manufacturers may elect to group individual models into basic models at their discretion to the extent the models have essentially identical electrical, physical, and functional characteristics that affect energy efficiency or energy consumption. Furthermore, manufacturers may rate models conservatively, meaning the tested performance of the model(s) must be at least as good as the certified rating, after applying the appropriate sampling plan. 76 FR 12429. DOE believes these provisions will reduce the burden of testing for refrigeration manufacturers, including those who make customized equipment. DOE may also consider methods which allow manufacturers to use an alternate method of determining the energy use of the refrigeration system in a future rulemaking. This concept is further discussed in section III.C.3.

B. Test Procedures for Envelope Components

The envelope consists of the insulated box in which items are stored and refrigerated. In the NOPR and SNOPR, DOE proposed methods for evaluating the performance characteristics of insulation, testing thermal energy gains related to air infiltration, and determining direct electricity use and heat gain due to internal electrical components. The proposed procedure used these methods to determine the energy use associated with the envelope by calculating the effect of the envelope's characteristics and components on the energy consumption of the walk-in as a whole. Those characteristics and components included the energy consumption of electrical components present in the envelope (such as lights) and variation in the energy consumption of the refrigeration system due to heat loads introduced as a function of envelope performance (such as conduction of heat through the walls of the envelope). The impact on the refrigeration system energy consumption was determined by calculating the energy consumption of a theoretical or "nominal" refrigeration system when paired with the tested envelope. 75 FR 186, 191 (Jan. 4, 2010) and 75 FR 55068, 55074 (Sept. 9, 2010).

As described in section III.A, DOE is no longer requiring manufacturers to determine the energy consumption of the entire envelope in this final rule. Rather, DOE is establishing metrics for the principal components of the envelope (*i.e.* the panels and doors) as described in section III.A.1. In doing so, DOE is requiring manufacturers to use the same physical tests for the components that it proposed in the NOPR and SNOPR, but is introducing revisions to the calculations in Appendix A of the new procedure. These revisions will enable manufacturers to calculate the required component metrics from the results of those tests.

For panels, DOE is adopting separate approaches depending on whether a given panel is a display or non-display panel. Display panels are panels that are primarily made of transparent material and used for display purposes. Display panels are considered equivalent to windows because of their transparent characteristics and associated thermal heat transfer properties, and therefore the U-factor will be measured by NFRC 100–2010[E0A1], "Procedure for Determining Fenestration Product U-factors," which DOE proposed in the SNOPR for measuring the U-factor of doors and windows, including their framing materials. 75 FR 55083. (Sept. 9, 2010) Non-display panels are floor and non-floor panels. Since both floor and non-floor panels are typically made out of a composite of insulation, framing, and facer material, both types of panels will be tested using the same methodology. In today's rule, the physical tests pertaining to the performance of non-display panels are from ASTM C1363–05, "Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus" and, for foams that experience aging, DIN EN 13164:2009–02, "Thermal insulation products for buildings—Factory made products of extruded polystyrene foam (XPS)—Specification" or DIN EN 13165:2009–02, "Thermal insulation products for buildings—Factory made rigid polyurethane foam (PUR) products—Specification," as applicable. These tests were proposed in the SNOPR. 75 FR 55068, 55075–55076 and 55081 (Sept. 9, 2010). In this final rule, panel performance is denoted by its overall U-factor, or thermal transmittance, which is determined by the test procedures and calculation methodologies described in section III.B.2.

DOE is requiring one test for door performance, NFRC 100–2010[E0A1], "Procedure for Determining Fenestration Product U-factors," which was proposed in the SNOPR. 75 FR 55083 (Sept. 9, 2010). This test measures conduction through a door, whether it is a display door or a non-display door. The total energy consumption of a door is calculated as the effect of a door's thermal load on the refrigeration system combined with the door's electrical energy use, as described in section 4.5 and section 4.4 of Appendix A of this final rule. The effect on the refrigeration system is determined by calculating the energy consumption that a theoretical or "nominal" refrigeration system would use to reject the heat that was transmitted through the door. The energy that would be used by the theoretical refrigeration system to reject a given amount of heat is represented by the energy efficiency ratio (EER) of the refrigeration system. The test procedure uses the same nominal refrigeration system EER for all tested doors to enable direct comparisons of the performance of walk-in doors across a range of sizes, product classes, and features. The nominal EER values for cooler and freezer refrigeration (i.e. 12.4 Btu/W-h and 6.3 Btu/W-h for coolers and freezers, respectively) are the same as those proposed in the SNOPR for calculating the energy use of the envelope. See 75 FR 55013 (Sept. 9, 2010).

1. Definition of Envelope

In the January 2010 NOPR, DOE proposed the following definition of "envelope:"

> Envelope means (1) a piece of equipment that is the portion of a walk-in cooler or walk-in freezer that isolates the interior, refrigerated environment from the ambient, external environment; and (2) all energy-consuming components of the walk-in cooler or walk-in freezer that are not part of its refrigeration system.

75 FR 186, 192 (Jan. 4, 2010).

The walk-in envelope was proposed to include, but not be limited to, walls, floors, ceilings, seals, windows, doors, or any combination thereof, composed of single or composite materials. DOE did not propose any changes to this definition in the September 2010 SNOPR.

Master-Bilt, BASF, ThermalRite, ACEEE, and ICS submitted written comments supporting the proposed definition for the walk-in envelope. (Master-Bilt, No. 0027.1 at p. 1; BASF, No. 0021.1 at p. 3; ThermalRite, No. 0049.1 at p. 1; ACEEE, No. 0052.1 at p. 2; ICS, No. 0045.1 at p. 1) However, Nor-Lake asked that the definition of envelope exclude components of the envelope purchased separately by the end user to enable the manufacturer of the envelope to avoid compliance responsibility for the performance of those components. (Nor-Lake, No. 0023.1 at p. 2) ICS requested clarification on the preemption of energy codes by building, electrical, and mechanical codes and stated that the definition must allow for structural and electrical safety code compliance over energy compliance when in conflict. (ICS, No. 0045.1 at p. 1) A representative from Gonzaga Law argued that the definition proposed by the DOE was too inclusive but did not propose an alternative definition. (Gonzaga Law, No. 0018 at p. 1) At the public meeting for the January 2010 NOPR, ICS suggested that DOE's standards and definitions should align with NSF's (formerly known as the National Sanitation Foundation) definition of envelope and requirements. (ICS, Public Meeting Transcript, 0016 at p. 30) (In this and subsequent citations, "Public Meeting Transcript" refers to the transcript of the March 1, 2010, public meeting on the proposed test procedures for walk-in coolers and freezers. "No. 0016" refers to the document number of the transcript in the Docket for the DOE rulemaking on test procedures for walk-in coolers and freezers, Docket No. EERE–2008–BT–TP–0014; and the page number refers to the place in the transcript where the statement preceding appears.)

DOE notes the comments and suggestions from Master-Bilt, BASF, ThermalRite, ACEEE, ICS, and Gonzaga Law. However, because DOE is taking a component-based approach, the proposed envelope definition is no longer applicable for the purpose of this test procedure. As suggested by ICS, when evaluating potential standards applicable to walk-ins, DOE will also consider their related requirements that manufacturers need to satisfy. In response to Nor-Lake's comment regarding components not supplied by the envelope manufacturer, DOE clarifies that each component manufacturer is responsible for testing its component with the appropriate test procedure as discussed in section III.A.2. The envelope component manufacturer is not responsible for the end user's implementation of the component; rather, the manufacturer would be responsible only for the component's compliance as designed. Also, the envelope assembler is responsible for using WICF-compliant components to assemble the total envelope.

2. Heat Transfer through Panels

a. U-Factor of Composite Panels Including Structural Members of Panels

EPCA specifies that ASTM C518–04, "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus," must be used to determine the K-factor of walk-in insulation. The statute defines the R-value as equal to the value of 1/K-factor multiplied by the thickness of the panel. (42 U.S.C. 6314 (a)(9)(A)(i) – (ii)) In response to the January 2010 NOPR, interested parties commented that the heat conduction through structural members must be considered because this factor could affect the conductance through the composite walk-in insulation panel. Accordingly, DOE proposed in the September 2010 SNOPR to use ASTM C1363–05, "Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus," to measure the overall U-factor of fully assembled panels to help account for the impact that structural members have on the overall U-factor. 75 FR 55074.

Several interested parties—NEEA, AHRI, Master-Bilt, Thermo-Kool, Carpenter, and Bally—supported the use of ASTM C1363–05 to measure the overall panel U-factor. (NEEA, No. 0061.1 at p. 2; AHRI, No. 0070.1 at p. 2; Master-Bilt, No. 0069.1 at p. 1; Thermo-Kool, No. 0072.1 at p. 1; Carpenter, No. 0070.1 at p.2; Bally, No. 0078.1 at p. 2))

Other interested parties, however, disagreed with DOE's proposal to use ASTM C1363–05 to measure panel performance. At least some of these concerns were premised on a mistaken belief that DOE's proposal would result in the elimination of structural members embedded into panels. For example, a comment submitted jointly by the manufacturers CrownTonka, ThermalRite, and ICS (collectively referred to as the Joint Manufacturers) recommended that structural members be excluded from the stated R-value requirements for overall envelope thermal resistance. The Joint Manufacturers explained that many walk-ins require the use of structural members to comply with building codes and to help support loads placed on the building from factors such as snow and wind. The Joint Manufacturers stated that ASTM C518–04 should be used to measure the K-factor of foam, as specified in EPCA. (42 U.S.C. 6314 (a)(9)(A)(i)–(ii)) (Joint Manufacturers, No. 0062.1 at p. 1)

While American Panel agreed with DOE's general approach that the R-value

of structural members should be considered in determining the overall U-factor and submit data to demonstrate the impact of structural members on the overall U-factor, it stated that the composite panel must meet the minimum R-value requirement. American Panel continued to state that the R-value should be calculated by using a weighted percentage of foam R-value and structural R-value based on the percentage each material represents in the panel. (American Panel, No. 0057.1 at p. 1; American Panel, No. 0057.1 at p. 2; American Panel, No. 0057.3 at p. 1) It asserted that ASTM C1363–05 is not the appropriate test method for measuring the insulating values of foam, and added, along with Craig Industries and Carpenter, that ASTM C518–04 should be used to measure heat conduction through panels. (American Panel, No. 0057.1 at p. 2; Craig, No. 0068.1 at p. 2; Carpenter, No. 0067.1 at p. 2) Craig Industries was concerned that using ASTM C1363–05 to calculate the heat conduction through structural members may not take the reduction of joints (that is, panel to panel interfacing members) into consideration. Craig Industries recommended that the structural members should be tested with a procedure to represent the real R-value, which would replace the R-value of the insulation where it is replaced with structural members. (Craig, No. 0057.13 at p. 2) Carpenter further asserted that ASTM C518–04 is simpler and less costly to perform than C1363–05. (Carpenter, No. 0067.1 at p. 2) Thermo-Kool, on the other hand, disagreed with the approach of using R-value testing of different components of the composite panel to determine heat loss. (Thermo-Kool, No. 0072.1 at p. 1) Bally, who agreed with DOE's proposed approach, requested clarification specifically regarding how the two tested areas would be used to represent the performance of a panel. (Bally, No. 0078.1 at p. 2)

None of the interested parties offered any further explanation for their views other than those already described.

In this final rule, the terms "foam" and "insulation" are used synonymously, but a panel is the fully manufactured product that contains, but is not limited to, the insulating material, metal skin, framing material, other structural members, or any combination thereof. To address the Joint Manufacturers' concerns about the potential elimination of structural members, DOE emphasizes that the overall U-factor testing required by today's final rule will not prevent manufacturers from including structural members in panels because the existing standards in EPCA only regulate the R-value of the foam and do not restrict the overall panel U-factor or the R-value of the structural components. The R-value of insulation, which is 1/K-factor as determined by ASTM C518–04, will still have to comply with the existing EPCA requirements for insulation. (42 U.S.C. 6314 (a)(9)(A)(i)–(ii)) However, the overall U-factor of the fully assembled panel, including structural members, may be used to meet an energy conservation standard for panels, which will be determined in a parallel rulemaking. Including ASTM C1363–05 will provide a more accurate means to represent the overall heat transfer performance of panels. DOE believes this procedure will be beneficial because it will capture the effects of structural members that incorporate insulation or otherwise contribute to the efficiency of the walk-in.

Additionally, while DOE acknowledges the concerns raised by American Panel, the Joint Manufacturers, Craig Industries, and Carpenter, the final rule includes ASTM C1363–05 as part of the test procedure in order to determine the overall U-factor of the panel. DOE is including this protocol as part of the test procedure because heat conduction through structural members is a significant panel characteristic that is not addressed under the statutorily-prescribed testing requirements (i.e. ASTM C518–04). While ASTM C518–04 could be used to individually measure the R-value of structural members, or any other material, as Craig Industries suggested, DOE believes that this approach would be more costly because of the many materials that could comprise a panel and the need to test each material separately under that approach. Furthermore, DOE believes that panel geometry could make calculations to combine the R-value of each material into an overall panel R-value complicated and burdensome.

DOE also acknowledges Craig Industries' concern that ASTM C1363–05 does not account for the reduction of joints (that is, panel to panel interfacing members). Since DOE is adopting an approach to ensure the energy efficiency performance of particular components, an approach suggested by numerous commenters, and is no longer considering the effects of infiltration, panel joint issues are outside of this approach.

DOE notes that American Panel supported the inclusion of structural members in calculating the overall U-factor. Furthermore, DOE would like to clarify the calculation methodology to address the comment from Bally. Today's final rule adopts a weighted percentage of the panel edge (which may contain structural members) and panel core region (which may also include structural members) in order to calculate the panel's total U-factor. DOE believes that using the weighted percentage of edge U-factor and core U-factor to calculate the total U-factor will help reduce the manufacturer's testing burden.

In applying this weighted percentage approach, today's final rule provides that for floor or non-floor panels of the same thickness, construction methods, and materials, manufacturers must test a pair of 4 ft. by 8 ft. "test panels" to obtain a core U-factor and an edge U-factor. The manufacturer must then calculate the overall U-factor of other floor or non-floor panels with the same panel thickness, construction methods, and materials using the U-factor results for the core and edge region "test panels." For example, a manufacturer tests a 4 ft. by 8 ft. test panel and finds the edge region and core region U-factors. The same manufacturer also produces 6 ft. by 8 ft. panels that have identical core and edge region thickness, construction methods and materials. Therefore, the manufacturer may apply the core and edge region factors to the 6 ft. by 8 ft. panel to calculate the overall U-factor of the 6 ft. by 8 ft. panel instead of performing an additional test. DOE notes that any calculations that support the certified ratings must be retained along with the test data for the "test panels" for all basic models pursuant to the requirements for the maintenance of records promulgated in the CCE final rule. 76 FR 12494. DOE expects that, based on the information it has collected, including information made available by manufacturers on their Web sites and submitted comments, most manufacturers use the same panel thickness, materials, and construction methods for many of their panels, which results in a minimal testing burden.

In regard to American Panel's comment that the composite panel must meet the minimum R-value requirement, DOE clarifies that EPCA states that only the insulation material (that is, the foam) must meet the prescribed R-value. (42 U.S.C. 6313(f)(1)(C)) The test procedure is prescribing ASTM C1363–05 as a method of measuring the overall U-factor of the entire panel. For EPCA compliance, the R-value of the insulation must be separately determined in accordance with ASTM C518–04 as specified in EPCA. (42 U.S.C. 6313(f)(1)(C))

Finally, interested parties suggested changes to the test methodology DOE proposed. NRDC stated that irregular or non-homogeneous foam products should be tested for actual R-value where there is no quality control to maintain the orientation of the foam in the finished product. To clarify, DOE believes that when NRDC noted the concern about the orientation of the foam, they were referring to bun-stock foam products. Bun-stock products are manufactured in "buns" that may have foam cell structure similar to the grains in wood. Like wood, depending on how the buns are cut into boards, the orientation of the cell "grains" may vary by finished board. NRDC continued to suggest that if a foam product cannot be tested, then the stated R-value should be a conservative number representing the lowest R-value for a tested material. (NRDC, No. 0064.1 at p. 4) NRDC also suggested that DOE review the impact of testing the final fabricated panel rather than requiring manufacturers to specially construct units for testing, because specially constructed units may not represent the typical product. (NRDC, No. 0064.1 at p. 4) Master-Bilt suggested changing the width and length of the panel to 8 x 4 ft. +/- 1 ft. to have more tolerance and allow for the testing of standard width panels. (Master-Bilt, No. 0069.1 at p. 2)

In response to NRDC's comment about irregular or non-homogeneous foam products, DOE anticipates that the prescribed sampling procedures for certification will accurately capture the foam's R-value. A sampling plan is intended to ensure accurate and statistically repeatable results are achieved when using the test procedure. DOE notes NRDC's concern that specifically constructed units may not represent an actual product. However, in order to reduce the testing burden presented by ASTM C1365–05, DOE is maintaining the approach of specifying two test regions of a pair of representative panels. At one test region, the tester measures the U-factor of the perimeter that may contain structural members and panel-to-panel interface area (the "Panel Edge"), while at the other region the tester measures the U-factor of the core area of the panel (the "Panel Core") which may also contain structural members. The U-factor for each region is then applied to panels of the same type (that is, same foam type, framing material, and panel thickness) to obtain an overall U-factor that is representative of actual products sold by the panel manufacturer. DOE applies a calculation methodology to extrapolate the core and edge U-factor to determine the U-factor of any panel produced by a manufacturer.

In response to Master-Bilt's comment, DOE agrees that increasing the tolerance of the 8 ft x 4 ft test panel to +/− 1 ft will provide manufacturers with a greater range of standard sized panels. DOE conducted a mathematical analysis to determine how changing the tolerance would affect the U-factor as determined by ASTM C1363–05. DOE found that increasing the size tolerance of the test panel results in less than a 0.5 percent change to the U-factor as determined by ASTM C1363–05. Therefore, DOE has amended the standard size of a test panel for ASTM C1363–05 to be 8 ft x 4 ft +/− 1 ft.

b. Long-Term Thermal Resistance

In the January 2010 NOPR and September 2010 SNOPR, DOE cited several studies that conclude that lateral gas diffusion, which causes a reduction in R-value, occurs in impermeably faced foams. See 75 FR 192–194 and 75 FR 55075–55079. These types of foams are common to walk-ins. The lateral gas diffusion occurs over time and affects the energy efficiency performance of the foam as diffusion continues. To account for this aging effect on a foam's insulation performance—and, by extension, the energy consumption of a walk-in due to thermal losses attributable to this reduced performance—DOE, consistent with its proposed approach, is adopting a method to account for this phenomenon in walk-in applications. Hill Phoenix added that different methods of manufacturing panels should be taken into account when determining the test procedure. (Hill Phoenix, No. 0063.1 at p. 2)

The most significant factor affecting the efficiency of a walk-in panel is the insulating foam in a panel, and accurately capturing the foam's R-value is critical to measuring the overall performance of the panel. Panels can be in use for 10 to 20 or more years before they are replaced. Performance metrics for a panel based on initial foam R-value will tend to overestimate the amount of energy saved over this equipment's lifetime. Research on panel aging has shown that a 5-year aged R-value found by LTTR testing is representative of the panel's insulation performance over its lifetime, and there are industry tests for walk-in foam that estimate the aged R-value over time. Using these industry-developed protocols will enable manufacturers to more accurately capture the lifetime performance of a walk-in panel.

