DEPARTMENT OF ENERGY

10 CFR Part 431

[EERE–2017–BT–TP–0010]

RIN 1904–AD78

Energy Conservation Program: Test Procedures for Certain Commercial and Industrial Equipment; Early Assessment Review: Walk-In Coolers and Freezers

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

ACTION: Request for information.

SUMMARY: The U.S. Department of Energy (''DOE'') is undertaking an early assessment review to determine whether amendments are warranted for the test procedures for walk-in coolers and walk-in freezers (''WICFs'' or ''walk-ins''). DOE has identified certain issues associated with the currently applicable test procedures on which DOE is interested in receiving comment. The issues outlined in this document address definitions and equipment classes of walk-in components, test procedure waivers received, and other test procedure issues related to walk-in doors, panels, and refrigeration systems. DOE welcomes written comments from the public on any subject within the scope of this document, including topics not raised in this request for information (''RFI'').

DATES: Written comments and information are requested and will be accepted on or before July 19, 2021.

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *https://www.regulations.gov.* Follow the instructions for submitting comments. Alternatively, interested persons may submit comments by email to the following address: *WICF2017TP0010@ee.doe.gov.* Include docket number EERE–2017–BT–TP–0010 and/or RIN number 1904–AD78 in the subject line of the message. Submit electronic comments in WordPerfect, Microsoft Word, PDF, or ASCII file format, and avoid the use of special characters or any form of encryption. No telefacsimiles (faxes) will be accepted. For detailed instructions on submitting comments and additional information on the rulemaking process, see section III (Submission of Comments) of this document.

Although DOE has routinely accepted public comment submissions through a variety of mechanisms, including postal mail and hand delivery/courier, the Department has found it necessary to make temporary modifications to the comment submission process in light of the ongoing Covid–19 pandemic. DOE is currently accepting only electronic submissions at this time. If a commenter finds that this change poses an undue hardship, please contact Appliance Standards Program staff at (202) 586–1445 to discuss the need for alternative arrangements. Once the Covid–19 pandemic health emergency is resolved, DOE anticipates resuming all of its regular options for public comment submission, including postal mail and hand delivery/courier.

Docket: The docket for this activity, which includes **Federal Register** notices, comments, and other supporting documents/materials, is available for review at *https://www.regulations.gov.* All documents in the docket are listed in the *https://www.regulations.gov* index. However, some documents listed in the index, such as those containing information that is exempt from public disclosure, may not be publicly available.

The docket web page can be found at: *https://www.regulations.gov/#!docketDetail;D=EERE-2017-BT-TP-0010.* The docket web page contains instructions on how to access all documents, including public comments, in the docket. See section III of this document for information on how to submit comments through *https://www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT:

Dr. Stephanie Johnson, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 287–1943. Email: *ApplianceStandardsQuestions@ee.doe.gov.*

Mr. Michael Kido, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 586–8145. Email: *Michael.Kido@hq.doe.gov.*

For further information on how to submit a comment or review other public comments and the docket, contact the Appliance and Equipment Standards Program staff at (202) 287–1445 or by email: *ApplianceStandardsQuestions@ee.doe.gov.*

SUPPLEMENTARY INFORMATION:

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I. Introduction

DOE established an early assessment review process to conduct a more focused analysis that would allow DOE to determine, based on statutory criteria, whether an amended test procedure is warranted. 10 CFR 431.4; 10 CFR part 430 subpart C appendix A section 8(a). This RFI requests information and data regarding whether an amended test procedure would more accurately and fully comply with the requirement that the test procedure produce results that measure energy use during a representative average use cycle for the equipment, and not be unduly burdensome to conduct. To inform interested parties and to facilitate this process, DOE has identified several issues associated with the currently applicable test procedures on which DOE is interested in receiving comment. Based on the information received in response to the RFI and DOE's own analysis, DOE will determine whether to proceed with a rulemaking for an amended test procedure.

If DOE makes an initial determination that an amended test procedure would more accurately or fully comply with statutory requirements, or DOE's analysis is inconclusive as to whether amendments are warranted, DOE would undertake a rulemaking to issue an amended test procedure. If DOE makes an initial determination based upon available evidence that an amended test procedure would not meet the applicable statutory criteria, DOE would engage in notice and comment rulemaking before issuing a final determination that an amended test procedure is not warranted.

A. Authority

The Energy Policy and Conservation Act, as amended (''EPCA''),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part C[2] of EPCA, added by Public Law 95–619, Title IV, section 441(a) (42 U.S.C. 6311–6317 as codified), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency. This equipment includes walk-in coolers and freezers (collectively, ''walk-ins'' or ''WICFs''), the subject of this document. (42 U.S.C. 6311(1)(G))

Under EPCA, DOE's energy conservation program consists essentially of four parts: (1) Testing, (2) labeling, (3) Federal energy conservation standards (''ECS''), and (4) certification and enforcement procedures. Relevant provisions of EPCA include definitions (42 U.S.C. 6311), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), energy conservation standards (42 U.S.C. 6313), and the authority to require information and reports from manufacturers (42 U.S.C. 6316).

Federal energy efficiency requirements for covered equipment established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6316(a) and (b); 42 U.S.C. 6297) DOE may, however, grant waivers of Federal preemption in limited instances for particular State laws or regulations, in accordance with the procedures and other provisions set forth under 42 U.S.C. 6316(b)(2)(D).

EPCA also requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered equipment, including walk-in coolers and freezers, to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle. (42 U.S.C. 6314(a)(1)) DOE is publishing this RFI to collect data and information to inform its decision to satisfy the 7-year-lookback review requirement.

B. Rulemaking History

DOE has established test procedures to measure walk-in energy use, establishing separate test procedures for the principal components that make up a walk-in (*i.e.,* doors, panels, and refrigeration systems) with separate test metrics for each component. 10 CFR 431.304(b). For walk-in doors and display panels, the efficiency metric is daily energy consumption, measured in kilowatt-hours per day (''kWh/day''), which accounts for the thermal conduction through the door or display panel and the direct and indirect electricity use of any electrical components associated with the door. 10 CFR 431.304(b)(1)–(2) and 10 CFR part 431, subpart R, appendix A, ''Uniform Test Method for the Measurement of Energy Consumption of the Components of Envelopes of Walk-In Coolers and Walk-In Freezers'' (''Appendix A'').

For walk-in non-display panels and non-display doors, DOE codified in the Code of Federal Regulations (''CFR'') prescriptive standards established in EPCA based on R-value, expressed in units of (h-ft^2-°F/Btu),[3] which is calculated as 1/K multiplied by the thickness of the panel.[4] 10 CFR 431.304(b)(3) and 10 CFR part 431 subpart R, appendix B, titled ''Uniform Test Method for the Measurement of R-Value for Envelope Components of Walk-In Coolers and Walk-In Freezers'' (''Appendix B''). (See also, 42 U.S.C. 6314(a)(9)(A)) The K factor is calculated based on American Society for Testing and Materials (''ASTM'') C518, ''Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus'' (''ASTM C518''), which is incorporated by reference. *Id.*

For walk-in refrigeration systems, the efficiency metric is Annual Walk-in Energy Factor (''AWEF''), which is determined by conducting the test procedure set forth in American National Standards Institute (''ANSI'')/Air-Conditioning, Heating, and Refrigeration Institute (''AHRI'') Standard 1250P (I–P), ''2009 Standard for Performance Rating of Walk-In Coolers and Freezers,'' (''AHRI 1250–2009''), with certain adjustments specified in the CFR. 10 CFR 431.304(b)(4) and 10 CFR part 431 subpart R, appendix C, ''Uniform Test Method for the Measurement of Net Capacity and AWEF of Walk-In Cooler and Walk-In Freezer Refrigeration Systems'' (''Appendix C''). A manufacturer may also determine AWEF using an alternative efficiency determination method (''AEDM''). 10 CFR 429.53(a)(2)(iii). An AEDM enables a manufacturer to utilize computer-based or mathematical models for purposes of determining an equipment's energy use or energy efficiency performance in lieu of testing, provided certain prerequisites have been met. 10 CFR 429.70(f).

On August 5, 2015, DOE published its intention to establish a Working Group under the Appliance Standards and Rulemaking Federal Advisory Committee (''ASRAC'') to negotiate energy conservation standards to replace the standards established in the final rule published on June 3, 2014 (''June 2014 ECS final rule''). 80 FR 46521 (August 5, 2015). The Working Group assembled its recommendations into a Term Sheet[5] (Docket EERE–2015–BT–STD–0016, No. 56) that was presented to, and approved by, ASRAC on December 18, 2015 (''Term Sheet'').

The Term Sheet provided recommendations for energy conservation standards to replace standards that had been vacated by the United States Court of Appeals for the Fifth Circuit in a controlling order issued August 10, 2015. It also included recommendations regarding definitions for a number of terms related to the WICF regulations, as well as recommendations to amend the test procedure that the Working Group viewed as necessary to properly implement the energy conservation standards recommendations. Consequently, DOE initiated both an energy conservation standards rulemaking and a test procedure rulemaking in 2016 to implement these

[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Public Law 116–260 (Dec. 27, 2020).

[2] For editorial reasons, upon codification in the U.S. Code, Part C was redesignated Part A–1.

[3] The R-value is the capacity of an insulated material to resist heat-flow. See 42 U.S.C. 6313(f)(1)(C) for the EPCA R-value requirements for non-display panels and doors.