Incorporating a long term thermal resistance degradation factor improves the reliability of test results for walk-in panels. While EPCA contains standards for the R-value or insulating performance of the foam, these standards do not specify when the insulating foam must be tested. (42 U.S.C. 6313(f)(1)(C)) Variables that impact the time at which panels are tested include shipping time, production time, shipment of completed panels to test lab, and test facility availability. Changing any one of these variables could result in significantly different test results and measured R-values. This is in contrast to most other types of equipment within the appliance standards program, which would not exhibit significant differences in performance based on the length of time between manufacture and testing. Because of the unique aging profile of certain foam types, the timing of a walk-in panel test would affect both manufacturers' certification of the panel U-factors and any enforcement testing undertaken by DOE. Therefore, using LTTR values to measure foam performance eliminates the "time" variable that could affect whether a panel is shown to comply with an overall performance standard that DOE may set. The purpose of the LTTR testing is to accelerate foam aging to the point where the R-value changes relatively slowly over time and to then measure its performance, thus improving the repeatability of the test because the timing of the test is no longer critical.

In the January 2010 NOPR, DOE proposed to use ASTM C1303–08, "Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation," to calculate the long-term thermal resistance (LTTR) of walk-in foam insulation. 75 FR 186, 193–94 (Jan. 4, 2010). In the September 2010 SNOPR, DOE proposed to use the updated version of ASTM C1303–08, which was ASTM C1303–10. 75 FR 55068, 55075 (Sept. 9, 2010). In that notice, DOE also offered an alternative method, Annex C of either DIN EN 13164:2009–02, "Thermal insulation products for buildings— Factory made products of extruded polystyrene foam (XPS)—Specification" or DIN EN 13165:2009–02, "Thermal insulation products for buildings—Factory made rigid polyurethane foam (PUR) products—Specification," as applicable, to test for the LTTR. This alternative was offered in response to concerns raised in response to the NOPR. The SNOPR requested comments on both of these alternative methods. 75 FR 55079 (Sept. 9, 2010).

In light of the comments that DOE received on all of these various testing methods, which are addressed below, DOE has decided to adopt DIN EN 13165:2009–02 or DIN EN 13164:2009–02, as applicable, as the test procedure for determining LTTR. The LTTR value determined by DIN EN 13165:2009–02 or DIN EN 13164:2009–02 will be used to determine a degradation factor, which will be the LTTR R-value divided by the initial R-value of the foam. The initial R-value will be determined in accordance with ASTM C518–04 as specified in the EISA 2007 amendments to EPCA and used to establish compliance with those statutorily-prescribed requirements. (42 U.S.C. 6313(f)(1)(C)) The degradation factor is applied to the U-factor of the panel found by ASTM C1365–05; see section 4.2 and 4.3 in Appendix A.These protocols are preferable to ASTM C1303–10 because they account for the effect of impermeable facers, which ASTM C1303–10 does not.

In response to this approach, DOE received a number of comments. Thermo-Kool noted the general need to consider LTTR. It also suggested that the potential for thermal degradation is more likely to occur at the panel joints than from actual polyurethane (*i.e.* foam) issues. (Thermo-Kool, 0072.1 at p. 1) The Joint Manufacturers recommended that structural members be considered in the long-term thermal resistance performance of any panels with structural edges because they may lessen or slow off-gassing over time. (The Joint Manufacturers, No. 0062.1 at p. 1).

American Panel and Bally opposed DOE's inclusion of a test procedure that measured LTTR. (American Panel, No. 0057.2 at p. 1; Bally, No. 0078.1 at p. 2) American Panel explained that impermeable or metal skins protect the polyurethane foam from aging and that little change will occur in the long term R-value. In support of its claim that impermeably faced metal skins protect foam from aging, American Panel submitted the results of a study conducted by Carpenter. That study found a 3.6 percent loss in insulating value of a panel after 9 years in a walk-in application. (American Panel, No. 0057.2 at p. 1) American Panel also asserted that none of its customers complained about R-value loss in the panels that American Panel sold to them. (American Panel, No. 0057.1 at p. 2)

One interested party recommended that DOE collect test data before prescribing a particular test method. Bally stated that more data from actual walk-in panels with intact metal skins and sealed edges should be collected before DOE includes a test procedure for long-term thermal resistance. (Bally, No. 0078.1 at p. 2)

DOE acknowledges Thermo-Kool's assertion that most aging occurs at the panel joints and Bally's suggestion that DOE collect more data to support long term thermal aging. DOE notes, however, that polyurethane itself has the potential to age significantly. DOE cited multiple studies, in both the January 2010 NOPR and September 2010 SNOPR, that conclude that aging occurs in most types of foams commonly used in walk-in applications, including polyurethane. 75 FR 192–194 (Jan. 4, 2010) and 75 FR 55075–55079 (Sept. 9, 2010). In response to the Joint Manufacturers' comment about accounting for the effect structural members have on LTTR, DOE also notes that no known test procedures are available that address edge sealing at this time but that this factor could be considered in a future rulemaking.

DOE also considered the merits of the submissions in support of American Panel's contention that impermeably faced foams do not undergo significant aging. After evaluating this information, however, DOE continues to believe that the inclusion of LTTR testing in the test procedure is necessary to accurately measure the R-value of foam. DOE notes that the samples in the Carpenter study cited by American Panel were taken from the center of the panel. As DOE noted in the SNOPR, another study (the Ottens study, "Industrial Experiences with CO_2 Blown Polyurethane Foams in the Manufacture of Metal Faced Sandwich Panels") found that core samples do not represent the overall aging of foam in panels because most aging occurs at the panel's perimeter. 75 FR 55068, 55077 (Sept. 9, 2010) (citing Ottens *et al.,* "Industrial Experiences with CO_2 Blown Polyurethane Foams in the Manufacture of Metal Faced Sandwich Panels," Polyurethane World, 1997.) As a result, the data from this study indicate that the Carpenter study's results do not necessarily provide an accurate portrayal of the likely effects of panel aging.

Additionally, while American Panel asserted that the lack of customer complaints about R-value loss in panels indicates that the deterioration of LTTR values is insignificant, the lack of customer complaints may be influenced by a variety of factors. For example, a panel is normally only replaced when visibly damaged. However, a panel may have reduced thermal performance without any accompanying visual cues suggesting problems with the panel. Accordingly, DOE does not believe that the statements and materials cited by American Panel support the premise that LTTR of foam is negligible for walk-in panels.

Interested parties also made comments on the specific test methods that DOE proposed. DOE received some comments from interested parties in favor of using ASTM C1303–10 to determine the LTTR of foam insulation. Owens Corning agreed that DOE should use the most current version of whichever ASTM standards it planned to use. (Owens Corning, No. 0058.1 at p. 1) Craig Industries agreed with the use of ATSM C1303–10, but stated that DOE should evaluate if ASTM C1303–10 is appropriate for all present and future foam insulation products. (Craig, No. 0068.1 at p. 4) NRDC supported testing insulated products to determine whether the R-value degraded over time, and stated that the proposed ASTM standard is acceptable and known in the industry. (NRDC, No. 0064.1 at p. 4) NEEA stated that although some interested parties have concerns about LTTR values derived from ASTM C1303–10, NEEA believed that carefully specifying the physical characteristics of the tested panel samples will address their concerns. (NEEA, No. 0061.1 at p. 2)

Some interested parties disapproved of ASTM C1303–10. American Panel, Hill Phoenix, Thermo-Kool, and the Joint Manufacturers opposed using ASTM C1303–10 as the test procedure to measure LTTR. (American Panel, No. 0057.1 at p. 2; Hill Phoenix, No. 0063.1 at p. 2; Thermo-Kool, 0072.1 at p. 1; the Joint Manufacturers, No. 0062.1 at p. 1) American Panel asserted that any testing to determine R-value must allow the foamed-in-place polyurethane to remain encapsulated by the metal facers to resemble the real-world application. (American Panel, No. 0057.1 at p. 2) Hill Phoenix and Thermo-Kool did not recommend the use of ASTM C1303–10 because, as noted in section 1.3 of ASTM C1303–10, the standard does not apply to impermeably faced foams; therefore, applying the results from ASTM C1303–10 to impermeably faced foams would be misleading. Hill Phoenix also suggested that ASTM C1303–10 would significantly overestimate foam aging of foamed-in-place polyurethane panels. (Hill Phoenix, No. 0063.1 at p. 2) The Joint Manufacturers opposed the use of ASTM C1303–10 for measuring long-term R-value decline because it is not intended for use with faced panels and unfairly penalizes foamed-in-place polyurethane that has minimal or zero exposure of permeable surfaces (the Joint Manufacturers, No. 0062.1 at p. 1)

Owens Corning stated that the prescriptive and research methods of ASTM C1303–10 are not comparable and will not generate comparable results. It added that the Canadian test procedure CAN/ULC S770, which is based on various versions of ASTM C1303, has a positive bias and may over-predict foam aging, and submitted foam aging data and an article about the CAN/ULC S770 test to support this comment. (Owens Corning, No. 0058.1 at p. 2; Owens Corning, No. 0058.1 at p. 1; Owens Corning, No. 0058.5 at p. 19; Owens Corning, No. 0058.2 at p. 2)

Carpenter and Master-Bilt also opposed the use of ASTM C1303–10 for LTTR testing and suggested possible alternatives. Carpenter suggested testing initial and aged K-factors per ASTM C518 at 20 °F and 55 °F for freezers and coolers, respectively. (Carpenter, No. 0067.1 at p. 3) Carpenter stated that ASTM C1303–10 would underestimate the LTTR of impermeably faced panels and that LTTR tests should be performed on samples with intact facers. (Carpenter, No. 0067.1 at p. 2) Similarly, Master-Bilt explained that panel edges are not 100 percent exposed, but are tight against one another and sealed with caulk and vinyl gaskets. Collectively, the caulk and gaskets significantly reduce gas migration, thus reducing the effects of aging. Therefore, in its view, the testing of skinned panels with exposed edges still considerably overstates the insulation degradation. Master-Bilt suggested that a formula based on test data from actual walk-in panels that have been installed could be used instead of ASTM C1303–10. (Master-Bilt, No. 0068.1 at p. 2)

DOE agrees with the assessment that ASTM C1303–10 is not adequate for testing impermeably faced foams. DOE believes that the concerns about ASTM C1303–10 expressed by American Panel, Hill Phoenix, Thermo-Kool, Master-Bilt, the Joint Manufacturers, Carpenter, and Owens Corning are addressed by DIN EN 13165:2009–02 and DIN EN 13164:2009–02, which account for impermeably faced foams, reduce the testing burden, and are appropriate for different types of foam. DIN EN 13165:2009–02 and DIN EN 13164:2009–02 partially rely on a formula based on test data, as suggested by Master-Bilt. DOE agrees with Owens Corning that the prescriptive and research methods of ASTM C1303–10 are not comparable, and notes that DIN EN 13165:2009–02 and DIN EN 13164:2009–02 do not have this problem.

One interested party expressed concerns about two of the studies DOE referenced in the September 2010 SNOPR. One study was the Ottens study, in which an experiment was completed on polyurethane foamed-in-place panels to assess their long-term insulating behavior. 75 FR 55068, 55077 (Sept. 9, 2010). (Ottens *et al.*, "Industrial Experiences with CO_2 Blown Polyurethane Foams in the Manufacture of Metal Faced Sandwich Panels," Polyurethane World, 1997.) In the SNOPR, DOE estimated that the test was likely representative of panels aged for at least 5 years. 75 FR at 55077 (Sept. 9, 2010). ORNL challenged this estimate and stated that the results from the Ottens study cannot be correlated to a particular aging period. (ORNL, No. 0060.1 at p. 2)

The second study DOE referenced was a round robin test using CAN/ULC–S770–03, a standard with the same test methodology as a previous version of ASTM C1303. DOE referenced the test to address concerns raised by various interested parties that the thin slicing method, CAN/ULC–S770–03. Results from the round-robin study predicted that polyurethane would perform at a lower level than extruded polystyrene or even at a level as low as expanded polystyrene. 75 FR 55079 (Sept. 9, 2010). ORNL stated the testing used in the referenced study relied on the original version of S770, which has been shown to over-predict thermal resistance. ORNL added that the test was performed on foams created with blowing agents that are no longer used, and the results are not representative of current products. (ORNL, 0060.1 at p. 2)

Regarding ORNL's comment about the Ottens study, DOE agrees that the method in the study cannot be accurately correlated to a particular aging period. However, in DOE's view, the conclusions reached in those studies illustrate that impermeably faced foams are subject to aging. DOE agrees with ORNL's evaluation of the flaws in the round robin test data but notes that the same test was used on each type of foam evaluated, which permits a comparison of the results from each type of tested foam. DOE used the results of the round robin test to demonstrate that there were no performance differences between polyurethane and polystyrene foams—not to predict the level of thermal resistance over time.

Interested parties also commented on the specific testing conditions for ASTM C1303–10. ORNL proposed that, if adopted, ASTM C1303–10 should be modified to allow the user to take multiple 12 inch x 12 inch specimens from the 48 inch x 96 inch panel, at least 12 inches away from the edge of the 48 inch x 96 inch source. (ORNL, No. 0060.1 at p. 2) ORNL suggested specifying the aging conditioning temperatures for foam insulation. ORNL explained that while most insulation foams must follow aging condition requirements, the conditions used to age bun stock foam, which is used in producing foam insulation, may be freely modified. This situation could lead to skewed comparisons between products. (ORNL, No. 0060.1 at p. 2)

Manufacturers also offered views regarding these proposed testing conditions. Craig Industries, Carpenter, and Owens Corning stated that the procedures detailed in ASTM C1303–10 should be conducted at the specified EPCA mean temperatures 55 °F and 20 °F for a cooler and freezer, respectively. (Craig Industries, 0068.1 at p. 4; Carpenter, No. 0067.1 at p. 3; Owens Corning, No. 0058.1 at p. 2) Carpenter also suggested modifying DOE's proposal by adding a provision for molding test panels using unprimed aluminum facers. (Carpenter, No. 0067.1 at p. 3) NRDC asserted that the proposed temperatures for testing insulation needed to be substantiated. (NRDC, 0064.1 at p. 4) Craig Industries asserted that the modifications to ASTM C1303–10 proposed by DOE in the September 2010 SNOPR test were acceptable, but wanted DOE to ensure that the changes would also apply to expanded polystyrene insulation. (Craig Industries, No. 0068.1 at p. 4) Bally suggested that the initial panel size should be changed to 48 inches ± 3 inches and 96 inches ± 2 inches so that a standard panel configuration could be used for the test panel. Bally stated that manufacturers could incur significant costs from manufacturing test panels. (Bally, No. 0078.1 at p. 2)

While DOE appreciates ORNL's and Bally's suggested improvements to ASTM C1303–10, these recommendations are no longer relevant since DOE has decided to adopt DIN EN 13165:2009–02 and DIN EN 13164:2009–02, which collectively address some of the shortcomings of ASTM C1303–10. For example, DIN EN 13165:2009–02 and DIN EN 13164:2009–02 provide for inclusion of metal facers, while ASTM C1303–10 does not. In regard to Bally's concern about the size of the test panel, a test panel is no longer required to be a certain size as long as the panel is large enough for the test sample to be cut from its geometric center, as prescribed in Appendix A. Additionally, given the comments from Craig Industries, Carpenter, Owens Corning, and NRDC about the temperature conditions for testing, DOE has decided to adopt the EPCA mean temperatures of 55 °F and

20 °F for a cooler and freezer, respectively for the DIN EN 13165:2009–09 and DIN EN 13164:2009–02 testing conditions. This means that when a manufacturer tests a panel for LTTR, the manufacturer will determine the initial and aged R-value as specified by DIN EN 13165:2009–09 and DIN EN 13164:2009–02 except the panel will be rated at 55 °F and 20 °F for a cooler and freezer, respectively. By deviating from the temperature condition specified in DIN EN 13165:2009–09 and DIN EN 13164:2009–02, the fixed increment values and safety increment values will be slightly more conservative than the values that would be expected if the LTTR test were performed at the temperature condition specified in DIN EN 13165:2009–09 and DIN EN 13164:2009–02, when applied to freezer panels.

In response to Craig Industries' comment that whatever method is adopted should be applicable to expanded polystyrene foam, DOE notes that the foam aging procedures it proposed are only applicable to foams that rely on low conductivity blowing agents that are intended to stay within the foam for the life of the product. Because it is DOE's understanding that expanded polystyrene foam is not blown with low conductivity blowing agents that are intended to remain in the product for its usable life and does not exhibit long term changes in thermal resistance, these tests would not apply, nor would they be needed to assess the long term thermal resistance of this type of foam.

One commenter did not agree with the proposed use of any of the protocols. Thermo-Kool disagreed with both ASTM C1303–10 and DIN EN 13165:2009–02 and DIN EN 13164:2009–02 because none of these protocols, in its view, is designated for testing composite panels faced with metal skins. (Thermo-Kool, 0072.1 at p. 1) DOE agrees with Thermo-Kool that ASTM C1303–10 was not designed to test panels with metal facers. However, DIN EN 13165:2009–02 and DIN EN 13164:2009–02 were designed to account for metal facers on foam. DIN EN 13165:2009–02 and DIN EN 13164:2009–02 allow all metal skins or facers to remain on the foam during aging and testing. See, e.g., DIN EN 13165:2009–02, Annex C (instructing in relevant part to "select a product sample including any product facing.").

DOE notes that many of the interested parties that opposed using ASTM C1303–10 to measure LTTR supported using DIN EN 13165:2009–02 and DIN EN 13164:2009–02 instead. Carpenter agreed with using DIN EN 13165:2009–02 and DIN EN 13164:2009–02 as an alternative to ASTM C1303–10. (Carpenter, No. 0067.1 at p. 2) Hill Phoenix and AHRI requested more time to review the European test procedure, but Hill Phoenix's initial assessment was that DIN EN 13165:2009–02 was a better option than ASTM C1303–10. (Hill Phoenix, No. 0063.1 at p. 2; AHRI, No. 0070.1 at p. 2) Hill Phoenix added that DOE should adopt test procedures that are appropriate for the insulation materials that could be found in walk-in panels, which DOE interprets to mean that Hill Phoenix is suggesting that DOE adopt both DIN EN 13165:2009–02 and DIN EN 13164:2009–02 if DOE uses these standards instead of ASTM C1303–10. (Hill Phoenix, No. 0063.1 at p. 2) Master-Bilt also stated DIN EN 13165:2009–02 and DIN EN 13164:2009–02 seemed to better account for long-term degradation of foam performance, though they acknowledged they did not fully understand DIN EN 13165:2009–02 and DIN EN 13164:2009–02. (Master-Bilt, No. 0069.1 at p. 2)

Other stakeholders had reservations about DIN EN 13165:2009–02 and DIN EN 13164:2009–02. Craig Industries stated that the alternatives to ASTM C1303–10 may ignore the fact that different plastic foam product insulations in the marketplace respond differently to heat. (Craig Industries, No. 0068.1 at p. 4) It added that DOE should prevent foamed-in-place walk-in manufacturers from picking the most efficient part of the panel for testing. (Craig, No. 0068.1 at p. 4) Owens Corning noted that DIN EN 13165:2009–02 and DIN EN 13164:2009–02 appeared to be material standards and not test methods, and Owens Corning asked for clarification on what the test method would be. (Owens Corning, 0058.1 at p. 1) NRDC suggested that DOE review the proposed standards, ASTM C1303–10, DIN EN 13165:2009–02, and DIN EN 13164:2009–02, to determine which standard yields better results, and what the related testing burden would be to adopt a foreign standard. (NRDC, No. 0064.1 at p. 4)

DOE notes Carpenter's, Hill Phoenix's, AHRI's, and Master-Bilt's approval of DIN EN 13165:2009–02 and DIN EN 13164:2009–02, and in light of the criticisms that DOE has received about ASTM C1303–10 and the support for DIN EN 13165:2009–02 and DIN EN 13164:2009–02, DOE has decided to adopt DIN EN 13165:2009–02 and DIN EN 13164:2009–02 as the test procedure for determining LTTR of polyurethane products and extruded polystyrene products, respectively (polyisocyanurate products are covered by the test for polyurethane products). Today's final rule provides that the LTTR value determined by Annex C of DIN EN 13165:2009–02 or DIN EN 13164:2009–02 shall be used to determine a degradation factor. The degradation factor will be the LTTR R-value divided by the original R-value of the foam. The original R-value of the foam will be tested with ASTM C518–04, as specified by the EISA 2007 amendments to EPCA, and can be used for compliance with the relevant R-value requirement established by those amendments. (42 U.S.C. 6313(f)(1)(C)) The degradation factor is applied to the U-factor of the panel found by ASTM C1365–05; see section 4.2 and 4.3 in Appendix A.

In response to Owens Corning's comment that DIN EN 13165:2009–02 and DIN EN 13164:2009–02 appeared to be material standards and not test methods, DOE notes that Annex C of both DIN EN 13165:2009–02 and DIN EN 13164:2009–02 provide the methodology for testing. DOE also notes Craig Industries' concern about using heat to test for LTTR and NRDC's recommendation that DOE compare the different standards that were proposed; however, DOE believes DIN EN 13165:2009–02 and DIN EN 13164:2009–02 are more accurate and appropriate for assessing the long-term performance of impermeably faced foams used in walk-in coolers and freezers because they permit panels to be tested with their facers, and accounts for impermeably faced foam. Also, to address Craig Industries' concern about manufacturers not all choosing the same part of the panel, DOE is requiring that this test sample should be taken from the geometric center of the test specimen.

DOE is largely incorporating DIN EN 13165:2009–02 and DIN EN 13164:2009–02 except for the requirement that the thermal resistance measurement is conducted at a mean temperature of 10 °C. DOE has decided to adopt the EPCA mean temperatures of 55 °F and 20 °F for a cooler and freezer, respectively for the DIN EN 13165:2009–09 and DIN EN 13164:2009–02 testing conditions. However, the manufacturer will still have to follow any applicable aging conditions prescribed by DIN EN 13165:2009–09 and DIN EN 13164:2009–02. By deviating from the temperature condition specified in DIN EN 13165:2009–09 and DIN EN 13164:2009–02, the fixed increment values and safety increment values will be slightly more conservative than the values that would be expected if the

LTTR test were performed at the temperature condition specified in DIN EN 13165:2009–09 and DIN EN 13164:2009–02, when applied to freezer panels.

c. Moisture Absorption

In the January 2010 NOPR, DOE discussed the possibility of testing the impact of moisture absorption on the R-value of different insulation materials, evaluated various tests developed by ASTM, and reviewed a research paper completed by the U.S. Army Corps of Engineers' Cold Regions Research and Engineering Laboratory (CRREL), which Owens Corning submitted to the docket. (Owens Corning, No. 0054.3 at p. 1) DOE initially concluded that testing the effect of moisture absorption on the R-value of insulation foam would be complex, costly, and time-consuming, and that there was no well-accepted testing method. As a result, DOE proposed that the impact of water absorption on R-value not be included in the test procedure. 75 FR 186, 194 (Jan. 4, 2010).

DOE received many comments from interested parties that supported the inclusion of some means to account for the effect of water infiltration. At the NOPR public meeting, and in several written comments, Craig Industries urged DOE to test for and include the impact of moisture absorption in foam. (Craig Industries, Public Meeting Transcript, No. 0016 at p. 248; Craig Industries, No. 0035.1 at p. 3; Craig Industries, No. 0068.1 at p. 5; Craig Industries, No. 0057.13 at p. 5) ACEEE also stated that it was imperative to include the effect of moisture absorption. (ACEE, No. 0052.1 at p. 2) Kysor maintained that moisture did not affect the R-value of poured-in-place polyurethane, but laminated panels would be severely affected by water because of the water-based glue used to bond the insulation to the metal skins. (Kysor, No. 0053.1 at p. 3)

Some interested parties suggested possible tests and studies that could be used to measure the effect of water absorption. For example, Craig Industries and Owens Corning referred to the CRREL study for information about the performance of various materials with water. (Craig Industries, No. 0054.1 at p. 2; Owens Corning, Public Meeting Transcript, No. 0016 at p. 250) Nor-Lake suggested that an adequate test for water absorption would be ASTM D2842–06, "Standard Test Method for Water Absorption of Rigid Cellular Plastics." (Nor-Lake, No. 0047.1 at p. 3) Owens Corning suggested that ASTM E96, "Standard Test Methods for Water Vapor Transmission of Materials," could be used to test water vapor permeability rates and determine the effect of moisture absorption on foam. (Owens Corning, Public Meeting Transcript, No. 0016 at p. 253; Owens Corning, No. 0048.1 at p. 1; Owens Corning, No. 0032.1 at p. 3) Owens Corning also suggested that ASTM E96 could be used to identify suitable materials for walk-in cooler and walk-in freezer applications. (Owens Corning, No. 0048.1 at p. 1 and No. 0032.1 at p. 3)

Additionally, joint comments filed by SCE, SMUD, SDG&E, and SCG on the January 2010 NOPR, hereafter referred to as the Joint Comment, added that although ASTM E96 produces a conservatively low estimate of moisture permeance at high vapor pressures, DOE should evaluate whether using ASTM E96 is better than not accounting for the effect of moisture on insulating foam. (Joint Comment, No. 0037.1 at p. 11) The Joint Comment added that there may be difficulties in testing and characterizing R-value deterioration in foams due to moisture absorption, but DOE should still consider a requirement for testing vapor permeability. (Joint Comment, No. 0037.1 at p. 1) Owens Corning also stated that, since DOE raised the proposed relative humidity assumption for the test condition from 45 percent to 75 percent in the September 2010 SNOPR, DOE implicitly acknowledged the high humidity conditions present in walk-in cooler and freezer environments, which, in its view, supported the consideration of the impact of moisture on the thermal performance of a walk-in over its lifetime. (Owens Corning, No. 0058.1 at p. 2) ACEEE suggested that because a major threat to moisture control for panels is the integrity of the exterior skin, a minimally intrusive method to determine the impact of moisture absorption would be to assess the vapor diffusion integrity of the sealed panel. (ACEEE, No. 0052.1 at p. 2)

Other interested parties did not support including water absorption in the test procedure. ThermalRite stated that moisture infiltration was unlikely to occur in properly constructed panels, water infiltration would most likely be the result of improper materials or manufacturing, and that moisture infiltration should be considered inconsequential and removed from proposed test procedures. (ThermalRite, No. 0045.1 at p.1; ThermalRite, No. 0045.1 at p. 2; ThermalRite, No. 0049.1 at p.2) ICS commented that water infiltration is related to panel installation and that there were no data to support that moisture infiltration is caused by the walk-in's manufacture or design. (ICS, Public Meeting Transcript, No. 0016 at p. 253; ICS, No. 0045.1 at p. 1) ICS went on to state that, under actual and average usage conditions, water absorption in foam is negligible and it recommended that the impact of moisture absorption should be removed from the proposed test procedure. (ICS, No. 0045.1 at p. 1; ICS, No. 0045.1 at p. 2) Hill Phoenix commented that moisture absorption was not an issue and any moisture issues were generally reported by the walk-in cooler or walk-in freezer user and were quickly repaired. (Hill Phoenix, No. 0041.1 at p. 2) Carpenter agreed with DOE that the impact of water absorption of foam would be difficult to study and quantify, and added that polyurethane foam has an inherently low permeability, which would minimize water absorption. (Carpenter, No. 0043.1 at p. 2) TAFCO concurred that moisture infiltration into polyurethane foam is not an issue, and that it would not cause the R-value to degrade significantly over time. (TAFCO, No. 0040.1 at p. 2) TAFCO also stated that they have installed panels in high-humidity environments and they did not encounter any cases of water absorption by panels. It urged that DOE not pursue this issue further. (TAFCO, No. 0040.1 at p. 2)

DOE understands that interested parties have concerns regarding the potential impact of moisture absorption on the thermal performance of insulating material over the lifetime of a walk-in cooler or freezer. Prior to the publication of the January 2010 NOPR, DOE reviewed several methods for testing vapor permeance and water absorption in foam insulation materials. However, this review of various test methods showed that there were disparities among the different methods, and that there was no general agreement upon a single approach. 75 FR 186, 194 (Jan. 4, 2010). Moreover, while these tests are designed to measure the performance of insulating foam by itself, they would not account for the many unique construction methods and combinations of materials employed by manufacturers of panels to minimize moisture infiltration.

At this time, test procedures for measuring the impact of water on foam R-value are not yet recognized by a national organization such as ASTM. DOE notes that because of the absence of any nationally recognized testing standards, it would need to develop such a protocol. To this end, one of DOE's national labs is in the process of developing procedures to evaluate the impact of moisture on insulation R-values. Accordingly, because of the potential ambiguities that are currently

present with respect to the means by which to assess the impact of moisture absorption on the thermal performance of insulating material over time, DOE is not incorporating a method to account for moisture absorption at this time. DOE may, however, consider adopting such a procedure in the future.

d. Display Panels

In the September 2010 SNOPR, DOE proposed that glass walls ("display panels") would be tested using NFRC 100–2001–E0A to measure their thermal transmittance, or U-factor. 75 FR 55068, 55098 (Sept. 9, 2010). Display panels are typically found on beer caves and share many characteristics with display doors. Notably, they are readily tested or simulated using the procedure in NFRC 100–2001–E0A. DOE received no comments regarding its proposed approach for display panels. Consequently, DOE is including this test procedure (to be codified in section 4.1 of Appendix A) to measure the thermal transmittance of display panels or walls. Additionally, to improve clarity, DOE is defining "display panels" as a panel that is entirely or partially comprised of glass, a transparent material, or both and is used for display purposes.

e. Open Areas of Walk-Ins

The test procedure DOE is establishing today contains tests for components of walk-ins that separate the interior refrigerated environment of the walk-in from the exterior. Zero Zone stated that the test procedure should include a method to determine the energy use for walk-ins that have open areas to display food. (Zero Zone, No. 0077.1 at p. 1) Because an open area does not, by definition, separate the interior refrigerated environment of the walk-in from the exterior, an open area is not a component of the walk-in that is covered under this test procedure. Accordingly, DOE is not adopting Zero Zone's suggestion.

3. Energy Use of Doors

a. U-Factor of Doors

In the September 2010 SNOPR, DOE proposed to rate the total thermal transmittance (i.e. U-factor) of doors, including their framing materials or complete door plug, using the test procedure NFRC 100–2010[E0A1], "Procedure for Determining Fenestration Product U-factors." 75 FR 55068, 55083 (Sept. 9, 2010). DOE specified internal and external rating conditions for the test procedure to closely match conditions that would be experienced by the door when it is part of a walk-in.

NEEA strongly supported DOE's use of NFRC 100–2010[E0A1] procedures for testing the performance of walk-in cooler and freezer doors. (NEEA, No. 0061.1 at p. 2) NRDC agreed with DOE's use of NFRC 100–2010[E0A1] for rating doors with the proposed changes to the temperatures used for the testing procedure. (NRDC, No. 0064.1 at p. 6)

DOE notes NEEA's and NRDC's support and has incorporated the use of NFRC 100–2001–E0A1 in this final rule. DOE also notes that none of the interested parties submitted comments that disagreed with using NFRC 100–2001–E0A1. The thermal transmittance result from NFRC 100–2001–E0A1 is then used to calculate the corresponding energy consumption of a refrigeration system whose efficiency is given in sections 4.4 and 4.5 of Appendix A for display and non-display doors, respectively. This energy metric is combined with the electricity consumption from electrical door components to calculate the door's total energy consumption.

b. Electrical Components of Doors

As described in section III.A.1, the test metric for doors includes the energy consumed by electrical components associated with a walk-in door. The electricity consumed by the door will be the sum of the rated power associated with each electricity consuming device multiplied by the assumed time the device will be operational. Percent time off (PTO) assumptions are given in sections 4.4.2 and 4.5.2 of Appendix A for display and non-display doors, respectively. PTO assumptions are specified for some electrical components, such as anti-sweat heater wire. For any electricity consuming devices for which a PTO is not specified in Appendix A, today's final rule provides that if a manufacturer can demonstrate that the device is controlled by a preinstalled timer, control system or other auto-shut-off system, the PTO is assumed to be 25 percent. For example, if a door has a thermometer mounted on it that consumes electricity, but the thermometer has a built in timer so that it shuts off at certain times, then the manufacturer of the door can use the PTO value of 25 percent when calculating the energy consumption of the thermometer.

The test procedure also provides a means for measuring the heat generation of door electrical components that are located on the inside surface of the door. This heat is added to the heat transmitted through the door and the corresponding refrigeration energy use is calculated using the method described in section III.B.3.c. The refrigeration energy use is added to the electrical energy use to calculate the total energy consumption of the door.

DOE received a comment challenging its assumptions about heat from electrical devices. Zero Zone disagreed with the assumption that all anti-condensate heat contributes to the walk-in heat load, and instead suggested that 50 to 75 percent of the anti-condensate heat going into the display case would be a more appropriate assumption. (Zero Zone, No. 0077.1 at p. 2) After further analysis, DOE agrees with Zero Zone's observation that not all anti-condensate heat necessarily contributes to the walk-in heat load because the anti-condensate heat is applied to the transparent surface of the display case. Because one side of the transparent surface is in contact with the surrounding external environment, a portion of the heat is transmitted from the display case to the surrounding environment. Therefore, DOE has revised the equations in sections 4.4.2and 4.5.2of Appendix A to capture only 75 percent of the power from anti-sweat heaters as an additional compressor load.

c. Energy Efficiency Ratio

In the January 2010 NOPR, DOE proposed to require that manufacturers measure the energy use of walk-in cooler and walk-in freezer envelopes in kWh/day. However, most metrics used to describe heat transfer losses are in units of British thermal units (Btu) per unit time. In order to convert the thermal energy transmission calculation (Btu/hr) into a measure of electrical energy consumed by the refrigeration equipment, DOE proposed to use an energy efficiency ratio based on a nominal efficiency of an assumed refrigeration system. The EER values proposed for coolers and freezers were 12.4 Btu/W-h and 6.3 Btu/W-h respectively. The values were selected to provide a means of comparison and were not intended to represent the actual efficiency of the refrigeration system with which the envelope would ultimately be paired. 75 FR 186, 197 (Jan. 4, 2010). Although the test procedure no longer requires one to calculate the overall envelope energy, the concept is still relevant for calculating door energy.

DOE received comments in response to the January 2010 NOPR regarding the use of an EER value, the assumptions used to calculate the EER value, and the proposed EER values for coolers and freezers. BASF commented that the proposed EER assumptions were reasonable. (BASF, No. 0021.1 at p. 4) Nor-Lake agreed with DOE's use of a

nominal EER value to convert the thermal energy transmission to electrical energy consumption. (Nor-Lake, No. 0047.1 at p. 5) Master-Bilt also agreed with the proposed use of a nominal EER but stated that the proposed EER values are not achievable. (Master-Bilt, No. 0027.1 at p. 2) Kason requested that the nominal EER values be reassessed to represent real world values. (Kason, No. 0055.1 at p. 4) Nor-Lake commented that the EER values on their refrigeration models did not match DOE's proposed nominal values. (Nor-Lake, 0023.1 at p. 4)

DOE considered these comments and, in conjunction with the supportive comments from Master-Bilt, Nor-Lake, and BASF, continues to use an EER value to relate the thermal energy transmission to the electrical energy consumed for doors. Despite the comments from Kason, Master-Bilt, and Nor-Lake, DOE finds 12.4 Btu/W-h and 6.3 Btu/W-h to be appropriate conversions for walk-in coolers and walk-in freezers, respectively, because these EER values correspond to nominal EER values contained in the refrigeration test procedure for unit coolers connected to multiplex condensing systems (AHRI 1250 (I–P)–2009). DOE is aware that the nominal values for this configuration may not represent all walk-ins, but notes that these EER values are intended to provide a means of comparison and not directly reflect a real walk-in installation. In particular, these EER assumptions are not intended to represent the expected efficiency of any particular refrigeration system produced by a manufacturer and are provided as a method to converting thermal energy to electrical energy consumed by a refrigeration system.