[4] The K factor represents the thermal conductivity of a material, or its ability to conduct heat, in units of Btu-in/(h-ft^2-°F).

[5] Appliance Standards and Rulemaking Federal Advisory Committee Refrigeration Systems Walk-in Coolers and Freezers Term Sheet, available at *https://www.regulations.gov/document?D=EERE-2015-BT-STD-0016-0056.*

recommendations. The Term Sheet also included recommendations for future amendments to the test procedure intended to make DOE's test procedure more fully representative of walk-in energy use.

On December 28, 2016, DOE published a final rule amending the test procedure (''December 2016 TP final rule''), consistent with the Term Sheet recommendations and provisions to facilitate implementation of energy conservation standards for walk-in components. 81 FR 95758. Subsequently, on July 10, 2017, DOE published a final rule amending the energy conservation standards for WICF refrigeration systems (''July 2017 ECS final rule''). 82 FR 31808.

To address Term Sheet recommendations regarding hot gas defrost, DOE published a final rule for hot gas defrost unit coolers on March 26, 2021 (''March 2021 hot gas defrost TP final rule'') that amended the test procedure to rate hot gas defrost unit coolers using modified default values for energy use and heat load contributions that would make their ratings more consistent with those of electric defrost unit coolers. 86 FR 16027.

II. Request for Information

DOE is publishing this RFI to collect data and information during the early assessment review to inform its decision, consistent with its obligations under EPCA, as to whether the Department should proceed with an amended test procedure rulemaking and if so, to assist in the development of proposed amendments. Accordingly, in the following sections, DOE has identified specific issues on which it seeks input to aid in its analysis of whether an amended test procedure for walk-in coolers and freezers would more accurately or fully comply with the requirement that the test procedure produces results that measure energy use during a representative average use cycle for the equipment, and not be unduly burdensome to conduct. DOE also welcomes comments on other issues relevant to its early assessment that may not specifically be identified in this document.

A. Scope and Definitions

This RFI covers equipment meeting the ''walk-in cooler and walk-in freezer'' definition codified in 10 CFR 431.302: An enclosed storage space refrigerated to temperatures (1) above 32 °F for walk-in coolers and (2) at or below 32 °F for walk-in freezers, that can be walked into, and has a total chilled storage area of less than 3,000 square feet, but excluding equipment designed and marketed exclusively for medical, scientific, or research purposes. 10 CFR 431.302. (See also 42 U.S.C. 6311(20)) In addition to the prescriptive requirements for walk-ins established by EPCA (42 U.S.C. 6313(f)(3)(A)–(D)) and codified at 10 CFR 431.306(a)–(b), DOE established performance-based energy conservation standards for doors and refrigeration systems. 10 CFR 431.306(c)–(e).

1. Walk-In Refrigeration Systems

DOE is aware of equipment that would appear to meet the walk-in definition and for which there is no current DOE test procedure or energy conservation standard. DOE indicated in a public meeting on October 22, 2014 that the WICF test procedures and standards did not apply to water-cooled condensing units or systems. (Docket EERE–2011–BT–TP–0024, No. 109 [6] at p. 11) DOE notes that the EPCA definition for walk-ins makes no distinction on how the condenser is cooled. (42 U.S.C. 6311(20)(A))

The current DOE test procedure for walk-in refrigeration systems, which incorporates by reference AHRI 1250–2009, does not address how to test liquid-cooled systems. Additionally, liquid-cooled condensing units are outside the scope of the most recent version of AHRI 1250, AHRI 1250–2020. Liquid-cooled condensing units for walk-ins are readily available for a wide range of capacities and refrigerants from major walk-in refrigeration system manufacturers. (See for example, Airdyne W-series indoor units (water-cooled), and Russell (water-cooled, glycol-cooled) (see Docket No. EERE–2017–BT–TP–0010–0001, Docket No. EERE–2017–BT–TP0010–0002, and Docket No. EERE–2017–BT–TP–0010–0003).

Issue 1: DOE seeks comment on how liquid-cooled refrigeration systems are (or could be) used with respect to walk-in applications. DOE requests comment on whether it should consider establishing a test procedure for liquid-cooled refrigeration systems. If test procedures were considered for liquid-cooled refrigeration systems, DOE requests information on whether there is an industry standard or standards that should be considered.

DOE is considering modifying the current equipment class definitions for refrigeration systems, which are based on walk-in application temperature. In the June 2014 ECS final rule, DOE established equipment classes for medium- and low- temperature walk-in refrigeration systems. 79 FR 32050, 32069–32070. While the terms ''medium-temperature'' and ''low-temperature'' are not explicitly defined, the June 2014 ECS final rule, 2015 ASRAC negotiations, December 2016 TP final rule, and July 2017 ECS final rule all consistently used the term ''medium-temperature'' to refer to walk-in cooler refrigeration systems and the term ''low-temperature'' to refer to walk-in freezer refrigeration systems.

Rating conditions are 35 °F for cooler systems and −10 °F for freezer systems. DOE acknowledges that there are ''medium-temperature'' systems designed to operate between these two rating conditions, specifically between 10 °F and 32 °F. However, the EPCA definitions for walk-in freezers and walk-in coolers draws the line between them at 32 °F, thus classifying such refrigeration systems as freezer refrigeration systems. DOE is considering whether equipment definitions and requirements should be amended to address these systems, which are discussed in detail in Section II.E.7.

Finally, DOE is considering defining walk-in wine cellar refrigeration systems. These systems are typically designed to provide a cold environment at a temperature range between 45–65 °F with 50–70 percent relative humidity (''RH''), and typically are kept at 55 °F and 55 percent RH rather than the 35 °F and less than 50 percent RH test condition prescribed by the DOE test procedure. Operating a wine cellar at the 35 °F condition would adversely mechanically alter the intended performance of the system, which would include icing of the evaporator coil that could potentially damage the compressor, and would not result in an accurate representation of the performance of the cooling unit. To distinguish walk-in wine-cellar refrigeration systems from other walk-in cooler systems, DOE is considering whether to specify 45 °F as the minimum temperature at which a walk-in wine cellar refrigeration system can effectively operate. If DOE were to specify a minimum operating temperature, DOE would need to develop a definition specific for products that operate in this temperature region. Walk-in wine cellar refrigeration systems are discussed in more detail in Section II.E.2.

Issue 2: DOE seeks comment on how wine cellar refrigeration systems should be defined to best represent the conditions under which these systems

[6] Details of Executing the Test Procedures for Refrigeration Systems use in Walk-in Coolers and Freezers, available at *https://www.regulations.gov/document?D=EERE-2011-BT-TP-0024-0109.*

are designed to operate and to fully distinguish these systems from systems designed to meet safe food storage requirements. Additionally, DOE requests comment on applications other than wine cellar storage for refrigeration systems that are designed to operate at temperatures warmer than typical for coolers and for which testing at 35 °F would be representative of use. If there are such additional applications, DOE seeks information regarding the specific operating requirements (*i.e.,* temperature and humidity) for these systems.

2. Walk-In Doors

DOE is also reviewing the definitions applicable to WICF doors. DOE defines a ''door'' as 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. 10 CFR 431.302. DOE is interested in using language that is consistent across the walk-in door industry to define a door.

Issue 3: DOE requests comment on the current definition of ''door'' in 10 CFR 431.302. DOE seeks feedback on the terminology of door components used and whether these are consistently interpreted. DOE seeks specific feedback from manufacturers on how they use the term ''door plug'' and whether it is essential to the definition of a WICF ''door''.

DOE differentiates WICF doors by whether such doors are ''display doors'' or not display doors. A ''display door'' is defined as a door that: (1) Is designed for product display; or (2) has 75 percent or more of its surface area composed of glass or another transparent material. 10 CFR 431.302. WICF doors that are not display doors are differentiated according to whether they are ''freight doors'' or ''passage doors.'' A ''freight door'' is a door that is not a display door and is equal to or larger than 4 feet wide and 8 feet tall. *Id.* A ''passage door'' is a door that is not a freight or display door. *Id.*

The use of dimensions in the definition of freight door conveys that these doors are intended for large machines (*e.g.,* forklifts) to pass through carrying freight. However, the definition does not explicitly provide whether classification as a freight door occurs when one of the dimensions exceeds the dimension provided in the definition, but the other dimension is smaller than the dimension provided in the definition. For such doors, in some cases the surface area could be larger than 32 square feet, the area of a 4-foot by 8-foot door provided in the definition (*e.g.,* a door 5 feet wide and 7 feet tall, with a surface area of 35 square feet); in other cases, the surface area could be smaller than 32 square feet (*e.g.,* a door 5 feet wide and 6 feet tall, with a surface area of 30 square feet). DOE reviewed the surface area of certified freight and passage doors in DOE's Compliance Certification Management System (''CCMS'') Database.[7] Among 1,114 unique individual models[8] of freight doors, 44 unique individual models have a surface area less than 32 square feet. These models appear to have been classified on the understanding that a door is a freight door if just one dimension is larger than the dimensions specified in the freight door definition. Among 1,540 unique individual models of passage doors, 789 unique individual models have a surface area greater than or equal to 32 square feet.[9] These models either are multi-door configurations, or they have been classified assuming that to be a freight door, both dimensions must be equal to or exceed the dimensions in the freight door definition. DOE further notes that the standards for each class of WICF doors are a function of surface area, and that different standards apply for freight doors and passage doors. DOE seeks information that would inform any potential revision of the door definitions, particularly ''freight door'' and ''passage door,'' to improve their clarity and ensure that there is no overlap between these definitions.

Issue 4: DOE requests comment on whether height and width or surface area are distinct attributes that effectively distinguish between passage and freight doors. DOE seeks information on any building codes, standards, or industry practices to support or refute maintaining the dimensions of a door as the defining characteristic which separates freight and passage doors.

Issue 5: Regarding a door that meets the freight door definition but does so only because it has a multi-door configuration in which the individual component doors each would by themselves not meet the freight door definition, DOE seeks comment on how such doors should be classified, and whether such classification should depend on other factors, such as whether one or more frame members divides the door opening into smaller openings.

Issue 6: DOE seeks comment on whether any attribute, or combination of attributes, other than size, would affect energy use and could be used to distinguish between freight doors and passage doors. If so, DOE requests data and comment on such attributes.

B. Industry Test Standards

The current DOE test procedure for walk-in coolers and freezers incorporates the following industry test standards: NFRC 100[10] into Appendix A; ASTM C518–04[11] into Appendix B; and AHRI 1250–2009[12], AHRI 420–2008[13] and ASHRAE 23.1–2010[14] into Appendix C.

1. NFRC 100 and NFRC 102

Appendix A requires manufacturers to determine door thermal transmittance according to NFRC 100. See Appendix A, Section 5.3. NFRC 100 includes a computational method to determine the thermal transmittance for a product line of doors if simulated results meet the validation requirements specified in NFRC 100. This approach may be less costly but generally may result in a higher, more conservative thermal transmittance value than the thermal transmittance value determined by testing each door. Section 4.3.2 of NFRC 100 provides a method for physically testing the thermal transmittance of walk-in doors by referencing NFRC 102, ''Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems'' (''NFRC 102''). DOE is considering explicitly incorporating by reference NFRC 102 as

[7] Data from the DOE CCMS database was accessed on March 6, 2020. This database can be found at *http://www.regulations.doe.gov/certification-data/.*

[8] Unique individual models exclude any duplicate entries using the same individual model number.

[9] DOE understands that some certified passage doors may represent multi-door configurations in which the individual component doors each have a surface area of less than 32 square feet.

[10] National Fenestration Rating Council (''NFRC'') 100–2010, ''Procedure for Determining Fenestration U-factors'' (''NFRC 100'').

[11] American Society for Testing and Materials (''ASTM'') C518–04, ''Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus'' (''ASTM C518–04'').

[12] American National Standards Institute (''ANSI'')/Air-Conditioning, Heating, and Refrigeration Institute (''AHRI'') Standard 1250P (I–P), ''2009 Standard for Performance Rating of Walk-In Coolers and Freezers'' (''AHRI 1250–2009'').

[13] AHRI 420–2008, ''Performance Rating of Forced-Circulation Free-Delivery Unit Coolers for Refrigeration'' (''AHRI 420–2008'').

[14] ANSI/ASHRAE 23.1–2010, ''Methods of Testing for Rating the Performance of Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant'' (''ASHRAE 23.1–2010'').

the test method for determining the thermal transmittance of walk-in doors in place of NFRC 100 and adopting AEDM provisions for walk-in display and non-display doors to replace the computational methodology in NFRC 100.

Issue 7: DOE requests comment on the accuracy of the computational method in NFRC 100 to predict U-factor for display and non-display doors. DOE seeks feedback regarding the differences in results (if any) between those obtained using the NFRC 100 computational method and those obtained when conducting physical testing using NFRC 102 for display and non-display doors. DOE is also interested in the magnitude of these differences and whether the computational method can be modified to yield results that more closely match the results obtained from actual physical testing. If manufacturers are aware of other methods to predict U-factor for either display doors or non-display doors besides NFRC 100, DOE requests how the results from these methods compare to physical testing.

Issue 8: DOE seeks information from manufacturers and other interested parties regarding how the industry currently rates individual door models, including the prevalence within the industry of using the computational method from NFRC 100. DOE also requests information on the costs associated with the computational method of NFRC 100 or an alternative computational method compared to physically testing the thermal transmittance of walk-in doors using NFRC 102.

2. ASTM C518

Currently, section 4.2 of Appendix B references ASTM C518 to determine the thermal conductivity of panel insulation (the ''K factor''). EPCA requires that the measurement of the K factor used to calculate the R-value ''be based on ASTM test procedure C518–2004.'' (42 U.S.C. 6314(a)(9)(A)(ii)) In December 2015, ASTM published a revision of this standard (''ASTM C518–15''). ASTM C518–15 removed references to ASTM Standard C1363, ''Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus'' (''ASTM C1363''), and added references to ASTM Standard E456, ''Terminology Relating to Quality and Statistics''. Additionally, ASTM C518–15 relies solely on the International System of Units (''SI units''), with paragraph 1.13 clarifying that these SI unit values are to be regarded as standard.

In July 2017, ASTM published another revision of ASTM C518 (''ASTM C518–17''). ASTM C518–17 added a summary of precision statistics from an interlaboratory study from 2002–2004 in section 10 ''Precision and Bias''. DOE has initially determined that the changes made in 2015 and 2017 to ASTM C518 do not substantively change the test method and, therefore, DOE is considering specifying ASTM C518–17 as the referenced test procedure in Appendix B. If DOE makes this change as part of a test procedure rulemaking, it would also consider any changes necessary to ensure rounding consistency when converting the output of ASTM C518–17 from SI units to English units.

Issue 9: DOE requests comment on what issues, if any, would be present if ASTM C518–17 were to be referenced in the Appendix B test procedure for measuring panel K-factor, or average thermal conductivity. While not exhaustive, primary areas of interest to DOE include any differences between the currently referenced version of the industry standard (ASTM C518–04) and ASTM C518–17 that would result in a difference in the determined R-value and/or test burden (whether an increase or decrease), and if there are such differences, the magnitude of impact to the determined R-value and/or test burden.

3. AHRI 1250

The current DOE test procedures for walk-in refrigeration systems incorporate by reference AHRI 1250–2009. 10 CFR 431.303(b)(2). AHRI 1250–2009 provides test methods for determination of performance for matched pair refrigeration systems consisting of a unit cooler and a condensing unit, or for the individual unit cooler or condensing unit alone.[15] In 2014, AHRI published a revision to this standard (''AHRI 1250–2014''). AHRI 1250–2014 primarily aligned the test standard for consistency with the DOE test procedure, *e.g.* specifying that unit coolers be tested using 25 °F saturated suction temperature for refrigerator unit coolers and −20 °F for freezer unit coolers.

AHRI again published a revision to the standard in April 2020 (''AHRI 1250–2020''). AHRI 1250–2020 includes many updates, including (a) providing complete instructions for testing of unit coolers alone instead of incorporating by reference AHRI 420, (b) providing complete instructions for testing of condensing units alone instead of incorporating by reference ASHRAE 23.1–2010, (c) revision of instrument accuracy and test tolerances, (d) adding test methods for testing of single-package systems, (e) modified correlations for default evaporator fan power, defrost thermal load, and defrost energy use for use when testing condensing units alone, (f) correlations for defrost thermal load and energy use for use when testing hot gas defrost systems, (g) measurement of all relevant off-cycle energy use, including compressor crankcase heater energy use, and (h) methods to verify whether a refrigeration system has hot gas defrost and/or adaptive defrost capabilities.

DOE may consider incorporating by reference AHRI 1250–2020 as the test method for walk-in refrigeration systems.

Issue 10: DOE requests comment on what issues, if any, would be present if AHRI 1250–2020 were to be referenced in the Appendix C test procedure for measuring walk-in refrigeration system AWEF. While not exhaustive, primary areas of interest to DOE include any differences between the currently referenced version of the industry standard (AHRI 1250–2009) and AHRI 1250–2020 that would result in a difference in the determined AWEF and/or test burden (whether an increase or decrease), and if there are such differences, the magnitude of impact to the determined AWEF and/or test burden.

C. Test Procedure for Walk-In Doors

In the following subsections, DOE discusses several topics specific to walk-in doors that may affect the test procedure's ability to provide results that are more fully representative of walk-in door energy use during an average use cycle. In particular, the discussion focuses on: (a) The distinction between the surface area used for determining maximum energy consumption and the surface area used to calculate thermal transmittance; (b) walk-in door electrical components, such as motors, that may require specific consideration in the test procedure; (c) assumptions of refrigeration system energy efficiency ratio (''EER'') for calculating energy use associated with the thermal loads of walk-in doors; (d) calibrations of the hot box used for determining thermal transmittance (also referred to as ''U-factor''); (e) maintaining tolerances on heat transfer coefficients for U-factor tests; and (f) measuring and accounting for air infiltration.

[15] A split-system refrigeration system consists of two separate components: A unit cooler that is installed inside a walk-in enclosure, and a condensing unit, which is installed outside the enclosure, either inside a building in which the walk-in is constructed, or outdoors.