4. Heat Transfer via Air Infiltration

In the January 2010 NOPR, DOE stated that, compared with other energy consumption factors such as conduction losses through insulation, air infiltration may be the largest contributing factor to envelope thermal load. That notice identified two infiltration pathways: steady state leakage and air losses due to door-opening events. To address this issue, DOE proposed to include test procedures to measure the steady state infiltration and infiltration from door opening events and subsequently modified these test procedures in response to comments to the September 2010 SNOPR. See 75 FR 196–197 (Jan. 4, 2010) and 75 FR 55084–55086 (Sept. 9, 2010). Interested parties submitted comments pertaining to the topic of envelope infiltration, including steady state infiltration, door opening infiltration, calculations, and empirical methodologies for quantifying the effects of infiltration.

a. Steady State Infiltration

In the January 2010 NOPR, DOE proposed that steady state infiltration of fully assembled envelopes must be tested using the method described in ASTM E741–06, "Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution." 75 FR 196 (Jan. 4, 2010).

Some interested parties stated that steady state infiltration should not be included in the test procedure. Hill Phoenix maintained that an insufficient amount of infiltration would occur in a properly installed walk-in, essentially suggesting that DOE abandon the inclusion of infiltration in the test. (Hill Phoenix, No. 0063.1 at p. 2) AHRI concurred, stating that a steady-state infiltration test is not necessary due to the insignificant amount of infiltration present in a walk-in * * * (AHRI, No. 0070.1 at p. 3) Master-Bilt agreed, suggesting that testing steady-state infiltration is unnecessary because this infiltration is insignificant compared with infiltration from door openings. (Master-Bilt, No. 0069.1 at p. 2) NRDC suggested that DOE confirm the assumption that the impact of infiltration and exfiltration through the envelope is minimal compared to the infiltration through the doors, and suggested that DOE should weigh each impact. (NRDC, No. 0064.1 at p. 6)

Other interested parties commented on the specific test methods DOE proposed in the January 2010 NOPR for measuring steady-state infiltration of walk-in envelopes. TAFCO stated that ASTM E741–06, Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution, is an acceptable method for determining steady state air infiltration. (TAFCO, No. 0040.1 at p. 3) ACEEE also agreed with using ASTM E741–06. (ACEEE, 0052.1 at p. 3) NEEA commented that either ASTM E741–06 or a standard blower test is a reasonable method of calculating steady state infiltration, but noted that the blower test would be faster and less costly to administer. Therefore, NEEA recommended that DOE test ASTM E741–06 and the standard blower door test before prescribing which methodology must be used. (NEEA, No. 0061.1 at p. 2) Kysor, on the other hand, stated that it is neither necessary nor cost effective to assemble an entire walk-in to test for air infiltration. Kysor stated that each component should be tested separately and recommended that DOE use ASTM E1424–08, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure and Temperature Differences Across the Specimen, and ASTM E2357–05, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies, because either can test any assembly that will become part of a walk-in. (Kysor, No. 0053.1 at p. 3)

In the January 2010 NOPR, DOE proposed that ASTM E741–06 should be used to measure infiltration; however, in the September SNOPR, DOE determined that ASTM E741–06 could present an undue burden for manufacturers with respect to the many door combinations that are possible. Therefore, DOE proposed in its September 2010 SNOPR to also consider measuring steady state infiltration through doors using NFRC 400–2010–E0A1, "Procedure for Determining Fenestration Product Air Leakage." 75 FR 55068, 55084 (Sept. 9, 2010).

Interested parties commented on NFRC 400–2010–E0A1 and suggested alternatives. NRDC agreed with using NFRC 400–2010–E0A1 to determine infiltration of individual envelope components, but also recommended using a pressurization test to determine infiltration of fully assembled envelopes, based on ASTM D6670, "Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products." (NRDC, No. 2.3.008 at p. 6) AHRI recommended that infiltration could be estimated for a family of doors by using a scaling methodology based on a limited number of tests. AHRI cautioned DOE against requiring the manufacturer to test every single door because it would be burdensome. (AHRI, No. 2.3.015 at p.3) Some interested parties commented on the prescribed testing conditions to be implemented with NFRC 400–2010–E0A1. American Panel stated that the proposed steady state infiltration test unit is not representative of the average walk-in size and suggested a more representative size of 8 feet by 12 feet by 8 feet high. (American Panel, No. 2.3.001 at p. 3) American Panel, NEEA, and Bally concurred with DOE's assumption of 75 percent relative humidity, which DOE proposed as a condition of testing. (American Panel, No. 2.3.001 at p. 3; NEEA, No. 2.3.005 at p. 5; Bally, No. 0078.1 at p.2)

DOE notes the specific comments and suggestions from TAFCO, NEEA, ACEEE, Kysor, NRDC, AHRI, and American Panel, but has decided not to include steady state infiltration in the WICF test procedure at this time. In response to NRDC's suggestion that DOE

weigh the impact of steady-state infiltration against other sources of infiltration, DOE believes that the contribution of steady state infiltration towards the aggregate energy consumption of a well-constructed factory-built walk-in unit is most likely negligible compared to other energy consumption pathways for current WICF designs. Higher steady-state infiltration across the envelope for site-assembled walk-in coolers and freezers appears to be generally caused by poor installation and construction practices. As such, DOE is not incorporating an overall infiltration measurement, which is a factor that relies heavily on on-site assembly practices rather than the performance of individual components. Given that today's final rule includes a means to assess the performance of specific individual components, the performance of these components will be captured under the new procedure and should be sufficiently adequate prior to their installation as part of a completed walk-in unit. Should this prove not to be the case, DOE may re-examine the procedure and consider modifications to address its potential shortcomings.

b. Door Opening Infiltration

In the January 2010 NOPR, DOE proposed to calculate air infiltration associated with each door-opening event using established analytical methods based on equations and computational values published in the ASHRAE Refrigeration Handbook. DOE also made several assumptions in the test procedure that could have a significant impact on the predicted air exchange. The assumptions with the most impact were the number of doorway passages (the number of door-opening cycles for a given door), door open-close time, and the amount of time the door is held or propped open. 75 FR 186, 196 (Jan. 4, 2010). In the September 2010 SNOPR, DOE did not propose to change the basic methodology, but modified some of the assumptions in order to differentiate door types. 75 FR 55068, 55085 (Sept. 9, 2010).

Some interested parties supported the proposed method. Hired Hand agreed with the methodology used for calculating the air infiltration from door openings. (Hired Hand, Public Meeting Transcript, No. 0016 at p. 309) Hired Hand emphasized that air infiltration may be the largest contributing factor to envelope energy losses. (Hired Hand, Public Meeting Transcript, No. 0016 at p. 28; Hired Hand, Public Meeting Transcript, No. 0016 at p. 279; Hired Hand, Public Meeting Transcript, No. 0016 at p. 285) American Panel suggested the use of ASHRAE values for heat load as the best way to account for the effects of air infiltration. (American Panel, No. 0042.1 at p. 2) ThermalRite, Nor-Lake, and Master-Bilt agreed with American Panel's suggestion. (ThermalRite, No. 0049.1 at p. 2; Nor-Lake, No. 0047.1 at p.4; Master-Bilt, Public Meeting Transcript, No. 0016 at p. 311) Master-Bilt and Zero Zone also agreed with DOE's assumptions regarding infiltration attributed to door openings. (Master-Bilt, No. 0069.1 at p. 2; Zero Zone, No. 0077.1 at p. 2)

Other interested parties questioned the applicability of the method to walk-in cooler and freezer doors, or questioned DOE's assumptions in calculating door opening infiltration. Schott Gemtron contended that ASHRAE equations may be based on supermarket display cases, implying that they may not be applicable to some walk-in doors. (Schott Gemtron, Public Meeting Transcript, No. 0016 at p. 314) Hired Hand was concerned that the proposed test procedures do not account for the effect of fast-acting doors on air infiltration. (Hired Hand, Public Meeting Transcript, No. 0016 at p. 286) SCE and Hired Hand both stated that the parameters used to calculate air infiltration should clearly show the benefit of fast-acting doors. (SCE, Public Meeting Transcript, No. 0016 at p. 320; Hired Hand, Public Meeting Transcript, No. 0016 at p. 320) Hired Hand also recommended that the equations used to calculate air infiltration should be based on the operational time the doors are opened over an assumed 24-hour day. (Hired Hand, No. 0051.1 at p. 4) Zero Zone stated that any air infiltration calculations should include additional air infiltration if the evaporator is discharging air in the direction of the display doors. (Zero Zone, No. 0077.1 at p. 1) Bally stated that hybrid walk-ins, that is, walk-ins sited within another walk-in, should be given beneficial consideration. Bally explained that a walk-in freezer sited inside a walk-in cooler would experience less infiltration because of the smaller temperature differential between the interior and exterior of the freezer. (Bally, No. 0078.1 at p.2)

Interested parties also made specific comments on the effect of infiltration reduction devices (IRDs). ACEEE and ThermalRite supported the infiltration device effectiveness test methodology. (ACEEE, No. 0052.1 at p. 3; ThermalRite, No. 0049.1 at p. 2) TAFCO also stated that ASTM E741–06 is an acceptable method for determining IRD effectiveness. (TAFCO, No. 0040.1 at p. 3) NRDC stated that the proposed door opening infiltration calculation from ASHRAE Fundamentals 2009 is acceptable for conventional doors, but when doorways are protected by an air curtain or other infiltration reduction device, calculations should include the effect of such devices on energy use. (NRDC, No. 0064.1 at p. 6)

Master-Bilt commented that air infiltration from door openings cannot be modeled in a meaningful way and should be excluded from the test methodology. (Master-Bilt, No. 0027.1 at p. 2) Hill Phoenix noted that the panel manufacturer has no bearing on door opening frequency, which accounts for the majority of the infiltration. (Hill Phoenix, No. 0063.1 at p. 2) NEEA suggested that DOE should not make assumptions about the nature of the use of a particular walk-in. (NEEA, No. 0061.1 at p. 5) Instead, it recommended that DOE include a prescriptive requirement for infiltration reduction devices. (NEEA, No. 0061.1 at p. 5)

DOE has decided not to include any test procedure for door opening infiltration following its decision to have component-level test procedures and standards. Door infiltration is primarily reduced by incorporating a separate infiltration reduction device at the assembly stage of the complete walk-in. Based on DOE's understanding of the door manufacturing industry, a typical door manufacturer has very few direct means for reducing the door infiltration on its own since IRDs are generally designed and manufactured independently from doors and they require proper field installation to achieve rated performance. Consequently, at this time, DOE is not incorporating provisions that would require measuring the effectiveness of the infiltration reduction devices and door infiltration, as suggested by Master-Bilt, Hill Phoenix, and NEEA. Likewise, reduction of door infiltration due to the location of the walk-in is not captured, as suggested by Bally.

In response to NEEA's comment recommending a prescriptive standard, DOE notes that EPCA has already established a prescriptive requirement for infiltration reduction devices, and there may be limited if any benefit to DOE adding additional prescriptive standards for infiltration reduction devices. (42 U.S.C. 6313(f)(1)(B)) Nevertheless, DOE will consider the need for these types of standards within the context of its ongoing energy standards rulemaking.

5. Electrical Components

In the January 2010 NOPR, DOE proposed to calculate the energy consumption of electrical devices using their nameplate rating and duty cycle

assumptions about their daily operation. In addition, the heat loads from electrical devices were factored into the envelope refrigeration load calculations. DOE proposed to incorporate 100 percent of the electrical energy consumed to operate the devices that are internally located and to convert the electrical energy consumed to a thermal load. The associated thermal load was then used to calculate the additional refrigeration load using the nominal refrigeration EER values described in section III.B.3.c. DOE also proposed a variety of PTO values in the NOPR to account for reductions in energy use due to component control and hours of usage. 75 FR 186, 198 (Jan. 4, 2010).

BASF supported including electricity consumption as part of the energy calculation, and concurred with the duty cycle assumptions. (BASF, No. 0021.1 at p. 5) Master-Bilt and Nor-Lake also agreed with the electrical duty cycle equation proposed by DOE. (Master-Bilt, No. 0027.1 at p. 2; Nor-Lake, No. 0023.1 at p. 4) ACEEE supported the methods and assumptions for PTO values and electrical loads and agreed with the use of nameplate power ratings because it encouraged load reduction. (ACEEE, No. 0052.1 at p. 3) ThermalRite noted that while it did not fully understand how the proposed PTO values listed in the January 2010 NOPR were developed, it believed that the proposed values represented a fair method of comparison among manufacturers because the same assumptions are made for all users. ThermalRite asked that DOE ensure that the values include all device types. (ThermalRite, No. 0049.1 at p. 2) ORNL requested that DOE include the ground heater below the floor insulation as part of the energy use calculation. (ORNL, No. 0028.1 at p. 2) Craig Industries requested that DOE accommodate high-efficiency heater wires that apply heat on demand. (Craig Industries, Public Meeting Transcript, No. 0016 at p. 325 and No. 0054.1 at p. 3) Finally, Nor-Lake expressed the opinion that the proposed PTO values for lights are low because in most applications the lights would be shut off each night for 8 hours. (Nor-Lake, No. 0047.1 at p. 5)

DOE notes support from BASF, Master-Bilt, Nor-Lake, ACEEE, and ThermalRite for its methodology and assumptions. DOE is also aware of the concerns presented by ORNL, Craig Industries, and Nor-Lake. However, since DOE will implement a component-based standard, electrical components not part of a door are not included in the component test or component metric. DOE notes that assemblers or manufacturers of complete walk-ins must still use lighting that complies with the efficacy standard prescribed in EPCA. (42 U.S.C. 6313(f)(1)(G)) DOE will continue to use the method proposed in the January 2010 NOPR to calculate the energy consumption of lights, sensors, and other miscellaneous electrical devices associated with walk-in doors. Regarding Craig Industries' specific comment about door heater wire, DOE's PTO assumptions take into account demand-based control of components, which includes the loads from door heater wires. PTO assumptions are given in sections 4.4.2 and 4.5.2 of Appendix A for display and non-display doors, respectively. See section III.B.3.b for further discussion of electrical components of doors.

C. Test Procedures for Refrigeration Systems

The refrigeration system is the equipment that performs the mechanical work necessary to cool the interior space of a walk-in cooler or freezer. As previously discussed, DOE considers the refrigeration system an individual component of the walk-in cooler or walk-in freezer. Therefore, in this test procedure, DOE establishes a test of the performance of a refrigeration system itself, assuming nominal envelope characteristics. In the concurrent standards rulemaking, DOE intends to establish energy conservation standards for the refrigeration system. See generally 75 FR 17080 (April 5, 2010). The following sections address issues raised by interested parties on the January 2010 NOPR and September 2010 SNOPR.

1. Definition of Refrigeration System

In the January 2010 NOPR, DOE proposed a definition of refrigeration system that described three types of systems that would be covered: (1) Single-package systems containing the condensing and evaporator units; (2) split systems with the condensing unit and unit cooler physically separated and connected via refrigerant piping; or (3) unit coolers that receive refrigerant from a compressor rack system shared with other refrigeration equipment. 75 FR at 200 (Jan. 4, 2010). In the September 2010 SNOPR, DOE proposed minor revisions to that definition to clarify some of these terms. That notice proposed the following definitions:

> Refrigeration system means the mechanism (including all controls and other components integral to the system's operation) used to create the refrigerated environment in the interior of a walk-in cooler or freezer, consisting of (1) a packaged system where the unit cooler and condensing unit are integrated into a single piece of equipment, (2) a split system with separate unit cooler and condensing unit sections, or (3) a unit cooler that is connected to a multiplex condensing system.

75 FR 55068, 55093 (Sept. 9, 2010).

NRDC, Craig Industries, and Master-Bilt agreed with the revisions proposed in the September 2010 SNOPR. (NRDC, No. 0064.1 at p. 7; Craig Industries, No. 0068.1 at p. 5; Master-Bilt, No. 0069.1 at p. 3) Other interested parties did not agree with the classification contained in the definition or the types of systems covered. NEEA stated that the three refrigeration types do not accurately represent the market, and recommended that the equipment classification should instead match the classifications contained in DOE's regulations for commercial refrigeration equipment. (NEEA, No. 0061.1 at pp. 2 and 4) The Joint Utilities also disagreed with the concept of defining systems as "matched" ("packaged" or "split" systems as termed in the proposed definition) or "remote" (a unit cooler connected to a multiplex condensing system as in the proposed definition). (Joint Utilities, No. 0059.1 at p. 2) Like NEEA, the Joint Utilities suggested that DOE change its proposed definition by adopting the approach taken with the commercial refrigeration equipment efficiency regulations: "packaged" systems should be termed "self-contained condensing units" and all other condensing units should be considered "remote condensing units." The Joint SNOPR comment also agreed with this approach, suggesting that DOE classify refrigeration systems as self-contained (packaged systems) or unit coolers connected to remote condensing units (both dedicated and multiplex). It also suggested that for remote condensing systems, any applicable energy conservation standards should only apply to the unit cooler. (Joint SNOPR Comment, No. 0074.1 at p. 3)

DOE believes the three types of refrigeration systems described in the definition accurately represent the range of refrigeration equipment that is used in walk-in coolers and freezers. Although the definition differs from the definition for commercial refrigeration equipment, there are key differences between commercial refrigeration equipment refrigeration systems and walk-in refrigeration systems that make a new definition necessary. NEEA and the Joint Utilities refer to two common types of commercial refrigeration equipment refrigeration units. Some are "self-contained" (meaning the entire refrigeration system is built into the case). Others are "remote condensing" (meaning the unit cooler is built into the

case, but the whole case is connected to a central system of compressors and condensers (called a "rack" or "multiplex condensing system") that is connected to most or all of the refrigeration units in a building). The latter configuration is common in supermarkets. For all remote condensing systems, the commercial refrigeration equipment test procedure rulemaking assumed a certain efficiency of the multiplex condensing system and the standards rulemaking did not regulate this part of the equipment. 71 FR 71340 and 74 FR 1092.

However, "remote condensing" can also refer to a configuration in which the unit cooler is connected to a dedicated (that is, only serving that one unit) compressor and condenser that are located somewhere away from the walk-in. This configuration is very rare for commercial refrigeration equipment but comprises a large proportion of walk-in refrigeration system applications. For this reason, DOE does not agree with the suggestion of NEEA and the Joint Utilities that this configuration should be classified as "remote condensing" and does not agree that the compressor and condenser parts should not be covered under the walk-in coolers and freezers rulemaking. Rather, DOE believes that a dedicated condensing unit should be included in the rule, even if it is remotely located, because it could be viewed as part of the walk-in cooler as long as it is connected only to that cooler and not to other refrigeration equipment. For systems where the walk-in is connected to a multiplex condensing system that runs multiple pieces of equipment, the compressor and condenser would not be covered because they are not exclusively part of the walk-in.

In consideration of the above, DOE believes the commercial refrigeration equipment definition cannot be applied to walk-ins, because there is a certain type of walk-in refrigeration—namely, a split system with a dedicated but remotely located condensing unit—that is highly represented in walk-ins but rarely, if ever, represented in commercial refrigeration equipment. Thus, while the Joint Comment compares walk-in refrigeration systems to commercial refrigeration equipment, DOE believes this is not a relevant comparison. A closer comparison would be to residential central air conditioners—an example of equipment that almost always has a dedicated, but remotely located, condensing unit. In that instance, DOE's definition covers this type of remote condensing unit. Furthermore, DOE notes that manufacturers can optimize the dedicated, remote condensing unit with the unit cooler to take advantage of certain conditions such as low ambient outdoor temperatures. Therefore, DOE has retained the proposed definition's coverage of dedicated remote condensing systems. To further clarify this coverage, DOE has added the term "dedicated" to describe packaged systems and split systems in the definition it is adopting today.

2. Refrigeration Test Procedure: AHRI 1250 (I–P)–2009

DOE proposed to incorporate the industry standard AHRI 1250–2009, "2009 Standard for Performance Rating of Walk-In Coolers and Freezers," into the test procedure. (The January 2010 NOPR referred to the preliminary version of this standard, AHRI 1250P–2009. The SNOPR updated this reference to the final version.) 75 FR 186, 200–201 (Jan. 4, 2010) and 75 FR 55068, 55086 (Sept. 9, 2010). DOE proposed that manufacturers use this standard to rate the refrigeration systems of walk-in coolers and freezers.

AHRI 1250–2009 covers the testing of refrigeration systems for walk-in coolers and freezers, which includes unit coolers and condensing units that are sold together as a matched system, unit coolers and condensing units that are sold separately, and unit coolers connected to compressor racks. The procedure describes the method for measuring the refrigeration capacity and the electrical energy consumption for the condensing unit and the unit cooler, as well as the off-cycle fan energy and the defrost subsystem under specified test conditions. The standard test conditions specify the dry-bulb and wet-bulb temperatures of the air surrounding the unit cooler and the condensing unit. The standard test conditions are different for indoor and outdoor locations for the condensing unit and for coolers and freezers.

The AHRI procedure also specifies the calculations used to ascertain the nominal box loads under typical low-load and high-load conditions, expressed as a function of the ambient air temperature. (The "nominal box load" refers to the refrigeration load imposed on the system by the walk-in envelope.) During the test, the system must operate under steady-state conditions. For systems in which the condensing unit is located outdoors, the test procedure uses bin temperature data and bin hour data to represent the impact of the seasonal variation in outside ambient air temperature on energy use. The test procedure provides a calculation methodology to compute an annual walk-in efficiency factor (AWEF) for the refrigeration system under a specified load profile. For unit coolers and condensing units sold separately, the test procedure allows for testing the components individually and then calculating the system AWEF from the component test results.

Several interested parties agreed with DOE's proposed methodology. AHRI urged DOE to allow a rating of walk-in refrigeration systems using the calculation methodologies in the proposed protocols contained in AHRI 1250. (AHRI, No. 0070.1 at p. 2) American Panel, Thermo-Kool, Bally, and NRDC also supported DOE's proposal to allow the evaporator and condensing unit to be tested separately according to the proposed methodology. (American Panel, No. 0057.1 at p. 1; Thermo-Kool, No. 0072.1 at p. 1; Bally, No. 0078.1 at p. 3; NRDC, No. 0064.1 at p. 3) Craig Industries supported a formula that would allow the efficiency of the refrigeration system to be calculated from testing data provided by each component supplier. (Craig, No. 0068.1 at p. 3) Heatcraft advised that the refrigeration system procedure should allow for testing new components. (Heatcraft, No. 0065.1 at p. 1) However, the Joint Utilities disagreed with the assumption in AHRI 1250–2009 that unit coolers and remote condensing units that are sold separately will be matched and installed together, and stated that AHRI 1250–2009 does not allow unit coolers to be compared with each other unless they have been tested on the same condensing unit. (Joint Utilities, No. 0059.1 at p. 2) No parties opposed DOE's proposal to allow evaporator and condensing unit to be tested separately.

DOE notes the support of AHRI, American Panel, and NRDC for the proposed method and incorporates it into this final rule. In response to Heatcraft's suggestion that the procedure should allow for testing new components, DOE anticipates that the method will lead to manufacturers testing unit coolers and condensing units when they are manufactured separately, so that they can be used in new systems. Regarding the issues raised by Craig Industries and the Joint Utilities, DOE emphasizes that the proposed procedure contains a calculation method by which the overall refrigeration performance can be calculated using testing data from a condensing unit and unit cooler, even if the two components are provided by different suppliers. The test results for a unit cooler or condensing unit are independent from whichever condensing unit or unit cooler is matched with the tested component. In

contrast, the test results for each component are in the form of a performance curve to facilitate calculation of matched performance, which, as suggested by the Joint Utilities, does not lend itself to meaningful comparisons between unit coolers without matching the particular unit coolers with the same condensing unit. DOE acknowledges this limitation but believes it is important to maintain the results in terms of the performance curve to facilitate calculation of the performance of the system as a whole, because the entire refrigeration system is treated as a component under the approach adopted in today's final rule. Given that the refrigeration system is treated as a single component under the procedure, the procedure offers a simple method for determining the energy efficiency profile of the walk-in refrigeration system because it allows the unit cooler and condensing unit to be tested separately.

Additionally, DOE notes that if unit coolers are tested and rated as if they were to be combined with a multiplex condensing system, they could be compared against each other. The test data for unit coolers in a mix-match system include the data necessary for calculating the unit cooler's performance when paired with a multiplex condensing system. Thus, it would be relatively simple for manufacturers of unit coolers to provide both the performance data for matching purposes and the performance as connected to a multiplex condensing system. DOE may consider requiring this information as part of any related labeling requirements for WICF equipment.

While interested parties generally agreed with the adoption of AHRI 1250–2009, others disagreed with how that method would be applied to different system configurations. The Joint Utilities and NEEA both recommended that all remote condensing systems be tested using the "walk-in unit cooler match to parallel rack system" test method and noted that the matched system approach only be used for self-contained condensing units. (Joint Utilities, No. 0059.1 at p. 3; NEEA, No. 0061.1 at p. 4) The Joint Utilities further stated that the proposed AHRI 1250–2009 test method for rating dedicated remote condensing systems would create confusion and additional testing burden because there are many different test methods and categories for different locations and types of condensing units. (Joint Utilities, No. 0059.1 at pp. 2 and 5) Other interested parties questioned the methodology for rating unit coolers connected to multiplex condensing systems. American Panel stated that the exemption of multiplex equipment would give that equipment an unfair advantage over single piece equipment. (American Panel, No. 0057.1 at p. 3) Master-Bilt stated that the multiplex exemption seemed to suggest that any condensing unit connected to more than one unit cooler would not be covered. (Master-Bilt, No. 0069.1 at p. 3) NRDC stated that the proposed equations for evaluating the energy use of units with indoor condensing units and those connected to multiplex condensing systems should account for differences in the systems' ability to reject heat. (NRDC, No. 0064.1 at p. 7)

Addressing the comments from the Joint Utilities and NEEA, as discussed in section III.C.1, DOE considers dedicated remote condensing units as distinct from multiplex condensing systems in that dedicated remote condensers are part of only one walk-in, while multiplex condensing systems are connected to more than one walk-in or other unit of refrigeration equipment. DOE believes that dedicated remote condensing units represent a substantial opportunity for energy savings in a regulation for walk-in components because the configuration of a dedicated remote condensing unit is widespread in several market segments such as restaurants. Manufacturers can optimize the dedicated remote condensing unit with the unit cooler to take advantage of certain conditions such as low ambient outdoor temperatures. The approach suggested by the Joint Utilities and NEEA would exclude dedicated remote condensing units from this regulation, but DOE views these units as part of the walk-in cooler or freezer if the unit is connected only to the walk-in and not to any other refrigeration equipment. Therefore, the test procedure for walk-in refrigeration equipment accounts for these units.

To address Master-Bilt's request for clarification, for systems where the walk-in is connected to a central multiplex condensing system that runs multiple pieces of equipment, the compressor and condenser would not be covered because they are not exclusively part of the walk-in. DOE realizes there are certain condensing units that are connected to more than one unit cooler inside a single walk-in. These systems would not be considered "multiplex condensing systems" because they are connected to a single walk-in. However, if the condensing unit were connected to more than one unit cooler inside more than one walk-in or other piece of equipment, DOE would consider that a multiplex condensing system because the system's performance could not be attributed to one walk-in alone. While DOE understands American Panel's concern that multiplex condensing systems could have an advantage because those condensing units would not need to be tested, the condensing unit and compressor part of a multiplex condensing system is not exclusively part of a walk-in unit. Therefore, DOE is not covering them in this test procedure. DOE notes that unit coolers connected to the multiplex condensing systems would still be considered part of the walk-in and would need to be tested. The procedure considers the different performance of multiplex condensing systems and indoor condensing systems as recommended by NRDC. For multiplex condensing systems, the calculation of energy use includes a nominal efficiency that accounts for that type of system's ability to reject heat. The rating conditions for indoor condensing units provide an opportunity for crediting energy savings that result from an increased ability to reject heat.

Finally, one interested party proposed to expand the test procedure to provide more information than DOE previously proposed. NRDC suggested that testing data should be input into standardized calculations that would determine the overall system performance for each application and recommended that performance data should be able to be interpolated or extrapolated for hot climates. (NRDC, No. 0064.1 at p. 3) DOE notes that standardized rating conditions are not typically application-specific and may not be useful for determining the performance of the system in conditions outside the rating conditions. To provide this flexibility, as suggested by NRDC, the AHRI 1250 test procedure contains provisions for conducting testing with application ratings to obtain the performance for a particular application. However, DOE emphasizes that the standardized rating conditions are useful for comparing systems with each other and must be used for evaluating a product's compliance with a particular standard.

3. Alternative Efficiency Determination Method

For some covered equipment, DOE has allowed manufacturers to use their own methods, whether a calculation or computer simulation, to rate their equipment after they substantiate those calculation or simulation methods with test data. The purpose of this provision is to reduce the burden of testing customized, low-volume equipment. DOE has allowed rating methods in the form of alternate rating methods (ARMs)

or alternative efficiency determination methods (AEDMs). An ARM, which is allowed for rating residential central air conditioners and heat pumps, must be a representation of the test data and calculations of a mechanical vapor-compression refrigeration cycle. Manufacturers may use an ARM after submitting documentation to DOE and receiving specific approval from DOE to use that ARM to rate their equipment. (10 CFR 430.24(m)(4)-(6)) An AEDM, which is allowed for certain products and commercial equipment—including electric motors, distribution transformers, and commercial heating, ventilating, air-conditioning, and water heating (HVAC and WH) equipment—is a rating method derived from a mathematical model that represents the mechanical and electrical characteristics of the equipment and is based on engineering or statistical analysis, computer simulation or modeling, or other analytical evaluations of performance data. An AEDM must be substantiated by test data before it can be used to rate equipment. (10 CFR 431.17(a)(2)–(3); 10 CFR 431.197(a)(2); and 10 CFR 431.197(a)(2)–(3))

For the walk-in coolers and freezers rulemaking, DOE introduced the concept of an AEDM at the Framework public meeting (February 4, 2009) and requested comment on whether it could be applied to walk-ins. At the Framework public meeting, DOE asked how an AEDM could be implemented for walk-ins, what a sufficient test sample size for validating an AEDM would be, and how accurate (to what percentage) an AEDM should be. DOE did not receive any feedback regarding these questions. Several interested parties did, however, raise concerns in written comments on the Framework and during the Framework public meeting about the potential for inconsistency among manufacturers' rating methods. For example, Owens Corning stated that a single AEDM should be accepted to keep comparisons consistent (instead of different AEDMs from different manufacturers), and Craig said that requiring manufacturers to follow the same model (that is, not allowing manufacturers to use their own AEDMs) would provide consistent information to end users. (Owens Corning, No. EERE–2008–BT–STD–0015–0034.1 at p. 2; Craig, No. EERE–2008–BT–STD–0015–0025.1 at p. 5) DOE summarized and addressed these comments in the January NOPR. 75 FR 186, 190 (Jan. 4, 2010).As a result, DOE did not propose any specific provisions regarding AEDMs or any other provisions that would allow manufacturers to develop their own rating methods for walk-ins. Instead, DOE proposed its own calculation methodology for manufacturers to use in rating similar units of walk-in equipment. 75 FR 186, 191 (Jan. 4, 2010).

While the procedure divides the envelope into its major components, the refrigeration system is considered as a single component. Consistent with this approach, DOE is incorporating a single metric to cover the performance of the refrigeration system. DOE noted in the September 2010 SNOPR that the proposed refrigeration test procedure, AHRI 1250 (I–P)-2009, "2009 Standard for Performance Rating of Walk-In Coolers and Freezers," allows manufacturers to test condensing units and unit coolers separately in certain situations, and to calculate the performance of the combined system. DOE anticipated that this approach would reduce the overall testing burden by eliminating the need to test the many possible unit cooler and condensing unit combinations that could comprise a complete refrigeration system. 75 FR 55073 (Sept. 9, 2010). In proposing this approach, DOE also recognized that there could still be some burdens due to system variations. To mitigate these burdens, DOE noted that it might consider allowing manufacturers of refrigeration to use AEDMs to rate their equipment. 75 FR 55089 (Sept. 9, 2010).

In comments on the September 2010 SNOPR, interested parties commented on the burden of testing refrigeration systems because a manufacturer's product line may have many different condensing units and unit coolers, which may be similar, but not identical, and need to be tested individually. Craig Industries stated that even if unit coolers and condensing units could be tested separately, testing each component with all the options available would substantially increase the need for testing and would discourage manufacturers from improving their equipment. (Craig Industries, No. 0068.1 at p. 3) AHRI requested that DOE allow manufacturers to rate their equipment and demonstrate compliance with the Federal standard through the use of an AEDM to minimize testing burden. (AHRI, No. 0070.1 at p. 3) Manufacturers were also concerned about how they would rate custom units. Heatcraft stated that refrigeration system manufacturers would face an undue testing burden and asserted that manufacturers would not be able to sell a particular piece of equipment if it had been tested. (Heatcraft, No. 0065.1 at p. 2) DOE acknowledges that when a refrigeration system is tested, it undergoes some modifications in order to accommodate the apparatus for taking test measurements. As a result, these units can no longer be sold as new equipment after testing and are typically destroyed. This situation, in Heatcraft's view, would prevent them from selling custom equipment if the inclusion of a custom piece requires a separate test of the refrigeration system.

DOE recognizes the potential for variability with respect to walk-in components, in terms of their physical characteristics and, consequently, their energy performance or efficiency. To address Craig's concern that testing all equipment variations would be burdensome, and AHRI's request that DOE allow manufacturers to use AEDMs, DOE will continue to consider the application of AEDMs or ARMs. DOE recognizes the value of permitting the use of AEDMs and ARMs in limited instances and may consider the adoption of such methods for walk-in equipment, including the statistical basis and the sample size required to validate them, in a future rulemaking.

D. Other Issues—Definition of Walk-In Cooler or Freezer

EPCA defines walk-in equipment at 42 U.S.C. 6311(20), codified at 10 CFR 431.302.

During the public meeting for the January 2010 NOPR, Hired Hand and several interested parties stated that DOE should clarify the definition of walk-in coolers and walk-in freezers with respect to temperature limits. Multiple interested parties commented that DOE should set an upper temperature limit for walk-ins. After reviewing the comments from interested parties, DOE proposed in the September 2010 SNOPR to modify the definition of "refrigerated" within the definition of walk-in cooler or freezer to mean at or below 55 °F. 75 FR 55068, 55069 (Sept. 9, 2010).

The Joint Utilities, AHRI, American Panel, the Joint Manufacturers, NEEA, Craig Industries, Thermo-Kool, Master-Bilt, and Bally agreed to the proposed upper temperature limit of 55 °F for walk-ins. (Joint Utilities, No. 0059.1 at p. 6; AHRI, No. 0070.1 at p. 1; American Panel, No. 0057.1 at p. 1; Joint Manufacturers, No. 0062.1 at p. 1, NEEA, No. 0061.1 at p. 2; Craig Industries, No. 0068.1 at p. 1; Thermo-Kool, No. 0072.1 at p. 1; Master-Bilt, No. 0069.1 at p. 1; Bally, No. 0078.1 at p. 1) The Joint Utilities also recommended that DOE develop definitions for walk-in coolers and freezers that are similar to California Title 24, Buildings Efficiency Standards, which contain a

definition for "refrigerated warehouse" that clarifies a temperature of 55 degrees or less. (Joint Utilities, No. 0059.1 at p. 6) NEEA suggested that walk-in coolers and freezers are essentially buildings and should be modeled as such. (NEEA, No. 0061.1 at p. 5)

DOE notes that any regulation it develops must be consistent with, and fall within the parameters of, the statutory provisions set by Congress. Working within the confines of the statutorily-prescribed definition of the walk-in definition, DOE is clarifying what the term "refrigerated" means in the context of the walk-in definition to help address the concerns raised by commenters. In particular, DOE is defining "refrigerated" for purposes of walk-ins to mean "held at a temperature at or below 55 degrees Fahrenheit using a refrigeration system" as suggested by commenters. Adopting this approach should enable DOE to sufficiently account for the range of walk-in equipment that exist.