1. Surface Area Used for Determining Compliance With Standards

The surface area of display doors and non-display doors (designated as A_{dd} and A_{nd}, respectively) are used to determine maximum energy consumption in kWh/day of a walk-in door. 10 CFR 431.306(c)–(d). Surface area is defined in Appendix A as ''the area of the surface of the walk-in component that would be external to the walk-in cooler or walk-in freezer as appropriate.'' Appendix A, Section 3.4. DOE recognizes that this definition may benefit from additional detail. As currently written, the definition does not provide detail on how to determine the boundaries of the walk-in door from which height and width are determined to calculate surface area. Additionally, the definition does not specify if these measurements are to be strictly in-plane with the surface of the wall or panel that the walk-in door would be affixed to, or if troughs and other design features on the exterior surface of the walk-in door should be included in the surface area.

Inconsistent determination of surface area, specifically with respect to the measurement boundaries, may result in unrepresentative maximum energy consumption. Display doors are fundamentally different from non-display doors in terms of their overall construction. For example, display door assemblies contain a larger frame encompassing multiple door openings; the entire assembly fits into an opening within a walk-in wall. Non-display doors differ in that they often are affixed to a panel-like structure that more closely resembles a walk-in wall rather than a traditional door frame. For the purposes of determining compliance with the standards, DOE interprets the surface area as the product of the height and width measurements of the door made external to the walk-in, where the height and width measurements are the maximum edge-to-edge dimensions of the door measured perpendicular to each other and parallel to the wall or panel of the walk-in to which the door is affixed. In applying this approach, DOE views the height and width measurements of display doors to include the frame and frame flange that overlaps the external edge of the WICF panel. For non-display doors, DOE views the height and width measurements to include only the swinging or sliding portion of the door and not the door frame or any localized appendages such as hinges or hanging rails and brackets. DOE seeks feedback on its interpretation of surface area for both display and non-display doors. DOE is also interested in feedback on whether additional detail is needed regarding the surface area for both non-display doors and display doors, and if so, what further detail should be provided.

Issue 11: DOE requests comment on how manufacturers determine surface area for the purpose of evaluating compliance with the standards for both display doors and non-display doors. DOE seeks input on any distinction between display doors and non-display doors, especially the door frames, which may warrant surface area for each to be determined differently.

Additionally, walk-in doors with antisweat heaters are subject to prescriptive standards for power use of antisweat heaters per square foot of door opening. 10 CFR 431.306(b)(3)–(4). Although ''door opening'' is not defined, DOE considers the relevant area for determining ''power use per square foot of door opening'' to be consistent with the surface area used to determine maximum energy consumption.

Issue 12: DOE seeks feedback on how manufacturers interpret and measure door opening as it relates to prescriptive standards for antisweat heaters, including whether or not manufacturers agree that the door opening considered for antisweat heat should be consistent with the surface area used to determine maximum energy consumption.

2. Thermal Transmittance Area

Currently, equations 4–19 and 4–28 of Appendix A specify that surface area, as defined in section 3.4 of Appendix A, of display doors and non-display doors, respectively, are used to convert a door's U-factor into a conduction load. This conduction load represents the amount of heat that transfers from the exterior to the interior of the walk-in. Based on recent review of the test procedure, DOE has identified that this defined surface area is inconsistent with the referenced industry test procedures for determining U-factor.

As stated previously, Appendix A references NFRC 100 for the determination of U-factor. When conducting physical testing,[16] U-factor (U_s) is calculated using projected surface area (A_s). ASTM C1199–09, Section 8.1.3. A_s is defined as ''the projected area of test specimen (same as test specimen aperture in surround panel)''. ASTM C1199–09, Section 3.3. This area differs from the currently defined areas (A_{dd} and A_{nd}) in Appendix A. See Appendix A, Section 3.4. DOE is considering whether the surface area used in calculating the conduction load in Equations 4–19 and 4–28 of Appendix A should be the same surface area used to determine U_s to provide greater consistency with the NFRC 100 definition of U-factor: ''The U-factor multiplied by the interior-exterior temperature difference and by the projected fenestration product area yields the total heat transfer through the fenestration product.''

Issue 13: DOE requests feedback on specifying the surface area used to determine thermal conduction through a walk-in door from the surface area used to determine the maximum energy consumption of a walk-in door.

3. Electrical Door Components

Sections 4.4.2 and 4.5.2 of Appendix A include provisions for calculating the direct energy consumption of electrical components of display doors and non-display doors, respectively. For example, electrical components associated with 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. See Appendix A, Sections 4.4.2 and 4.5.2. For each electricity-consuming component, the calculation of energy consumption is based on the component's ''rated power'' rather than an actual measurement of its power draw. Section 3.5 of Appendix A defines ''rated power'' as the electricity consuming device's power as specified on the device's nameplate, or from the device's product data sheet if the device does not have a nameplate or such nameplate does not list the device's power.

DOE has observed that walk-in doors often provide a single nameplate for the door, rather than providing individual nameplates for each electricity-consuming device. In many cases, the nameplate does not provide separate power information for the different electrical components. Also, the nameplate often specifies voltage and amperage (a measure of current) ratings without providing wattage (a measure of power) ratings, as is referenced by the definition of ''rated power''. While the wattage is equal to voltage multiplied by the current for many components, this may not be true of all components that may be part of a walk-in door assembly. Furthermore, nameplate labels typically do not specify whether any listed values of rated power or amperage represent

[16] As mentioned previously, NFRC 100 references NFRC 102 for determining U-factor through physical testing. NFRC 102 is based on American Society for Testing and Materials (''ASTM'') C1199–09, ''Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods'' (''ASTM C1199–09'') with some modifications.

the maximum operation conditions or continuous steady-state operating conditions, which could differ for components such as motors that experience an initial surge in power before leveling off at a lower power level. These issues make calculating a door's total energy consumption challenging when a test facility does not have in-depth knowledge of the electrical characteristics of the door components.

DOE is considering whether there may be value in adding an option for direct measurement of door component electrical power, either as part of the test procedure for manufacturers wishing to make direct measurements, or for DOE testing, as an alternative to using the nameplate value. DOE seeks comment on issues that should be considered were DOE to develop requirements for such measurements, such as any additional instrumentation or test conditions that would be required.

Issue 14: DOE seeks comment on whether, and if so how, an option for direct component power measurement could be included in the test procedure or compliance, certification, and enforcement (''CCE'') provisions to allow more accurate accounting for the direct electrical energy consumption of WICF doors. DOE also seeks input on whether specific provisions should be provided for determining power input from the information that is typically provided on nameplates, noting the limitations that were described above.

As stated previously, Appendix A accounts for the energy consumption of various electrical components, including lights, sensors, anti-sweat heater wire, and other miscellaneous electrical devices. The test procedure assigns percent time off (''PTO'') values to various walk-in door components.[17] Table II.1 lists the PTO values in the DOE test procedure for walk-in doors. This method provides a means to compare walk-in door performance while limiting the test burden on manufacturers.

TABLE II.1—ASSIGNED PTO VALUES FOR WALK-IN DOOR COMPONENTS

Component type	Percent time off (PTO) %
Lights without timers, control system or other demand-based control	25
Lights with timers, control system or other demand-based control	50
Anti-sweat heaters without timers, control system or other demand-based control	0
Anti-sweat heaters on walk-in cooler doors with timers, control system or other demand-based control	75
Anti-sweat heaters on walk-in freezer doors with timers, control system or other demand-based control	50
All other electricity consuming devices without timers, control systems, or other auto-shut-off systems	0
All other electricity consuming devices for which it can be demonstrated that the device is controlled by a preinstalled timer, control system or other auto- shut-off system	25

DOE has received several petitions for waivers and interim waivers with regard to the PTO used for doors with motorized door openers.[18] These manufacturers stated that the test procedure for walk-in doors overstates the energy consumption of motorized doors because the applicable PTO value prescribed in the test procedure is not representative of the actual energy use of the motorized doors used in these applications. Under the current test procedure, motorized door openers would be considered ''other electricity-consuming devices,'' with PTO values of either 0 percent or 25 percent. See Appendix A, Sections 4.4.2(a)(3) and 4.5.2(a)(3). Based on the characteristics of its doors, each manufacturer requested a different PTO value (shown in Table II.2) to be applied to its basic models. After reviewing the performance data, equipment characteristics, and door-opening frequency assumptions presented by door manufacturers, and after soliciting and reviewing feedback from the public, DOE granted waivers to the manufacturers shown in Table II.2.

TABLE II.2—PTO VALUES GRANTED IN DECISION AND ORDERS FOR MANUFACTURERS OF DOORS WITH MOTORIZED DOOR OPENERS

Manufacturer	Percent time off (PTO) %	Decision and order **Federal Register** citation
HH Technologies	96	83 FR 53457. (Oct. 23, 2018).
Jamison Door Company	93.5	83 FR 53460. (Oct. 23, 2018).
Senneca Holdings	97	86 FR 75. (Jan. 4, 2021).
Hercules	92	86 FR 17801. (Apr. 6, 2021).

DOE is reviewing the test procedure's current PTO values and is interested in establishing standard PTO values for motorized door openers as well as any other electricity-consuming devices that would warrant PTOs different from those currently in Appendix A, also listed in Table II.1 of this document. DOE seeks information regarding how closely these values represent actual PTO values experienced in the field. In addition to motorized door openers,

[17] PTO values are applied in order to reflect the hours in a day that an electricity-consuming device operates at its full rated or certified power (*i.e.,* daily component energy use is calculated assuming that the component operates at it rated power for a number of hours equal to 24 multiplied by (1–PTO)). PTO should not be incorporated into the rated or certified power of an electricity-consuming device.

[18] By letters dated July 26, 2017, December 21, 2017, March 13, 2020, and June 5, 2020, Jamison Door Company, HH Technologies, Senneca Holdings, and Hercules, respectively, submitted petitions for waivers and interim waivers for basic models of motorized walk-in doors, requesting the use of alternate PTO values. (Jamison, EERE–2017–BT–WAV–0040, No. 2 at p. 2; HH Technologies, EERE–2018–BT–WAV–0001, No. 1 at p. 2; Senneca Holdings, EERE–2020–BT–WAV–0009, No. 3 at p. 3; Hercules, EERE–2020–BT–WAV–0027, No. 2 at p. 3).

DOE is also investigating whether any additional walk-in door electrical components, such as heated air vents and heated thresholds, would warrant the use of specific PTO values when calculating door energy use.

Issue 15: DOE requests comment on the current PTO values and whether DOE should consider amending any of the current values or adding specific values for additional electrical components, specifically motorized door openers. DOE requests data from field studies or similar sources to support any proposed amendments (or additions) to these PTO values.

DOE is aware that some manufacturers design and market walk-in cooler display doors for high humidity applications. Ratings from the CCMS database [19] show these doors have more anti-sweat heater power per door opening area than standard cooler display doors. The average power use per door opening area for high humidity cooler doors is 1.66 W/ft^2, while the average power use for cooler doors not marketed for high humidity applications made by the same manufacturers who produce the high humidity doors is 1.01 W/ft^2. Section 4.4.2(a)(2) of Appendix A requires a PTO value of 50 percent be used when determining the direct energy consumption for anti-sweat heaters with timers, control systems, or other demand-based controls situated within a walk-in cooler door (which would include walk-in cooler doors marketed for high humidity applications). This approach assumes that the anti-sweat heaters are not operating for 50 percent of the time. DOE recognizes that anti-sweat heaters may be in operation for a different amount of time in high humidity installations than in standard installations.

Issue 16: DOE seeks feedback on whether the current PTO of 50 percent is appropriate for evaluating direct energy consumption of anti-sweat heaters with controls for walk-in cooler doors marketed for high humidity applications. DOE seeks feedback on the average amount of time per day or per year that anti-sweat heaters with controls are off for these high humidity doors and how this compares to standard (*i.e.,* non-high humidity) walk-in cooler display doors.

4. EER Values To Convert Thermal Load to Energy Consumption

To calculate the daily energy consumption associated with heat loss through a walk-in door, Appendix A requires dividing the calculated heat loss rate by specified EER values of 12.4 Btu per Watt-hour (''Btu/(W-h)'') for coolers and 6.3 Btu/(W-h) for freezers. Appendix A, Sections 4.4.4(a) and 4.5.4(a). DOE adopted these EER values in a final rule published April 15, 2011. 76 FR 21580, 21586, 21594 (''April 2011 TP final rule''). As explained in a notice of proposed rulemaking (''NOPR'') leading to this final rule, DOE defined nominal EER values because an envelope component manufacturer cannot control what refrigeration equipment is installed, and the defined EER value is intended to provide a nominal means of comparison rather than reflect an actual walk-in installation. 75 FR 186, 197 (January 4, 2010) (''January 2010 TP NOPR''). DOE selected EER values of 12.4 Btu/(W-h) for coolers and 6.3 Btu/(W-h) for freezers because these are typical EER values of walk-in cooler and walk-in freezer refrigeration systems, respectively.[20] 75 FR 186, 209.

The DOE test procedure also assigns nominal EER values when testing the refrigeration systems of walk-in unit coolers alone. When testing a unit cooler alone, the energy use attributed to the condensing unit is represented by a default value determined using the representative EER value specified for the appropriate ''adjusted'' dew point temperature in Table 17 of AHRI 1250–2009.[21] The resulting EER values for unit coolers tested alone are 13.3 Btu/(W-h) for coolers and 6.6 Btu/(W-h) for freezers, which are different than the EER values of 12.4 and 6.3, respectively, applied to walk-in doors, as described above. DOE notes that based on Table 17 of AHRI 1250–2009, EER values of 12.4 and 6.3 correspond to Adjusted Dewpoint Values of 19 °F for a refrigerator and −26 °F for a freezer (in contrast to Adjusted Dewpoint Values of 23 °F and −22 °F for unit cooler refrigerators and freezers, respectively, tested alone as defined in Table 15 and Table 16 of AHRI 1250–2009 and subtracting 2 °F as specified in section 7.9.1 of AHRI 1250–2009).

DOE is considering whether to make the EER values used to calculate the energy consumption of walk-in doors consistent with the values used to calculate unit cooler energy consumption and whether such a change would provide a more accurate representation of the energy use of walk-ins.

Issue 17: DOE seeks feedback on the current EER values specified in Appendix A used to calculate daily energy consumption for walk-in doors and the values used in testing of unit coolers alone, as specified in Appendix C. Specifically, DOE requests comment on which of these sets of EER values is more representative, whether DOE should make the values used for door testing and unit cooler testing consistent with each other, and if so, which of the sets of values should be used.

5. Thermal Transmittance

a. Calibration of Hot Box for Measuring U-factor

As stated previously, NFRC 100 references NFRC 102 as the physical test method for measuring U-factor, which in turn incorporates by reference ASTM C1199. ASTM C1199 references ASTM C1363–05, ''Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus'' (''ASTM C1363''). Section 6.1 of ASTM C1199 and Annexes 5 and 6 of ASTM C1363 include calibration requirements to characterize metering box wall loss and surround panel flanking loss, but the frequency at which these calibrations should occur is not specified in these test standards. DOE notes that ASHRAE Standard 16–2016, ''Method of Testing for Rating Room Air Conditioners and Packaged Terminal Air Conditioners'' (''ASHRAE 16–2016''), which is the test method incorporated by reference in the DOE test procedure for room air conditioners (10 CFR 430.3(g)(1)), uses in its determination of air conditioner capacity a value for heat loss through the partition wall based on prior calibration of the wall's heat loss. Conceptually, this use of a calibrated heat loss value is similar to the use of calibrated thermal losses in ASTM C1199 and ASTM C1363. DOE notes

[19] This data from the DOE CCMS database was accessed on March 17, 2021. This database can be found at *http://www.regulations.doe.gov/certification-data/.*

[20] The difference in EER values between coolers and freezers reflects the relative efficiency of the refrigeration equipment for the associated application. 75 FR 186, 197. As the temperature of the air surrounding the evaporator coil drops (that is, when considering a freezer relative to a cooler), thermodynamics dictates that the system effectiveness at removing heat per unit of electrical input energy decreases. *Id.*

[21] The dewpoint temperature to be used for testing unit coolers alone is defined in section 3.3.1 of Appendix C to be the Suction A saturation condition provided in Tables 15 or 16 of Appendix C (for refrigerator unit coolers and freezer unit coolers, respectively). Table 15 for refrigerator unit coolers defines the Suction A saturation condition (*i.e.,* dewpoint temperature) as 25 °F. Table 16 for freezer unit coolers defines the Suction A dewpoint temperature as −20 °F. Furthermore, section 7.9.1 of AHRI 1250–2009 specifies that for unit coolers rated at a suction dewpoint other than 19 °F for a refrigerator and −26 °F for a freezer, the Adjusted Dewpoint Value shall be 2 °F less than the unit cooler rating suction dewpoint—resulting in adjusted dewpoint values of 23 °F and −22 °F for refrigerator unit coolers and freezer unit coolers, respectively.

further that section 6.1.2.2 of ASHRAE 16–2016 includes a requirement to calibrate the partition wall thermal loss at least every two years. DOE is interested in feedback on the frequency of calibration and how recalibrations are performed for test facilities using test standard ASTM C1199.

Issue 18: DOE requests comment on how frequently test laboratories perform each of the calibration procedures referenced in ASTM C1199 and ASTM C1363, *e.g.,* those used to determine calibration coefficients that are used to calculate metering box wall loss and surround panel flanking loss. DOE also requests comment on the magnitude of variation in the calibration coefficients measured during successive calibrations.

b. Tolerances of Surface Heat Transfer Coefficients

Section 6 of ASTM C1199 specifies the standardized heat transfer coefficients and their tolerances as part of the procedure to set the surface heat transfer conditions of the test facility using the Calibration Transfer Standard (''CTS'') test. The warm-side surface heat transfer coefficient must be within ± 5 percent of the standardized warm-side value, and the cold-side surface heat transfer coefficient must be within ± 10 percent of the standardized cold-side value (ASTM C1199–09, sections 6.2.3 and 6.2.4). ASTM C1199 does not require that the measured surface heat transfer coefficients match or be within a certain tolerance of standardized values during sample testing—although test facility operational (*e.g.,* cold side fan settings) condition would remain identical to those set during the CTS test. On the other hand, Appendix A states in section 5.3(a)(1) that the average surface heat transfer coefficient on the cold-side of the apparatus shall be 30 Watts per square-meter-Kelvin ± 5 percent and that the average surface heat transfer coefficient on the warm-side of the apparatus shall be 7.7 Watts per square-meter-Kelvin ± 5 percent.