In comments on the January 2010 NOPR, interested parties expressed concern about the potential for abuse in light of the breadth of the exclusion in the statute and requested that DOE clarify the scope of this clause. At the public meeting for the January 2010 NOPR, Craig Industries stated that the definition of "medical, scientific, and research walk-ins" should be better defined, and Hired Hand agreed that the definition is unclear. (Craig Industries, Public Meeting Transcript, No. 0016 at p. 19; Hired Hand, Public Meeting Transcript, No. 0016 at p. 26) These commenters were concerned because the current statutory language does not account for the fact that, in practice, walk-ins may be used interchangeably for either food storage or medical, scientific, or research usage. Because a given walk-in sold by a company could be used in any of these types of applications, Craig Industries and Hired Hand were both concerned that a company could market its walk-in as medical equipment and avoid having to meet any energy efficiency standards. Craig Industries and Hired Hand requested that DOE work to improve the definition of exempted uses for walk-ins because the definition could create ambiguity and loopholes. (Craig Industries, Public Meeting Transcript, No. 0016 at p. 4; Hired Hand, No. 0051.1 at p. 2)

DOE is sensitive to the potential for abuse regarding walk-ins. To ensure that such abuse does not occur and to help clarify the scope of the exclusion created by Congress, DOE notes that for any walk-in—including those components that are covered by today's test procedure and any applicable standards that DOE may promulgate—a manufacturer seeking to avail itself of the statutory exclusion would, consistent with the statute, need to affirmatively demonstrate to DOE that its equipment is "designed and marketed exclusively for medical, scientific, or research purposes." 42 U.S.C. 6311(20)(B). Further, while DOE is currently unaware of any instances where this exclusion is being abused, DOE will monitor the situation and take steps to prevent these types of activities from occurring when it receives sufficient information substantiating the existence of such activities. In examining whether a given walk-in satisfies the statutory exclusion, DOE may consider a number of factors, including, but not limited to, how a particular walk-in has been designed, how it has been marketed, to whom the equipment has been distributed, and steps taken by manufacturers. Accordingly, while DOE appreciates the concerns raised by Craig Industries and Hired Hand, DOE has decided that, at this time, the exclusion set by Congress is sufficiently clear. DOE may revisit this issue in the future if necessary.

One commenter requested clarification of the 3,000 square foot provision. Bally suggested that DOE add a corroborating cubic foot threshold, and stated that the large variability in panel heights could impact the energy conservation standards. (Bally, No. 0078.1 at p. 1) Under the component-level test procedures established today, a cubic foot threshold for a walk-in is not necessary. Rather, a panel is considered as an individual component and its dimensions, including its height, are accounted for in the calculation methodology that DOE developed.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Office of Management and Budget has determined that test procedure rulemakings do not constitute "significant regulatory actions" under section 3(f) of Executive Order 12866, Regulatory Planning and Review, 58 FR 51735 (Oct. 4, 1993). Accordingly, this 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 (IFRA) for any rule that by law must be proposed for public comment, unless the agency certifies that the 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 DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site: *http://www.gc.doe.gov.*

DOE reviewed the test procedures considered in today's final rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003.

As discussed in detail below, DOE found that because these test procedures have not previously been required of manufacturers, all manufacturers, including small manufacturers, could experience a financial burden associated with new testing requirements. While examining this issue, DOE determined that it could not certify that this rule would not have a significant effect on a substantial number of small entities. Therefore, DOE prepared an Initial Regulatory Flexibility Analysis (IRFA) for this rulemaking. 75 FR 55068, 55087. The Final Regulatory Flexibility Analysis (FRFA) set forth below, which describes potential impacts on small businesses associated with walk-in cooler and freezer testing requirements, incorporates the IRFA and changes made to the IRFA in response to the comments from interested parties, including the Small Business Administration (SBA), on the September 2010 SNOPR.

1. Statement of the Need for, and Objectives of, the Rule

A statement of the need for, and objectives of, the rule is stated elsewhere in the preamble and not repeated here.

2. Summary of the Significant Issues Raised by the Public Comments, DOE's Response to These Issues, and Any Changes Made in the Proposed Rule as a Result of Such Comments

The comments received on the IRFA and the economic impacts of the rule and responses thereto are provided in the analysis below.

3. Description and Estimated Number of Small Entities Regulated

DOE uses the SBA small business size standards published on January 31, 1996, as amended, to determine whether any small entities would be required to comply with the rule. 61 FR 3286; see also 65 FR 30836, 30850 (May 15, 2000), as amended. 65 FR 53533, 53545 (September 5, 2000). The size standards are codified at 13 CFR Part 121. The standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *http://www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.pdf.*

In the January 2010 NOPR and September 2010 SNOPR, DOE classified walk-in cooler and freezer equipment manufacturing under NAICS 333415, "Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing," which has a size standard of 750 employees. 75 FR 186, 204 (Jan. 4, 2010) and 75 FR 55068, 55087 (Sept. 9, 2010). After reviewing industry sources and publicly available data, DOE identified at least 37 small manufacturers of walk-in cooler and freezer envelopes and at least 5 small manufacturers of walk-in cooler and freezer refrigeration systems that met this criterion. DOE also noted that the walk-in industry can be characterized by a few manufacturers that are subsidiaries of much larger companies (that would not be considered small businesses) and a large number of small companies as categorized by NAICS code 333415. Furthermore, more than half of small walk-in manufacturers have 100 or fewer employees. 75 FR at 55088 (Sept. 9, 2010).

Interested parties commented on the market characterization DOE presented in the September 2010 SNOPR. SBA agreed with DOE's characterization of the walk-in manufacturing industry. (SBA, No. 0066.1 at p. 2) American Panel stated that most walk-in companies are small businesses and would be at a disadvantage compared to the large conglomerates. American Panel characterized the majority of small walk-in manufacturers as making between $10 and $25 million in sales while large manufacturers represent $75 million in walk-in sales and $250 million in overall sales. (American Panel, No. 0057.1 at p. 3) American Panel stated that the cost of testing would be passed down to the product selling price, which would trickle down and seriously impact small business restaurant owners. (American Panel, No. 0057.1 at p. 4) Zero Zone agreed that small manufacturers would be impacted by the regulations and stated that many will not be able to stay in business once they are burdened with the costs of certification. (Zero Zone, No. 0077.1 at p. 2)

In response to comments on the January 2010 NOPR and September 2010 SNOPR regarding DOE's proposed standards for WICF, DOE is taking a component-level approach in the WICF test procedure rulemaking. Specifically, DOE is establishing test procedures for individual components of a walk-in: Panels, doors, and refrigeration systems. Manufacturers of these components will be required to test the components they manufacture for walk-ins and certify that they meet any applicable component performance standard. This approach will mitigate the overall burdens posed by this regulation and ensure that those burdens are borne on those manufacturers who are best suited and positioned to conduct these types of tests. See section III.A for further details on this approach.

As a result of this approach, DOE re-evaluated the number of small manufacturers it identified in the September 2010 SNOPR for this final rule. Because DOE is considering refrigeration systems as a single component under the proposed approach, DOE estimates that there are 4 small manufacturers of refrigeration systems. Furthermore, DOE notes that entities it previously considered walk-in envelope manufacturers also manufacture the panels. As a result, DOE estimates that there are 37 small manufacturers of panels. For doors, DOE notes that some of the panel manufacturers make doors and others buy doors from suppliers. DOE researched manufacturers who solely manufacture the doors of WICF, and estimates that there are four small manufacturers of walk-in doors who do not also manufacture panels. DOE notes SBA's and American Panel's characterization of the walk-in industry as being composed mainly of small manufacturers. DOE believes the new approach of regulating WICFs at the component level will reduce burden on small manufacturers because the testing and compliance burden will be reduced due to an enhanced ability to apply the basic model concept. *See* section III.A.3.a for details. In response to American Panel's comment that the cost of testing would affect small restaurant owners, DOE notes that this analysis considers entities who are directly regulated by this test procedure rulemaking (*i.e.,* manufacturers). The concurrent energy conservation standards rulemaking will address effects on walk-in manufacturers' customers.

4. Description and Estimate of Compliance Requirements and Description of Steps To Minimize the Economic Impact on Small Entities

DOE recognizes the particular burden of the test procedures on small manufacturers. DOE does not expect that small manufacturers would have fewer basic models or component types than large manufacturers. Therefore, a small manufacturer could have the same total cost of testing as a large manufacturer, but this cost would be a higher percentage of a small manufacturer's annual revenues. Thus, the differential impact associated with walk-in cooler and walk-in freezer test procedures on small businesses may be significant even if the overall testing burden is reduced as described elsewhere in the preamble.

Due to the nature of walk-in coolers and freezers within the appliance standards program, DOE is considering use of a component-based approach to walk-in standards, setting individual performance standards for each component. This approach would require the component manufacturers to test the components they manufacture for walk-in applications, comply with the applicable performance standard for those components, and certify to DOE that those components meet the standard. See section III.A for details on this approach. At this time there are no performance standards in place for walk-in equipment, as those standards are being developed in a concurrent rulemaking. Details on the performance standards rulemaking can be found on the DOE Web site at *http://www1.eere.energy.gov/buildings/appliance_standards/commercial/wicf.html.* However, manufacturers will be required to use these test procedures to certify performance once any final standards are issued and must use the test procedures outlined in this final rule if they make representations as to the performance of their components.

To further address concerns about costs, DOE is anticipating developing a sampling plan in a future rulemaking to determine how many units of each walk-in component must be tested. In such a rulemaking, DOE will consider the impacts to small businesses.

a. Panel and Door Manufacturer Testing Impacts

In the September 2010 SNOPR, DOE proposed to require envelope manufacturers to test their equipment in accordance with several industry test standards: ASTM C1363–05, "Standard

Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus;" DIN EN 13164:2009–02, "Thermal insulation products for buildings—Factory made products of extruded polystyrene foam (XPS)—Specification;" DIN EN 13165:2009–02, "Thermal insulation products for buildings—Factory made rigid polyurethane foam (PUR) products—Specification;" and NFRC 100–2010[E0A1], "Procedure for Determining Fenestration Product U-factors."

DOE spoke with industry experts to determine the approximate cost of each test. Under the new component level approach to testing, entire walk-ins are not required to be tested or certified. Rather, component manufacturers are required to test and certify their own components. Therefore, DOE evaluated the cost of each test to the component manufacturer. For foam used in panels, a test using DIN EN 13164:2009–02 or DIN EN 13165:2009–02 costs approximately $5,000 for each type of foam, though DOE has found that most manufacturers use only one type. The test result would be used to calculate the LTTR for all the manufacturer's panels that use that type of foam. For the panels themselves, a test using ASTM C1363–05 costs approximately $5,000. Manufacturers would need to test the core and edge U-factor of a pair of 4 ft. by 8 ft. panels, for each foam type, frame type, and panel thickness they manufacture. DOE estimated that manufacturers use either one or two types of foam and may have up to nine different combinations of frame type and panel thickness. Using this estimate, the total cost of testing compliance with a panel standard could be up to an average of $5,000–$10,000 for the foam panels and $45,000 to test the U-factors of the different panel configurations. However, for manufacturers who have fewer unique combinations of frame type and panel thickness, the testing cost would be substantially less. DOE has incorporated other burden reducing measures to reduce cost. Specifically, it incorporated a method that allows manufacturers to test a reference panel that is 4 ft. by 8 ft. and then calculate the U-factor of other panels of different dimensions from those test results as long as certain aspects of the panels are the same. See section III.B.2 for details.

For doors, a test of door U-factor using NFRC 100 costs approximately $5,000. DOE estimates that a typical door manufacturer would have to certify up to 20 to 40 basic models of doors, which would cost $100,000 to $200,000 if each door were to be physically tested. However, NFRC 100 also permits computer modeling of a door's U-factor, which could further reduce the testing cost. See section III.B.3 for discussion of the NFRC testing requirements for doors.

The estimated costs only include the cost of one test on each basic model, and do not include additional testing on the same basic model that may be required as part of a sampling plan. As mentioned above, DOE anticipates developing sampling plans in a future rulemaking to determine how many tests need to be performed on the same type of envelope component, to ensure the test results are repeatable and statistically valid.

b. Refrigeration System Manufacturer Testing Impacts

The test procedure for refrigeration systems will require manufacturers to perform testing in accordance with a single industry test standard: AHRI 1250 (I–P)–2009, "2009 Standard for Performance Rating of Walk-In Coolers and Freezers." DOE researched the cost of performing this test and, based on discussions with experts, estimates that a test using AHRI 1250 (I–P)–2009 would likely cost approximately $8,500. DOE estimates that the total testing cost for a typical refrigeration manufacturer could be approximately $425,000, based on an estimate of 50 basic models, but that it could be higher for manufacturers of more customized equipment. For instance, a manufacturer with 200 basic models would incur a testing cost of approximately $1.7 million.

To address concerns of manufacturer impact, DOE is including burden-reducing measures for refrigeration system manufacturers. The test procedure referenced in this final rule, AHRI 1250–2009, allows for rating the condensing unit and the unit cooler separately and then calculating their combined efficiency. This reduces testing burden by not requiring testing of every combination. Allowing such a calculation to be used will significantly decrease the number of tests. See section III.C.2 for details. DOE also notes that the CCE final rule, published March 7, 2011, allows that in general, manufacturers may elect to group individual models of equipment into basic models at their discretion to the extent the models have essentially identical electrical, physical, and functional characteristics that affect energy efficiency or energy consumption. Furthermore, manufacturers may rate models conservatively, meaning the tested performance of the model(s) must be at least as good as the certified rating, after applying the appropriate sampling plan. 76 FR 12429. DOE believes these provisions will reduce the burden of testing for refrigeration manufacturers because they will reduce the number of basic models a manufacturer must test. DOE may also consider allowing manufacturers to use validated alternative methods to rate their equipment. See section III.C.3 for further discussion of these methods.

DOE also considered a number of alternatives to these test procedures, including test procedures that incorporate industry test standards other than the referenced standards, DIN EN 13164:2009–02, DIN EN 13165:2009–02, ASTM C1363–05, and AHRI 1250–2009, all previously described in section III. (DOE also notes that NFRC 100, the test method adopted for determining the U-factor of doors, was the least burdensome test DOE identified.) Instead of requiring DIN EN 13164:2009–02 or DIN EN 13165:2009–02 for testing the long-term thermal properties of insulation, DOE could require only ASTM C518–04, "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus," which tests the thermal properties of insulation at a certain point in time (that is, the point of manufacture). This test could also be used in place of ASTM 1363–05. A test conducted as per ASTM C518–04 would cost approximately $500 to $1,000, as compared to $5,000 for a test conducted as per DIN EN 13164:2009–02 or DIN EN 13165:2009–02 and $5,000 for a test conducted as per ASTM C1363–05. DOE is including ASTM C1363–05 as part of the test procedure because heat conduction through structural members is a significant panel characteristic that is not addressed under ASTM C518–04. See section III.B.2.a for details. DOE is including DIN EN 13164:2009–02 and DIN EN 13165:2009–02 as part of the test procedure because these methods account for the effect of aging on foam's insulation performance, a phenomenon that is not captured under ASTM C518–04. See section III.B.2.b for details.

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of walk-in cooler and walk-in freezer components must certify to DOE that their equipment complies with any applicable energy conservation standard. In certifying compliance, manufacturers must test their equipment according to the DOE test procedure for walk-in cooler and walk-in freezer components, including any amendments adopted for that test procedure. DOE has adopted regulations

for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including walk-in cooler and walk-in freezer components. 76 FR 12442 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping has been approved by OMB under control number 1910–1400. The public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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 Charles Llenza (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 final rule, DOE establishes a new test procedure for walk-in coolers and walk-in freezers. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this rule establishes a test procedure without affecting the amount, quality or distribution of energy usage, and, therefore, will not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A5 under 10 CFR part 1021, subpart D, which applies to any rulemaking that does 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," 64 FR 43255 (August 4, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE examined this 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. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

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

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For 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 a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a 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 small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *http://www.gc.doe.gov.* DOE examined today's final rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of $100 million or more in any year, so these requirements do not apply.

H. Review Under theTreasury 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 will 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 will not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

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

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for 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 final rule under the 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 OMB, a Statement of Energy Effects for any significant energy action. A "significant energy action" is defined as any action by an agency that promulgated 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. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

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

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

The procedures addressed by this action incorporate the following commercial standards: ASTM C1363–05, AHRI 1250 (I–P)–2009, DIN EN 13164:2009–02, DIN EN 13165:2009–02, and NFRC 100–2010[E0A1]. DOE has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA (i.e. whether they were 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).

N. Approval of the Office of the Secretary

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

List of Subjects in 10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation, Incorporation by reference, Reporting and recordkeeping requirements.

Issued in Washington, DC, on March 30, 2011.

Kathleen Hogan,

Deputy Assistant Secretary for Energy Efficiency, Office of Technology Development, Energy Efficiency and Renewable Energy.

PART 431—ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291–6317.

■ 2. Section 431.302 is amended by adding, in alphabetical order, new definitions for "Display door," "Display panel," "Door", "Envelope," "K-factor," "Panel," "Refrigerated," "Refrigeration system," and "U-factor" to read as follows:

§ 431.302 Definitions concerning walk-in coolers and walk-in freezers.

* * * * *

Display door means a door designed for product movement, display, or both, rather than the passage of persons.

Display panel means a panel that is entirely or partially comprised of glass, a transparent material, or both and is used for display purposes.

Door means an assembly installed in an opening on an interior or exterior wall that is used to allow access or close off the opening and that is movable in a sliding, pivoting, hinged, or revolving manner of movement. For walk-in coolers and walk-in freezers, a door includes the door panel, glass, framing materials, door plug, mullion, and any other elements that form the door or part of its connection to the wall.

Envelope means—

(1) The portion of a walk-in cooler or walk-in freezer that isolates the interior, refrigerated environment from the ambient, external environment; and

(2) All energy-consuming components of the walk-in cooler or walk-in freezer that are not part of its refrigeration system.

K-factor means the thermal conductivity of a material.

* * * * *

Panel means a construction component that is not a door and is used to construct the envelope of the walk-in, i.e., elements that separate the interior refrigerated environment of the walk-in from the exterior.

Refrigerated means held at a temperature at or below 55 degrees Fahrenheit using a refrigeration system.

Refrigeration system means the mechanism (including all controls and other components integral to the

system's operation) used to create the refrigerated environment in the interior of a walk-in cooler or freezer, consisting of:

(1) A packaged dedicated system where the unit cooler and condensing unit are integrated into a single piece of equipment; or

(2) A split dedicated system with separate unit cooler and condensing unit sections; or

(3) A unit cooler that is connected to a multiplex condensing system.

U-factor means the heat transmission in a unit time through a unit area of a specimen or product and its boundary air films, induced by a unit temperature difference between the environments on each side.

* * * * *

■ 3. Section 431.303 is amended by:

■ a. Redesignating paragraph (b) as paragraph (c);

■ b. Adding at the end of the sentence in redesignated paragraph (c)(1), "and Appendix A to Subpart R of Part 431".

■ c. Adding new paragraphs (b), (c)(2), (d), and (e) to read as follows.

§ 431.303 Materials incorporated by reference.