DOE originally proposed the heat transfer values and their associated tolerances in a supplemental notice of proposed rulemaking (''SNOPR'') published February 20, 2014 (''February 2014 AEDM TP SNOPR''). 79 FR 9818, 9837, 9847. DOE did not receive any comments from interested parties specific to the proposed tolerance of ±5 percent for both the cold-side and warm-side heat transfer coefficients, and finalized these values in a final rule published on May 13, 2014 (''May 2014 AEDM TP final rule''). 79 FR 27388, 27415.

DOE has found that meeting the standardized heat transfer values within specified tolerances in section 5.3(a)(1) of Appendix A on the warm-side and cold-side may not be achievable depending on the thermal transmittance through the door. Specifically, the warm-side heat transfer is dominated by natural convection and radiation and the heat transfer coefficient varies as a function of surface temperature. When testing doors with higher thermal resistance, less heat is transferred across the door from the warm-side to the cold-side, so the warm-side surface temperature is closer to the warm-side air temperature. However, the CTS method in ASTM C1199 does not require measurement of the warm-side surface temperature of the door. Rather, this value is calculated based on the radiative and convective heat flows from the test specimen's surface to the surroundings, which are driven by values determined from the calibration of the hot box (*e.g.,* the convection coefficient). See ASTM C1199, Section 9.2.1. When testing doors with extremely high- or low-thermal resistance, the resulting change in warm-side surface temperature can shift the warm-side heat transfer coefficient out of tolerance. The only way to adjust these coefficients to be within tolerance would be to recalibrate the hot box for a specific door, which would be burdensome and somewhat unpredictable.

Issue 19: DOE requests feedback on whether the tolerances in section 5.3(a)(1) of Appendix A applied to the surface heat transfer coefficients used to measure thermal transmittance are achievable for all walk-in doors and if not, whether the tolerances should be increased or omitted. Specifically, DOE seeks data to support any changes to the tolerances on the surface heat transfer coefficients.

6. Air Infiltration Reduction

EPCA includes prescriptive requirements for doors used in walk-in applications, which are intended to reduce air infiltration. Specifically, walk-ins must have (A) automatic door closers that firmly close all walk-in doors that have been closed to within 1 inch of full closure (excluding doors wider than 3 feet 9 inches or taller than 7 feet), and (B) strip doors, spring-hinged doors, or other method of minimizing infiltration when doors are open. 42 U.S.C. 6313(f)(1)(A)–(B). In the January 2010 TP NOPR and an SNOPR published on September 9, 2010 (''September 2010 TP SNOPR''), DOE proposed methods for determining the thermal energy leakage due to steady-state infiltration through the seals of a closed door and door opening infiltration. 75 FR 186, 214–216 and 75 FR 55068, 55107–55108. However, the April 2011 TP final rule did not include these methods because DOE concluded that steady-state infiltration was primarily influenced by on-site assembly practices rather than the performance of individual components. 76 FR 21580, 21594–21595. Similarly, DOE stated that, based on its experience with the door manufacturing industry, door opening infiltration is primarily reduced by incorporating a separate infiltration reduction device at the assembly stage of the complete walk-in. *Id.*

In this RFI, DOE is re-considering whether a method for measuring infiltration, specifically door opening infiltration, as well as a method to measure the impacts from technologies that reduce infiltration (*e.g.* fast-acting doors or air curtains), would improve on the current test procedure's accuracy and ability to produce results reflecting a given walk-in door's energy efficiency during a representative average use cycle, while not being unduly burdensome to conduct. Certain types of doors, like fast-acting doors, may have higher thermal transmittance, but may compensate for that factor by reducing infiltration from door openings—thereby, reducing a walk-in's overall energy use. DOE is considering how it may account for these types of doors in the walk-in test procedure.

In the January 2010 TP NOPR, DOE proposed to require that the thermal load from air infiltration associated with each door opening event be calculated using an analytical method based on equations published in the ASHRAE Refrigeration Handbook in combination with assumed values for door-opening frequency and duration. That proposed method would have accounted for the presence of infiltration reduction devices by discounting the thermal load from door opening air infiltration by the effectiveness of the air infiltration device. 75 FR 186, 196–197, 214–216. In order to determine the effectiveness of an infiltration reduction device, DOE proposed a two-part test that entailed measuring the concentration of tracer gas after a door opening event with and without the infiltration reduction device in place. *Id.* DOE proposed to use this effectiveness test for every unique door-device combination offered by a manufacturer. *Id.*

In the September 2010 TP SNOPR, DOE proposed a method for determining the thermal load associated with steady-state infiltration through walk-in doors. 75 FR 55068, 55084–55085, and 55107–

55108. For each door type with identical construction and only differences in dimensional size, DOE proposed to require calculating steady-state infiltration according to NFRC 400–2010–E0A1 (''Procedure for Determining Fenestration Product Air Leakage'') by testing three representative doors, one each of a ''small,'' ''medium,'' and ''large'' size.[22] *Id.* The steady-state infiltration from the representative doors would then be extrapolated or interpolated, as appropriate, to other doors that have the same construction. *Id.*

As noted, DOE is considering how to credit doors with infiltration-reducing features that reduce overall walk-in energy use and that are in addition to the prescriptive requirements mandated by EPCA. In doing so, DOE may consider a revised version of one of its previous proposals related to door infiltration, or offer a new method for determining heat load associated with infiltration.

DOE requests comment on whether it should account for steady-state and/or door opening infiltration in its test procedure—and if so, why; and if not, why not. With respect to suggestions for potential test methods, DOE is particularly interested in recommendations regarding test methods and calculation methods used by the industry to quantify heat load from infiltration. With respect to each of these methods, DOE seeks supporting information regarding the necessary costs in carrying them out. DOE seeks information and data on whether testing results obtained under any of the methods could be used to interpolate the load resulting from air infiltration of other door sizes in a product line. DOE also requests information on door usage patterns per door type (*e.g.,* display doors, passage doors, motorized doors, and fast-acting doors), including any supporting data from research or field studies.

D. Test Procedure for Walk-In Panels

In the following subsections, DOE presents several topics specific to walk-in panels that, if adopted, may improve the current test procedure's ability to provide results that more accurately depict walk-in panel energy use during a representative average use cycle without causing the test procedure to become unduly burdensome to conduct. That test procedure, found in 10 CFR part 431, subpart R, appendix B, provides a detailed method by which to measure the energy efficiency of a given panel used in the construction of a walk-in. Since publication of the December 2016 TP final rule, DOE has identified the potential need to provide additional clarification to Appendix B regarding the measurement of the thickness of walk-in panels (see Section II.D.1 of this document) and the procedure for determining parallelism and flatness of test specimens (see Section II.D.2 of this document). DOE also has identified differences between Appendix B and the industry test standards referenced, specifically for specimen[23] conditioning prior to testing (see Section II.D.3 of this document). In addition, DOE is examining the prospect of requiring a measurement for thermal transmittance for non-display panels (see Section II.D.4 of this document). While DOE previously adopted methods for measuring thermal transmittance in the April 2011 TP final rule, it later removed them. 79 FR 27387, 27405–27406. DOE remains interested in exploring the possibility of addressing this issue because of the potential variation in thermal transmittance of different panel designs with the same R-value, and seeks additional information regarding market-related and industry test method-related changes that would inform DOE's potential reconsideration of adopting a test method for measuring thermal transmittance. Finally, DOE is seeking comment on the test procedure for display panels (Section II.D.5 of this document).

1. Panel Thickness

DOE's test procedure for walk-in panels requires manufacturers to determine the panel's R-value by measuring the thermal conductivity, referred to as the ''K factor'' of a 1 ± 0.1-inch specimen of insulation according to ASTM C518–04. The R-value of the walk-in panel is determined by dividing the panel thickness by the K factor. See 10 CFR 431.304(b)(3) and Appendix B (detailing the test method used to measure the R-value for walk-in envelope components). DOE's current test procedure for determining a panel's R-value provides some direction for measuring panel thickness. However, because of the importance of this measurement in determining the panel's R-value, DOE is considering whether to include additional details regarding the thickness measurement.

Issue 20: DOE requests comment on how panel thickness is currently measured for determining the panel's R-value per the DOE test procedure, including number of measurements, measurement location, and any steps that are routinely followed for the removal of the protective skins or facers to obtain the full panel thickness. DOE requests that commenters identify any specific guidelines, practices or standardized approaches that are followed, as well as their date of publication, if applicable.

2. Parallelism and Flatness

The test procedure for determining R-value also requires that the two surfaces of the tested specimen that contact the hot plate assemblies (as defined in ASTM C518) maintain ±0.03 inches flatness tolerance and also maintain parallelism with respect to one another within a tolerance of ±0.03 inches.[24] Section 4.5 of Appendix B. The test procedure provides no direction on how flatness and parallelism should be measured or calculated. DOE is considering whether its test procedure should provide additional details indicating how to determine the flatness and parallelism of the tested specimen.

Issue 21: DOE requests comment on how flatness and parallelism of the test specimen surfaces that contact the hot plate assemblies described in ASTM C518 are typically determined by test laboratories and whether the test procedure should be revised to clarify how to determine these parameters, *e.g.,* what type of instruments are used to measure these values, how many measurements are made for a given specimen, and other details that could affect conclusions regarding compliance with the test procedure.

3. Specimen Conditioning

ASTM C518 directs that a test specimen cut from a panel be conditioned prior to testing. See ASTM C518–04, section 7.3 (referring to panel conditioning as ''specimen conditioning''). However, ASTM C518 does not specify the conditions at which specimen conditioning would be conducted, nor the duration. ASTM C518 states that specimen conditioning details should be provided in the

[22] DOE proposed a small size door as 48 inches ±0.5 inch wide and 84 inches ±0.5 inch high, a medium size door as 96 inches ±0.5 inch wide and 144 inches ±0.5 inch high, and a large size door as 144 inches ±0.5 inch wide and 180 inches ±0.5 inch high. 75 FR 55068, 55107.

[23] ASTM C518 uses ''specimen'' to refer to the piece of insulation that is cut to size for testing, while the CFR uses ''sample''. The discussion in this document is using ''specimen'' for consistency with the industry test standard.

[24] Maintaining a flatness tolerance means that no part of a given surface is more distant than the tolerance from the ''best-fit perfectly flat plane'' representing the surface. Maintaining parallelism tolerance means that the range of distances between the best-fit perfectly flat planes representing the two surfaces is no more than twice the tolerance (*e.g.,* for square surfaces, the distance between the most distant corners of the perfectly flat planes minus the distance between the closest corners is no more than twice the tolerance).

material specifications, and if not provided, conditions should be selected so as not to change the specimen in an irreversible manner. *Id.* ASTM C518 further states that material specifications typically call for specimen conditioning at 22 °C (72 °F) and 50 percent relative humidity until less than a 1 percent mass change is observed over a 24-hour period. *Id.* Calculations associated with conditioning are discussed in section 8.1 of ASTM C518, including calculation of the ''density of the dry specimen as tested,'' which suggests that the purpose of conditioning is, at least in part, to dry the specimen, *i.e.,* allow water to evaporate and/or diffuse out.

DOE has not found specimen conditioning details to be provided by suppliers of insulation for any of the common insulation materials used in walk-ins. Given this lack of supplier-provided specimen conditioning details, it is DOE's understanding that ''material specifications'' in section 7.3 refers to ASTM specifications, *e.g.* ASTM C578–2019, ''Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation'' or ASTM C1029–2015, ''Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation''. However, there is no uniform set of ASTM conditioning specifications, and the material specifications identified in ASTM C518 as ''typical'' do not reflect what is provided in other ASTM standards. For example, ASTM C578–2019 calls for conditioning as specified in the applicable test procedure—this circular reference back to ASTM C518 means that ASTM C578–2019 effectively provides no explicit conditions. ASTM C1029–2015 calls for conditioning at 73 ± 2 °F and 50 ± 5 percent relative humidity for 180 ± 5 days from time of manufacture. In the context of the DOE WICF test procedures, the ASTM C1029–2015 specifications may be insufficient or inappropriate because the date of manufacture of the insulation in a walk-in panel or door may not be known, and the 180-day condition would likely represent a significant test burden.

In the absence of clear instructions in ASTM C518, test laboratories may be using conditioning times, temperature, and humidity consistent with the conditions identified in ASTM C518–04 section 7.3 as ''typical conditions.'' Additionally, the provision in section 4.5 of Appendix B requires that testing per ASTM C518–04 must be completed within 24 hours of specimens being cut for the purpose of testing, eliminating use of the 180-day conditioning provided in ASTM C1029–2015 or the example of typical specimen conditioning provided by ASTM C518.

Issue 22: DOE requests comment on the extent to which manufacturers of insulation specify conditioning for insulation materials that differ from the typical conditioning approach described in ASTM C518. DOE also seeks feedback on whether more than one 24-hour conditioning period is ever needed to complete the conditioning (*i.e.,* the change in specimen mass is less than 1 percent after the first 24 hours of conditioning) for a specimen extracted from a WICF panel or door. Finally, DOE requests information or data on how specimen conditioning times less than or equal to 24 hours impacts the accuracy, repeatability, and representativeness of the test.

4. Overall Thermal Transmittance

In the April 2011 TP final rule, DOE adopted a test method for measuring the overall thermal transmittance of a walk-in panel, including the impacts of thermal bridges [25] and edge effects (*e.g.,* due to framing materials and fixtures used to mount cam locks). This method drew from an existing industry test method, incorporating by reference ASTM C1363–05. 76 FR 21580, 21605–21612. However, after receiving comments indicating that only two independent laboratories could conduct this test, DOE re-evaluated its earlier decision and removed this portion of the walk-in panel test procedure in the May 2014 AEDM TP final rule. 79 FR 27388, 27405–27406. Despite this decision to remove its overall thermal transmittance measurement method from the walk-in test procedure, DOE remains concerned that elements like framing materials and fixtures used to mount cam locks can significantly affect walk-in panel energy efficiency performance. To address this issue, DOE is re-evaluating whether—and if so, how—to account for the overall thermal transmittance of walk-in panels in its test procedure.

Issue 23: DOE requests information about panel construction factors that would affect thermal transmission and the magnitude of the energy efficiency-related impacts of thermal bridges in the panel assembly. Additionally, DOE requests comment on alternative test methods that measure the overall thermal transmittance of walk-in panels and the relative advantages and disadvantages of each. DOE also seeks feedback on the number and location of labs that have the facilities and are qualified to run ASTM C1363–05.

5. Display Panels

Display panels are defined in 10 CFR 431.302 as panels entirely or partially comprised of glass, a transparent material, or both that are used for display purposes. Display panels are subject to the test procedure in Appendix A for determining U-factor, conduction load, and energy use. 10 CFR 431.304(b)(1). Appendix A follows the procedure in NFRC 100 for determination of display panel U-factor. 10 CFR 431.303. Although DOE established a test procedure for display panels, DOE has not established energy conservation standards for them. DOE received no comments in response to the proposed test procedure outlined for display panels in the September 2010 TP SNOPR and DOE established Appendix A as the test procedure for display panels in the April 2011 TP Final Rule. 76 FR 21580, 21606. DOE is interested in any feedback on amending the current test procedure for display panels.

Issue 24: DOE seeks feedback on the current test procedure for display panels in Appendix A and what amendments should be made, if any, to it.

E. Test Procedure for Walk-In Refrigeration Systems

DOE's test procedure for walk-in refrigeration systems can be found in Appendix C to Subpart R of 10 CFR part 431. The test procedure primarily incorporates by reference AHRI 1250–2009.

DOE has also recently granted test procedure interim waivers and waivers to Appendix C specific to the testing of single-package systems, wine cellar refrigeration systems, and carbon dioxide (''CO_2'') refrigerant based systems, summarized in Table II.3. Test procedure waivers provide alternate test provisions for units that DOE determines cannot be appropriately tested to its current test procedure. A waiver granted by DOE remains in effect until DOE amends its regulations so as to eliminate any need for it, pursuant to 10 CFR 431.401(h) for commercial and industrial equipment. Sections II.E.1, II.E.2, and II.E.3, below discuss and request comment on addressing single-package systems, wine cellar

[25] Thermal bridging occurs when a more conductive material allows an easy pathway for heat flow across a thermal barrier.

refrigeration systems, and CO_2 systems in the test procedure.

TABLE II.3—INTERIM WAIVERS AND WAIVERS GRANTED TO MANUFACTURERS OF WALK-IN REFRIGERATION SYSTEMS

Manufacturer	Subject	Interim Waiver **Federal Register** citation	Waiver decision and order **Federal Register** citation
Air Innovations	Wine Cellar Refrigeration Systems	86 FR 2403 (Jan. 12, 2021)	86 FR 23702 (May 4, 2021).
Vinotheque	Wine Cellar Refrigeration Systems	86 FR 11961 (Mar. 1, 2021)	86 FR 26504 (May 14, 2021).
CellarPro	Wine Cellar Refrigeration Systems	86 FR 11972 (Mar. 1, 2021)	86 FR 26496 (May 14, 2021).
Vinotemp	Wine Cellar Refrigeration Systems	86 FR 23692 (May 4, 2021)	(*)
HTPG	CO_2 Unit Coolers	85 FR 83927 (Dec. 23, 2020)	86 FR 14887 (Mar. 19, 2021).
Hussmann	CO_2 Unit Coolers	86 FR 10046 (Feb. 18, 2021)	86 FR 24606 (May 7, 2021).
Keeprite	CO_2 Unit Coolers	86 FR 12433 (Mar. 3, 2021)	86 FR 24603 (May 7, 2021).
Store It Cold	Single-Package Systems	84 FR 11944 (Mar. 29, 2019)	84 FR 39286 (Aug. 9, 2019).

* A decision and order granting the manufacturer a waiver has not yet been issued.

As noted earlier, during DOE's previous rulemaking to develop standards for WICF refrigeration systems, the accompanying Term Sheet included a series of amendments to the test procedure that the Working Group viewed as necessary to properly implement its recommended energy conservation standards. Ultimately, DOE published final rules implementing the majority of both sets of recommendations. See 82 FR 31808, 31808–31838 (July 10, 2017) (final rule amending the energy conservation standards for walk-ins) and 81 FR 95758 (December 28, 2016) (final rule amending the walk-in test procedures).