* * * * *

(b) *AHRI.* Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Boulevard, Suite 500, Arlington, VA 22201, (703) 600–0366, or *http://www.ahrinet.org.*

(1) AHRI 1250 (I–P)-2009, ("AHRI 1250"), 2009 Standard for Performance Rating of Walk-In Coolers and Freezers, approved 2009, IBR approved for § 431.304.

(2) [Reserved]

(c) * * *

(2) ASTM C1363–05, ("ASTM C1363"), Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus, approved May 1, 2005, IBR approved for Appendix A to Subpart R of part 431.

(d) *CEN.* European Committee for Standardization (French: Norme or German: Norm), Avenue Marnix 17, B–1000 Brussels, Belgium, *Tel:* + 32 2 550 08 11, *Fax:* + 32 2 550 08 19 or *http://www.cen.eu/.*

(1) DIN EN 13164:2009–02, ("DIN EN 13164"), Thermal insulation products for buildings—Factory made products of extruded polystyrene foam (XPS)—Specification, approved February 2009, IBR approved for Appendix A to Subpart R of part 431.

(2) DIN EN 13165:2009–02, ("DIN EN 13165"), Thermal insulation products for buildings—Factory made rigid polyurethane foam (PUR) products—Specification, approved February 2009, IBR approved for Appendix A to Subpart R of part 431.

(e) *NFRC.* National Fenestration Rating Council, 6305 Ivy Lane, Ste. 140, Greenbelt, MD 20770, (301) 589–1776, or *http://www.nfrc.org/.*

(1) NFRC 100–2010[E0A1], ("NFRC 100"), Procedure for Determining Fenestration Product U-factors, approved June 2010, IBR approved for Appendix A to Subpart R of part 431.

(2) [Reserved]

■ 4. Section 431.304 is amended by redesignating paragraphs (b)(2), (b)(3), (b)(4), and (b)(5) as (b)(1), (b)(2), (b)(3), and (b)(4), respectively, and by adding new paragraphs (b)(5), (b)(6), (b)(7), and (b)(8) to read as follows.

§ 431.304 Uniform test method for the measurement of energy consumption of walk-in coolers and walk-in freezers.

* * * * *

(b) * * *

(5) Determine the U-factor, conduction load, and energy use of walk-in cooler and walk-in freezer display panels, floor panels, and non-floor panels by conducting the test procedure set forth in Appendix A to this subpart, sections 4.1, 4.2, and 4.3, respectively.

(6) Determine the energy use of walk-in cooler and walk-in freezer display doors and non-display doors by conducting the test procedure set forth in Appendix A to this subpart, sections 4.4 and 4.5, respectively.

(7) Determine the Annual Walk-in Energy Factor of walk-in cooler and walk-in freezer refrigeration systems by conducting the test procedure set forth in AHRI 1250 (incorporated by reference; see § 431.303).

(8) Determine the annual energy consumption of walk-in cooler and walk-in freezer refrigeration systems:

(i) For systems consisting of a packaged dedicated system or a split dedicated system, where the condensing unit is located outdoors, by conducting the test procedure set forth in AHRI 1250 and recording the annual energy consumption term in the equation for annual walk-in energy factor in section 7 of AHRI 1250:

$$\text{Annual Energy Consumption} = \sum_{j=1}^{n} E(t_j)$$

where t_j and n represent the outdoor temperature at each bin j and the number of hours in each bin j, respectively, for the temperature bins listed in Table D1 of AHRI 1250.

(ii) For systems consisting of a packaged dedicated system or a split dedicated system where the condensing unit is located in a conditioned space, by performing the following calculation:

$$\text{Annual Energy Consumption} = \left(\frac{0.33 \times \mathring{BLH} + 0.67 \times \mathring{BLL}}{\text{Annual Walk-in Energy Factor}}\right) \times 8760$$

where $\mathring{BLH}$ and $\mathring{BLL}$ for refrigerator and freezer systems are defined in sections 6.2.1 and 6.2.2, respectively, of AHRI 1250 and the annual walk-in energy factor is calculated from the results of the test procedures set forth in AHRI 1250.

(iii) For systems consisting of a single unit cooler or a set of multiple unit coolers serving a single piece of equipment and connected to a multiplex condensing system, by performing the following calculation:

$$\text{Annual Energy Consumption} = \left(\frac{0.33 \times \dot{BLH} + 0.67 \times \dot{BLL}}{\text{Annual Walk-in Energy Factor}}\right) \times 8760$$

where $\dot{BLH}$ and $\dot{BLL}$ for refrigerator and freezer systems are defined in section 7.9.2.2 and 7.9.2.3, respectively, of AHRI 1250 and the annual walk-in energy factor is calculated from the results of the test procedures set forth in AHRI 1250.

■ 5. Appendix A to subpart R of part 431 is added to read as follows:

Appendix A to Subpart R of Part 431—Uniform Test Method for the Measurement of Energy Consumption of the Components of Envelopes of Walk-In Coolers and Walk-In Freezers

1.0 Scope

This appendix covers the test requirements used to measure the energy consumption of the components that make up the envelope of a walk-in cooler or walk-in freezer.

2.0 Definitions

The definitions contained in § 431.302 are applicable to this appendix.

3.0 Additional Definitions

3.1 Automatic door opener/closer means a device or control system that "automatically" opens and closes doors without direct user contact, such as a motion sensor that senses when a forklift is approaching the entrance to a door and opens it, and then closes the door after the forklift has passed.

3.2 Core region means the part of the panel that is not the edge region.

3.3 Edge region means a region of the panel that is wide enough to encompass any framing members and edge effects. If the panel contains framing members (e.g. a wood frame) then the width of the edge region must be as wide as any framing member plus 2 in. ± 0.25 in. If the panel does not contain framing members then the width of the edge region must be 4 in. ± 0.25 in. For walk-in panels that utilize vacuum insulated panels (VIP) for insulation, the width of the edge region must be the lesser of 4.5 in. ± 1 in. or the maximum width that does not cause the VIP to be pierced by the cutting device when the edge region is cut.

3.4 Surface area means the area of the surface of the walk-in component that would be external to the walk-in. For example, for panel, the surface area would be the area of the side of the panel that faces the outside of the walk-in. It would not include edges of the panel that are not exposed to the outside of the walk-in.

3.5 Rating conditions means, unless explicitly stated otherwise, all conditions shown in Table A.1. For installations where two or more walk-in envelope components share any surface(s), the "external conditions" of the shared surface(s) must reflect the internal conditions of the adjacent walk-in. For example, if a walk-in component divides a walk-in freezer from a walk-in cooler, then the internal conditions are the freezer rating conditions and the external conditions are the cooler rating conditions.

3.6 Percent time off (PTO) means the percent of time that an electrical device is assumed to be off.

TABLE A.1—TEMPERATURE CONDITIONS

	Value
Internal Temperatures (cooled space within the envelope):	
Cooler Dry Bulb Temperature ..	35 °F
Freezer Dry Bulb Temperature	−10 °F
External Temperatures (space external to the envelope):	
Freezer and Cooler Dry Bulb Temperatures.	75 °F
Subfloor Temperatures:	
Freezer and Cooler Dry Bulb Temperatures.	55 °F

4.0 Calculation Instructions

4.1 Display Panels

(a) Calculate the U-factor of the display panel in accordance with section 5.3 of this appendix, Btu/h-ft² – °F.

(b) Calculate the display panel surface area, as defined in section 3.4 of this appendix, A_{dp}, ft², with standard geometric formulas or engineering software.

(c) Calculate the temperature differential, ΔT_{dp}, °F, for the display panel, as follows:

$$\Delta T_{dp} = \left|T_{DB,ext,dp} - T_{DB,int,dp}\right| \qquad (4\text{-}1)$$

Where:

$T_{DB,ext,dp}$ = dry-bulb air external temperature, °F, as prescribed in Table A.1; and

$T_{DB,int,dp}$ = dry-bulb air temperature internal to the cooler or freezer, °F, as prescribed in Table A.1.

(d) Calculate the conduction load through the display panel, $Q_{cond\text{-}dp}$, Btu/h, as follows:

$$Q_{cond,dp} = A_{dp} \times \Delta T_{dp} \times U_{dp} \qquad (4\text{-}2)$$

Where:

A_{dp}= surface area of the walk-in display panel, ft²;

ΔT_{dp}= temperature differential between refrigerated and adjacent zones, °F; and

U_{dp} = thermal transmittance, U-factor, of the display panel in accordance with section 5.3 of this appendix, Btu/h-ft² – °F.

(e) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(f) Calculate the total daily energy consumption, E_{dp}, kWh/day, as follows:

$$E_{dp} = \frac{Q_{cond,dp}}{EER} \times \frac{24\ \text{h} \times 1\ \text{kW}}{1\ \text{day} \times 1000\ \text{W}} \qquad (4\text{-}3)$$

Where:

$Q_{cond,dp}$ = the conduction load through the display panel, Btu/h; and

EER = EER of walk-in (cooler or freezer), Btu/W-h.

4.2 Floor Panels

(a) Calculate the surface area, as defined in section 3.4 of this appendix, of the floor panel edge, as defined in section 3.3, $A_{fp\ edge}$, ft², with standard geometric formulas or engineering software as directed in section 5.1 of this appendix.

(b) Calculate the surface area, as defined in section 3.4 of this appendix, of the floor panel core, as defined in section 3.2, $A_{fp\ core}$, ft², with standard geometric formulas or

engineering software as directed in section 5.1 of this appendix.

(c) Calculate the total area of the floor panel, A_{fp}, ft², as follows:

$$A_{fp} = A_{fp\ core} + A_{fp\ edge} \quad (4\text{-}4)$$

Where:

$A_{fp\ core}$ = floor panel core area, ft²; and

$A_{fp\ edge}$ = floor panel edge area, ft².

(d) Calculate the temperature differential of the floor panel, ΔT_{fp}, °F, as follows:

$$\Delta T_{fp} = |T_{ext,fp} - T_{DB,int,fp}| \quad (4\text{-}5)$$

Where:

$T_{ext,\ fp}$ = subfloor temperature, °F, as prescribed in Table A.1; and

$T_{DB,int,\ fp}$ = dry-bulb air internal temperature, °F, as prescribed in Table A.1. If the panel spans both cooler and freezer temperatures, the freezer temperature must be used.

(e) Calculate the floor foam degradation factor, DF_{fp}, unitless, as follows:

$$DF_{fp} = \frac{R_{LTTR,fp}}{R_{0,fp}} \quad (4\text{-}6)$$

Where:

$R_{LTTR,fp}$ = the long term thermal resistance R-value of the floor panel foam in accordance with section 5.2 of this appendix, h-ft²-°F/Btu; and

$R_{o,fp}$ = the R-value of foam determined in accordance with ASTM C518 (incorporated by reference; see section § 431.303) for purposes of compliance with the appropriate energy conservation standard, h-ft²-°F/Btu.

(f) Calculate the U-factor for panel core region modified by the long term thermal transmittance of foam, $U_{LT,fp\ core}$, Btu/h-ft² – °F, as follows:

$$U_{LT,fp\ core} = \frac{U_{fp\ core}}{DF_{fp}} \quad (4\text{-}7)$$

Where:

$U_{fp\ core}$ = the U-factor in accordance with section 5.1 of this appendix, Btu/h-ft²-°F; and

DF_{fp} = floor foam degradation factor, unitless.

(g) Calculate the overall U-factor of the floor panel, U_{fp}, Btu/h-ft²-°F, as follows:

$$U_{fp} = \frac{A_{fp\ edge} \times U_{fp\ edge} + A_{fp\ core} \times U_{LT,fp\ core}}{A_{fp}} \quad (4\text{-}8)$$

Where:

$A_{fp\ edge}$ = area of floor panel edge, ft²;

$U_{fp\ edge}$ = U-factor for panel edge area in accordance with section 5.1 of this appendix, Btu/h-ft²-°F;

$A_{fp\ core}$ = area of floor panel core, ft²;

$U_{LT,fp\ core}$ = U-factor for panel core region modified by the long term thermal transmittance of foam, Btu/h-ft²-°F; and

A_{fp} = total area of the floor panel, ft².

(h) Calculate the conduction load through floor panels, $Q_{cond\text{-}fp}$, Btu/h,

$$Q_{cond-fp} = \Delta T_{fp} \times A_{fp} \times U_{fp} \quad (4\text{-}9)$$

Where:

ΔT_{fp} = temperature differential across the floor panels, °F;

A_{fp} = total area of the floor panel, ft²; and

U_{fp} = overall U-factor of the floor panel, Btu/h-ft²-°F.

(i) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(j) Calculate the total daily energy consumption, E_{fp}, kWh/day, as follows:

$$E_{fp} = \frac{Q_{cond-fp}}{EER} \times \frac{24\ h \times 1\ kW}{1\ day \times 1000\ W} \quad (4\text{-}10)$$

Where:

$Q_{cond\text{-}fp}$ = the conduction load through the floor panel, Btu/h; and

EER = EER of walk-in (cooler or freezer), Btu/W-h.

4.3 Non-Floor Panels

(a) Calculate the surface area, as defined in section 3.4, of the non-floor panel edge, as defined in section 3.3, $A_{nf\ edge}$, ft², with standard geometric formulas or engineering software as directed in section 5.1 of this appendix.

(b) Calculate the surface area, as defined in section 3.4, of the non-floor panel core, as defined in section 3.2, $A_{nf\ core}$, ft², with standard geometric formulas or engineering software as directed in section 5.1 of this appendix.

(c) Calculate total non-floor panel area, A_{nf}, ft²:

$$A_{nf} = A_{nf\ edge} + A_{nf\ core} \quad (4\text{-}11)$$

Where:

$A_{nf\ edge}$ = non-floor paneledge area,ft²; and

$A_{nf\ core}$ = non-floor panel core area, ft².

(d) Calculate temperature differential, ΔT_{nf}, °F:

$$\Delta T_{nf} = |T_{DB,ext,nf} - T_{DB,int,nf}| \quad (4\text{-}12)$$

Where:

$T_{DB,ext,\ nf}$ = dry-bulb air external temperature, °F, as prescribed in Table A.1; and

$T_{DB,int,\ nf}$ = dry-bulb air internal temperature, °F, as prescribed in Table A.1. If the non-floor panel spans both cooler and freezer temperatures, then the freezer temperature must be used.

(e) Calculate the non-floor foam degradation factor, DF_{nf}, unitless, as follows:

$$DF_{nf} = \frac{R_{LTTR,nf}}{R_{o,nf}} \quad (4\text{-}13)$$

Where:

$R_{LTTR,nf}$ = the R-value of the non-floor panel foam in accordance with section 5.2 of this appendix, h-ft²-°F/Btu; and

$R_{o,nf}$ = the R-value of foam determined in accordance with ASTM C518 (incorporated by reference; see section § 431.303) for purposes of compliance with the appropriate energy conservation standard, h-ft²-°F/Btu.

(f) Calculate the U-factor, $U_{LT,nf\ core}$, Btu/h-ft²-°F, as follows:

$$U_{LT,nf\ core} = \frac{U_{nf\ core}}{DF_{nf}} \qquad (4\text{-}14)$$

Where:

$U_{nf\ core}$ = the U-factor, in accordance with section 5.1 of this appendix, of non-floor panel, Btu/h- ft²-°F; and

DF_{nf} = the non-floor foam degradation factor, unitless.

(g) Calculate the overall U-factor of the non-floor panel, U_{nf}, Btu/h-ft²-°F, as follows:

$$U_{nf} = \frac{A_{nf\ edge} \times U_{nf\ edge} + A_{nf\ core} \times U_{LT,nf\ core}}{A_{nf}} \qquad (4\text{-}15)$$

Where:

$A_{nf\ edge}$ = area of non-floor panel edge, ft²;

$U_{nf\ edge}$ = U-factor for non-floor panel edge area in accordance with section 5.1 of this appendix, Btu/h-ft²-°F;

$A_{nf\ core}$ = area of non-floor panel core, ft²;

$U_{LT,nf\ core}$ = U-factor for non-floor panel core region modified by the long term thermal transmittance of foam, Btu/h-ft²-°F; and

A_{nf} = total area of the non- floor panel, ft².

(h) Calculate the conduction load through non-floor panels, $Q_{cond\text{-}nf}$, Btu/h,

$$Q_{cond-nf} = \Delta T_{nf} \times A_{nf} \times U_{nf} \qquad (4\text{-}16)$$

Where:

ΔT_{nf} = temperature differential across the non-floor panels, °F;

A_{nf} = total area of the non-floor panel, ft²; and

U_{nf} = overall U-factor of the non-floor panel, Btu/h-ft²-°F.

(i) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(j) Calculate the total daily energy consumption, E_{nf}, kWh/day, as follows:

$$E_{nf} = \frac{Q_{cond-nf}}{EER} \times \frac{24\ h \times 1\ kW}{1\ day \times 1000\ W} \qquad (4\text{-}17)$$

Where:

$Q_{cond\text{-}nf}$ = the conduction load through the non-floor panel, Btu/h; and

EER = EER of walk-in (cooler or freezer), Btu/W-h.

4.4 Display Doors

4.4.1 Conduction Through Display Doors

(a) Calculate the U-factor of the door in accordance with section 5.3 of this appendix, Btu/h-ft²-°F

(b) Calculate the surface area, as defined in section 3.4 of this appendix, of the display door, A_{dd}, ft², with standard geometric formulas or engineering software.

(c) Calculate the temperature differential, ΔT_{dd}, °F, for the display door as follows:

$$\Delta T_{dd} = \left| T_{DB,ext,dd} - T_{DB,int,dd} \right| \qquad (4\text{-}18)$$

Where:

$T_{DB,ext,\ dd}$ = dry-bulb air temperature external to the display door, °F, as prescribed in Table A.1; and

$T_{DB,int,\ dd}$ = dry-bulb air temperature internal to the display door, °F, as prescribed in Table A.1.

(d) Calculate the conduction load through the display doors, $Q_{cond\text{-}dd}$, Btu/h, as follows:

$$Q_{cond,dd} = A_{dd} \times \Delta T_{dd} \times U_{dd} \qquad (4\text{-}19)$$

Where:

ΔT_{dd} = temperature differential between refrigerated and adjacent zones, °F;

A_{dd} = surface area walk-in display doors, ft²; and

U_{dd} = thermal transmittance, U-factor of the door, in accordance with section 5.3 of this appendix, Btu/h-ft²-°F.

4.4.2 Direct Energy Consumption of Electrical Component(s) of Display Doors

Electrical components associated with display doors could include, but are not limited to: Heater wire (for anti-sweat or anti-freeze application); lights (including display door lighting systems); control system units; and sensors.

(a) Select the required value for percent time off (PTO) for each type of electricity consuming device, PTO_t (%)

(1) For lights without timers, control system or other demand-based control, PTO = 25 percent. For lighting with timers, control system or other demand-based control, PTO = 50 percent.

(2) For anti-sweat heaters on coolers (if included): Without timers, control system or other demand-based control, PTO = 0 percent. With timers, control system or other demand-based control, PTO = 75 percent. For anti-sweat heaters on freezers (if included): Without timers, control system or other auto-shut-off systems, PTO = 0 percent. With timers, control system or other demand-based control, PTO = 50 percent.

(3) For all other electricity consuming devices: Without timers, control system, or other auto-shut-off systems, PTO = 0 percent. If it can be demonstrated that the device is controlled by a preinstalled timer, control system or other auto-shut-off system, PTO = 25 percent.

(b) Calculate the power usage for each type of electricity consuming device, $P_{dd\text{-}comp,u,t}$, kWh/day, as follows:

$$P_{dd-comp,u,t} = P_{rated,u,t} \times (1 - PTO_{u,t}) \times n_{u,t} \times \frac{24h}{day} \qquad (4\text{-}20)$$

Where:

u = the index for each of type of electricity-consuming device located on either (1) the interior facing side of the display door or within the inside portion of the display door, (2) the exterior facing side of the display door, or (3) any combination of (1) and (2). For purposes of this calculation, the interior index is represented by u = int and the exterior index is represented by u = ext. If the electrical component is both on the interior and exterior side of the display door then u = int. For anti-sweat heaters sited anywhere in the display door, 75 percent of the total power is be attributed to u = int and 25 percent of the total power is attributed to u = ext;

t = index for each type of electricity consuming device with identical rated power;

$P_{rated,u,t}$ = rated power of each component, of type t, kW;

$PTO_{u,t}$ = percent time off, for device of type t, %; and

$n_{u,t}$ = number of devices at the rated power of type t, unitless.

(c) Calculate the total electrical energy consumption for interior and exterior power, $P_{dd\text{-}tot,\ int}$ (kWh/day) and $P_{dd\text{-}tot,\ ext}$ (kWh/day), respectively, as follows:

$$P_{dd-tot,int} = \sum_{1}^{t} P_{dd-comp,int,t} \qquad (4\text{-}21)$$

$$P_{dd-tot,ext} = \sum_{1}^{t} P_{dd-comp,ext,t} \qquad (4\text{-}22)$$

Where:

t = index for each type of electricity consuming device with identical rated power;

$P_{dd\text{-}comp,int,\ t}$ = the energy usage for an electricity consuming device sited on the interior facing side of or in the display door, of type t, kWh/day; and

$P_{dd\text{-}comp,ext,\ t}$ = the energy usage for an electricity consuming device sited on the external facing side of the display door, of type t, kWh/day.

(d) Calculate the total electrical energy consumption, $P_{dd\text{-}tot}$, (kWh/day), as follows:

$$P_{dd-tot} = P_{dd-tot,int} + P_{dd-tot,ext} \qquad (4\text{-}23)$$

Where:

$P_{dd\text{-}tot,int}$ = the total interior electrical energy usage for the display door, kWh/day; and

$P_{dd\text{-}tot,ext}$ = the total exterior electrical energy usage for the display door, kWh/day.

4.4.3 Total Indirect Electricity Consumption Due to Electrical Devices

(a) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/Wh

(2) For freezers, use EER = 6.3 Btu/Wh

(b) Calculate the additional refrigeration energy consumption due to thermal output from electrical components sited inside the display door, $C_{dd\text{-}load}$, kWh/day, as follows:

$$C_{dd-load} = P_{dd-tot,int} \times 3.\frac{412}{EER}\frac{Btu}{W-h} \qquad (4\text{-}24)$$

Where:

EER = EER of walk-in cooler or walk-in freezer, Btu/W-h; and

$P_{dd\text{-}tot,int}$ = The total internal electrical energy consumption due for the display door, kWh/day.

4.4.4 Total Display Door Energy Consumption

(a) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(b) Calculate the total daily energy consumption due to conduction thermal load, $E_{dd,\ thermal}$, kWh/day, as follows:

$$E_{dd,thermal} = \frac{Q_{cond,dd}}{EER} \times \frac{24\ h \times 1\ kW}{1\ day \times 1000\ W} \qquad (4\text{-}25)$$

Where:

$Q_{cond,\ dd}$ = the conduction load through the display door, Btu/h; and

EER = EER of walk-in (cooler or freezer), Btu/W-h.

(c) Calculate the total energy, $E_{dd,tot}$, kWh/day,

$$E_{dd,tot} = E_{dd,thermal} + P_{dd-tot} + C_{dd-load} \qquad (4\text{-}26)$$

Where:

$E_{dd,\ thermal}$ = the total daily energy consumption due to thermal load for the display door, kWh/day;

$P_{dd\text{-}tot}$ = the total electrical load, kWh/day; and

$C_{dd\text{-}load}$ = additional refrigeration load due to thermal output from electrical components contained within the display door, kWh/day.

4.5 Non-Display Doors

4.5.1 Conduction Through Non-Display Doors

(a) Calculate the surface area, as defined in section 3.4 of this appendix, of the non-display door, A_{nd}, ft², with standard geometric formulas or with engineering software.

(b) Calculate the temperature differential of the non-display door, ΔT_{nd},°F, as follows:

$$\Delta T_{nd} = \left|T_{DB,ext,nd} - T_{DB,int,nd}\right| \qquad (4\text{-}27)$$

Where:

$T_{DB,ext,\ nd}$ = dry-bulb air external temperature, °F, as prescribed by Table A.1; and

$T_{DB,int,\ nd}$ = dry-bulb air internal temperature, °F, as prescribed by Table A.1. If the component spans both cooler and freezer spaces, the freezer temperature must be used.

(c) Calculate the conduction load through the non-display door: $Q_{cond\text{-}nd}$, Btu/h,

$$Q_{cond-nd} = \Delta T_{nd} \times A_{ndploor anels\ and\ another\ foam\ type\ for\ floor\ panelsand\ one\ foam\ type\ for\ pan\ el\text{s},i=2a\ freezer\ glass\ door\ open} \qquad (4\text{-}28)$$

Where:

ΔT_{nd} = temperature differential across the non-display door, °F;

U_{nd} = thermal transmittance, U-factor of the door, in accordance with section 5.3 of this appendix, Btu/h-ft²-°F; and

A_{nd} = area of non-display door, ft².

4.5.2 Direct Energy Consumption of Electrical Components of Non-Display Doors

Electrical components associated with a walk-in non-display door comprise any components that are on the non-display door and that directly consume electrical energy. This includes, but is not limited to, heater wire (for anti-sweat or anti-freeze application), control system units, and sensors.

(a) Select the required value for percent time off for each type of electricity consuming device, PTO_t (%)

(1) For lighting without timers, control system or other demand-based control, PTO = 25 percent. For lighting with timers, control system or other demand-based control, PTO = 50 percent.

(2) For anti-sweat heaters on coolers (if included): Without timers, control system or other demand-based control, PTO = 0 percent. With timers, control system or other demand-based control, PTO = 75 percent. For anti-sweat heaters on freezers (if included): Without timers, control system or other auto-shut-off systems, PTO = 0 percent. With timers, control system or other demand-based control, PTO = 50 percent.

(3) For all other electricity consuming devices: Without timers, control system, or other auto-shut-off systems, PTO = 0 percent. If it can be demonstrated that the device is controlled by a preinstalled timer, control system or other auto-shut-off system, PTO = 25 percent.

(b) Calculate the power usage for each type of electricity consuming device, $P_{nd\text{-}comp,u,t}$, kWh/day, as follows:

$$P_{nd-comp,u,t} = P_{rated,u,t} \times \left(1 - PTO_{u,t}\right) \times n_{u,t} \times \frac{24h}{day} \qquad (4\text{-}29)$$

Where:

u = the index for each type of electricity-consuming device located on either (1) the interior facing side of the display door or within the inside portion of the display door, (2) the exterior facing side of the display door, or (3) any combination of (1) and (2). For purposes of this calculation, the interior index is represented by u = int and the exterior index is represented by u = ext. If the electrical component is both on the interior and exterior side of the display door then u = int. For anti-sweat heaters sited anywhere in the display door, 75 percent of the total power is attributed to u = int and 25 percent of the total power is attributed to u = ext;

t = index for each type of electricity consuming device with identical rated power;

$P_{rated,u,t}$ = rated power of each component, of type t, kW;

$PTO_{u,t}$ = percent time off, for device of type t, %; and

$n_{u,t}$ = number of devices at the rated power of type t, unitless.

(c) Calculate the total electrical energy consumption for interior and exterior power, $P_{nd\text{-}tot,\ int}$ (kWh/day) and $P_{nd\text{-}tot,\ ext}$ (kWh/day), respectively, as follows:

$$P_{nd-tot,int} = \sum_{1}^{t} P_{nd-comp,int,t} \qquad (4\text{-}30)$$

$$P_{nd-tot,ext} = \sum_{1}^{t} P_{nd-comp,ext,t} \qquad (4\text{-}31)$$

Where:

t = index for each type of electricity consuming device with identical rated power;

$P_{nd\text{-}comp,int,\ t}$ = the energy usage for an electricity consuming device sited on the internal facing side or internal to the

non-display door, of type t, kWh/day; and

$P_{nd\text{-}comp,ext,\ t}$ = the energy usage for an electricity consuming device sited on the external facing side of the non-display door, of type t, kWh/day. For anti-sweat heaters,

(d) Calculate the total electrical energy consumption, $P_{nd\text{-}tot}$, kWh/day, as follows:

$$P_{nd-tot} = P_{nd-tot,int} + P_{nd-tot,ext} \qquad (4\text{-}32)$$

Where:

$P_{nd\text{-}tot,int}$ = the total interior electrical energy usage for the non-display door, of type t, kWh/day; and

$P_{nd\text{-}tot,ext}$ = the total exterior electrical energy usage for the non-display door, of type t, kWh/day.

4.5.3 Total Indirect Electricity Consumption Due to Electrical Devices

(a) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/Wh

(2) For freezers, use EER = 6.3 Btu/Wh

(b) Calculate the additional refrigeration energy consumption due to thermal output from electrical components associated with the non-display door, $C_{nd\text{-}load}$, kWh/day, as follows:

$$C_{nd-load} = P_{nd-tot,int} \times 3.\frac{412}{EER}\frac{Btu}{W-h} \qquad (4\text{-}33)$$

Where:

EER = EER of walk-in cooler or freezer, Btu/W-h; and

$P_{nd\text{-}tot,int}$ = the total interior electrical energy consumption for the non-display door, kWh/day.

4.5.4 Total Non-Display Door Energy Consumption

(a) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(b) Calculate the total daily energy consumption due to thermal load, $E_{nd,\ thermal}$, kWh/day, as follows:

$$E_{nd,thermal} = \frac{Q_{cond-nd}}{EER} \times \frac{24\ h \times 1\ kW}{1\ day \times 1000\ W} \qquad (4\text{-}34)$$

Where:

$Q_{cond\text{-}nd}$ = the conduction load through the non-display door, Btu/hr; and

EER = EER of walk-in (cooler or freezer), Btu/W-h.

(c) Calculate the total energy, $E_{nd,tot}$, kWh/day, as follows:

$$E_{nd,tot} = E_{nd,thermal} + P_{nd-tot} + C_{load} \qquad (4\text{-}35)$$

Where:

$E_{nd,\ thermal}$ = the total daily energy consumption due to thermal load for the non-display door, kWh/day;

$P_{nd\text{-}tot}$ = the total electrical energy consumption, kWh/day; and

$C_{nd\text{-}load}$ = additional refrigeration load due to thermal output from electrical components contained on the inside face of the non-display door, kWh/day.

5.0 Test Methods and Measurements

5.1 Measuring Floor and Non-Floor Panel U-Factors

Follow the test procedure in ASTM C1363, (incorporated by reference; see § 431.303), exactly, with these exceptions:

(1) Test Sample Geometry Requirements

(i) Two (2) panels, 8 ft. ± 1 ft. long and 4 ft. ± 1 ft. wide must be used.

(ii) The panel edges must be joined using the manufacturer's panel interface joining system (e.g., camlocks, standard gasketing, etc.).

(iii) The Panel Edge Test Region, see figure 1, must be cut using the following dimensions:

1. If the panel contains framing members (e.g. a wood frame), then the width of edge (W) must be as wide as any framing member plus 2 in. ± 0.25 in. For example, if the face of the panel contains 1.5 in. thick framing members around the edge of the panel, then width of edge (W) = 3.5 in. ± 0.25 in and the Panel Edge Test Region would be 7 in. ± 0.5 in. wide.

2. If the panel does not contain framing members, then the width of edge (W) must be 4 in. ± 0.25 in.

3. Walk-in panels that utilize vacuum insulated panels (VIP) for insulation, width of edge (W) = the lesser of 4.5 in. ± 1 in. or the maximum width that does not cause the VIP to be pierced by the cutting device when the edge region is cut.

(iv) Panel Core Test Region of length Y and height Z, see Figure 1, must also be cut from one of the two panels such that panel length = Y + X, panel height = Z + X where X = 2W.

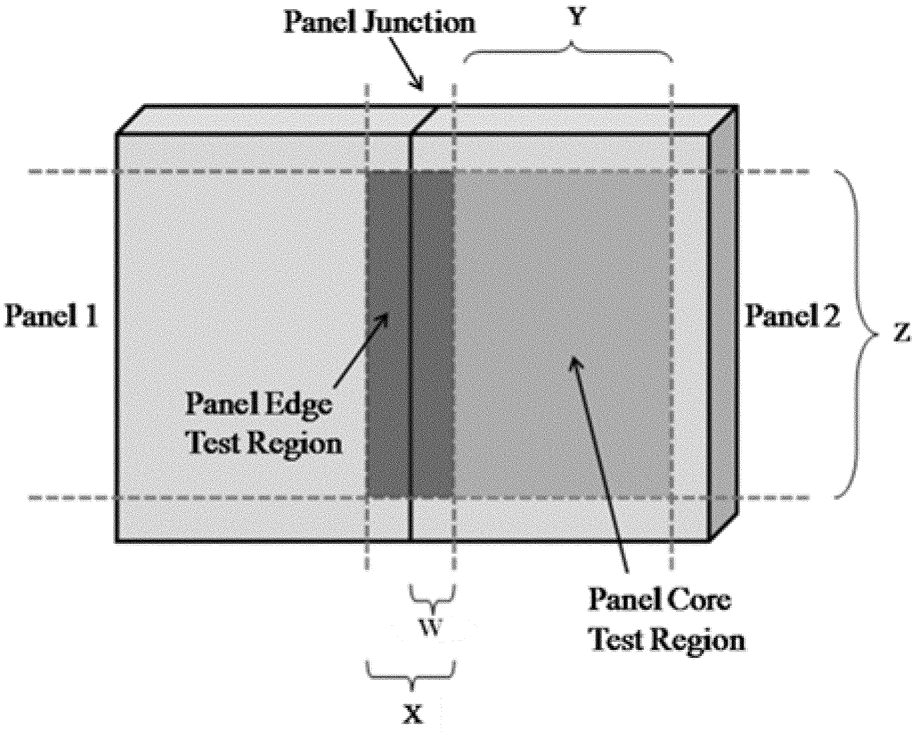

Figure 1 ASTM C1363 Test Regions (Note: diagram not drawn to scale)

(2) Testing Conditions

(i) The air temperature on the "hot side", as denoted in ASTM C1363, of the non-floor panel should be maintained at 75 °F ± 1 °F.

1. Exception: When testing floor panels, the air temperature should be maintained at 55 °F ± 1 °F.

(ii) The temperature on the "cold side", as denoted in ASTM C1363, of the panel should be maintained at 35 °F ± 1 °F for the panels used for walk-in coolers and − 10 °F ± 1 °F for panels used for walk-in freezers.

(iii) The air velocity must be maintained as natural convection conditions as described in ASTM C1363. The test must be completed using the masked method and with surround panel in place as described in ASTM C1363.

(3) Required Test Measurements

(i) Non-floor Panels

1. Panel Edge Region U-factor: $U_{nf,\ edge}$

2. Panel Core Region U-factor: $U_{nf,\ core}$

(ii) Floor Panels

1. Floor Panel Edge Region U-factor: $U_{fp,\ edge}$

2. Floor Panel Core Region U-factor: $U_{fp,\ core}$

5.2 Measuring Long Term Thermal Resistance (LTTR) of Insulating Foam

Follow the test procedure in Annex C of DIN EN 13164 or Annex C of DIN EN 13165 (as applicable), (incorporated by reference; see § 431.303), exactly, with these exceptions:

(1) Temperatures During Thermal Resistance Measurement

(i) For freezers: 35 °F ± 1 °F must be used

(ii) For coolers: 55 °F ± 1 must be used

(2) Sample Panel Preparation

(i) A 800mm × 800mm square (× thickness of the panel) section cut from the geometric center of the panel that is being tested must be used as the sample for completing DIN EN 13165.

(ii) A 500mm × 500mm square (× thickness of the panel) section cut from the geometric center of the panel that is being tested must be used as the sample for completing DIN EN 13164.

(3) Required Test Measurements

(i) Non-floor Panels

1. Long Term Thermal Resistance: $R_{LTTR,nf}$

(ii) Floor Panels

1. Long Term Thermal Resistance: $R_{LTTR,fp}$

5.3 U-factor of Doors and Display Panels

(a) Follow the procedure in NFRC 100, (incorporated by reference; see § 431.303), exactly, with these exceptions:

(1) The average convective heat transfer coefficient on both interior and exterior surfaces of the door should be based on the coefficients described in section 4.3 of NFRC 100.

(2) Internal conditions:

(i) Air temperature of 35 °F (1.7 °C) for cooler doors and − 10 °F (− 23.3 °C) for freezer doors

(ii) Mean inside radiant temperature must be the same as shown in section 5.3(a)(2)(i), above.

(3) External conditions

(i) Air temperature of 75 °F (23.9 °C)

(ii) Mean outside radiant temperature must be the same as section 5.3(a)(3)(i), above.

(4) Direct solar irradiance = 0 W/m² (Btu/h-ft²).

(b) Required Test Measurements

(i) Display Doors and Display Panels

1. Thermal Transmittance: U_{dd}

(ii) Non-Display Door

1. Thermal Transmittance: U_{nd}

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