Three test procedure-related recommendations from the Term Sheet, however, were not part of DOE's December 2016 TP final rule. (Term Sheet Recommendation #6). The Working Group believed these recommendations merited consideration by DOE as part of future amendments to help make the test procedure more fully representative of walk-in energy use. (*Id.*) Specifically, the Working Group recommended that DOE amend its procedure to (a) measure the energy use associated with the defrost function, taking into account the potential savings associated with hot gas and adaptive defrost, (b) incorporate the measurement of off-cycle power consumption, including crankcase heater power consumption, and (c) allow for separate ratings of stand-alone variable-capacity condensing units. (*Id.*). Sections II.E.4 through II.E.6 of this document discuss these issues in more detail.

Sections II.E.7 and II.E.8 discuss other issues that may also improve the test procedure's ability to provide results that are more representative of walk-in energy use. Specifically, these include consideration of amended test procedures and new equipment classes for so-called high-temperature freezer refrigeration systems used for walk-ins at temperatures between 10 °F and 32 °F, and discussion of the impact of refrigerant temperature glide [26] of zeotropic refrigerants such as R407A.

1. Single-Package Systems

As discussed in the December 2016 TP final rule, single-package systems are considered a type of dedicated condensing refrigeration system. 81 FR 95758, 95763–95764. The test methods in AHRI 1250–2009, which are incorporated by reference as DOE's test procedure for walk-ins (10 CFR 431.303(b)), do not fully address or account for the features of single-package systems. As discussed in the December 2016 TP final rule, commenters asserted that one practical challenge to testing single-package systems is the need to disassemble the unit under test in order to be able to install the refrigerant mass flow meters required for testing. *Id.* at 95763. Mass flow measurement is a key input in the calculation of capacity, as illustrated in equations C1 and C2 of AHRI 1250–2009.

Regarding this class of equipment, DOE received a petition for waiver with regard to testing of single-package units. By letter dated May 9, 2020, Store It Cold submitted a petition for waiver and interim waiver from Appendix C for basic models of single-package systems. (EERE–2018–BT–WAV–0002, No. 2) Store It Cold stated that testing single-package systems with refrigerant mass flow meters installed produces results unrepresentative of their true energy consumption characteristics and would provide materially inaccurate comparative data. The petitioner requested that DOE permit the use of psychrometric 'air-side' measurements to determine the Gross Total Refrigeration Capacity of such systems. DOE granted a test procedure waiver and interim waiver to Store It Cold for specified basic models in 2019. 84 FR 39286 (August 9, 2019) (''Store It Cold Decision and Order'').

AHRI 1250–2020 addresses testing of single-package systems in section C9 and incorporates by reference test standards developed for testing air-conditioning units that include alternative test methods that have been adapted for testing single-package systems. The air enthalpy methods in section C9 of AHRI 1250–2020 incorporate by reference ANSI/ASHRAE Standard 37–2009 (''ASHRAE 37–2009''), ''Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment'' and ANSI/ASHRAE 41.6–2014 (''ASHRAE 41.6''), ''Standard Method for Humidity Measurement''. The calorimeter methods in section C9 of AHRI 1250–2020 incorporate by reference ANSI/ASHRAE Standard 16–2016 (''ASHRAE 16–2016''), ''Method of Testing for Rating Room Air Conditioners, Packaged Terminal Air Conditioners, and Packaged Terminal Heat Pumps for Cooling and Heating Capacity''. The compressor calibration methods in section C9 of AHRI 1250–2020 incorporate by reference ASHRAE 37 and ANSI/ASHRAE 23.1–2010. AWEF calculations for matched pair and single-package systems are detailed in section 7.1.1 through 7.1.4 of AHRI 1250–2020.

AHRI 1250–2020 requires two simultaneous measurements of system capacity (*i.e.,* a primary and secondary method), and section C9.2.1 of Appendix C provides a requirement that the measurements agree within 6 percent. Table C4 to Appendix C to AHRI 1250–2020 details which of the test methods (calorimeter, air enthalpy, and compressor calibration) qualify as primary and/or secondary methods.

Issue 25: DOE requests comment on whether the single-package system test

[26] ''Temperature glide'' for a refrigerant refers to the increase in temperature at a fixed pressure as liquid refrigerant vaporizes during its conversion from saturated liquid to saturated vapor.

and calculation methods described in AHRI 1250–2020 provide representative energy use. DOE also requests comment on whether DOE should incorporate by reference AHRI 1250–2020 as the test procedure for single-package systems.

DOE also notes that, unlike split systems (*i.e.,* matched-pair refrigeration systems), single-package systems may experience additional thermal losses because they circulate cold walk-in air through a cold section that has exterior surfaces exposed to warm air outside the walk-in enclosure. This exposure can contribute to additional infiltration losses, *i.e.,* leakage of air between the interior and exterior of a walk-in. Accordingly, if these losses occur, they would reduce the net capacity of a single-package system without being fully captured by the refrigerant enthalpy methods established in AHRI 1250–2009.

Issue 26: DOE requests any data or calculations quantifying the additional thermal losses associated with testing single-package systems due to the exposure of their cold sides to the exterior air (*i.e.,* surface and infiltration losses). DOE additionally requests comment on whether the AHRI 1250–2020 test methodology for single-package systems fully accounts for these additional losses.

a. Calorimeter Method

As previously mentioned, AHRI 1250–2020 incorporates by reference ASHRAE 16–2016 as its indoor and outdoor room calorimeter method test procedure. ASHRAE 16–2016 includes a calorimeter test method with similarities to the calibrated box test method of AHRI 1250–2009, but with additional details and provisions. ASHRAE 16–2016 is used to measure the capacity and power input of single-package system products such as room air conditioners that have hot and cold sections, similar to single-package walk-in systems. The ASHRAE 16–2016 calorimeter test includes both outdoor- and indoor-based calorimetric measurements of the capacity—the indoor side measurement is similar to that of the calibrated box test method, while the outdoor side provides a determination of system cooling capacity by measuring the cooling required to maintain the outdoor room temperature and humidity conditions.

DOE's work in evaluating single-package systems using the calorimeter methods referenced in AHRI 1250–2020 has highlighted the need to make very precise determination of the calorimeter chamber cooling fluid heat capacity. This fluid cannot be pure water, since it must be below water freezing temperature for testing WICF refrigeration systems. This makes precise determination of heat capacity more challenging, since an accurate determination of glycol concentration is required.

Issue 27: DOE requests comment and data on the use of water, glycol, or other heat transfer liquid in maintaining test compartment temperature using the calorimeter methods referenced in AHRI 1250–2020 for the testing of single-package refrigeration systems. DOE requests comment on whether the description and requirements for calorimetric testing as provided in AHRI 1250–2020 should be modified or enhanced in order to better ensure that measurements are accurate and repeatable.

In addition, ASHRAE 16–2016 requires that a pressure-equalizing device be installed between the indoor and outdoor test compartments to maintain a balanced pressure between the compartments and to measure the air flow required to maintain equalization. Assuming the test facility is otherwise airtight, the air flow transferred and measured by the pressure-equalizing device represents air transferred in the opposite direction through leaks inside the equipment as a result of pressure differences between the warm and cold side of the system set up by its fans.

Given that the related calibrated box test method has no requirements for pressure equalization, DOE is considering the need for pressure equalization for single-package testing. Alternatives include (a) no requirement addressing transfer air or pressure equalization, or (b) a requirement that the test facility chambers be leak-free with no equalization requirement. DOE expects that the use of a pressure equalization apparatus would incrementally increase test facility cost and test burden, and would ensure operation with losses consistent with the measured air leakage, but such equalized pressure conditions may not be representative of WICF refrigeration system use. The alternative options may reduce facility cost and test burden. Option (a) may reduce accuracy and repeatability, while both options may mask potential performance degradation associated with air leakage.

Issue 28: DOE requests comment on whether calorimeter test methods for single-package systems should implement a pressure-equalizing device, as included in ASHRAE 16–2016. DOE requests information on any additional cost and resource burdens, if any, manufacturers would face when employing these methods to evaluate single-package systems.

Issue 29: DOE seeks comment regarding any alternative test methods not mentioned in this document that could be used to measure single-package system capacity. To the extent that any alternative test methods could be used for this purpose, DOE requests information on their advantages and disadvantages in measuring single-package system capacity.

2. Wine Cellar Refrigeration Systems

DOE is aware of certain equipment within the walk-in definition that may be incapable of being tested in a manner that would yield results measuring the energy efficiency or energy use of that equipment during a representative average use cycle under the current version of the walk-in test procedure. Specifically, wine cellars that are installed in a variety of commercial settings are set to operate at a temperature range of 45 °F to 65 °F. They also meet the criteria established by Congress in the definition for a walk-in. See generally 42 U.S.C. 6311(20). Under the walk-in test procedure, walk-in coolers must be tested while operating at 35 °F. Section 3.1.1 of Appendix C. Wines often suffer from damage when stored at temperatures below 45 °F. To the extent that a wine cellar is not operated at 35 °F, applying the required 35 °F testing temperature condition when evaluating the energy usage of this equipment would not produce results representative of an average use cycle.

DOE has received requests for waiver and interim waiver from several manufacturers from the test procedure in Appendix C for basic models of wine cellar refrigeration systems.[27]( ). Manufacturers stated that wine cellars are intended to operate at a temperature range of 45 to 65 °F and 50–70 percent relative humidity, rather than the 35 °F and less than 50 percent relative humidity test condition prescribed in Appendix C. Manufacturers asserted that testing at 35 °F would be unrepresentative of the true energy consumption characteristics of the specified units and that operation at this temperature may damage wine cellar refrigeration units. Given the number of waivers that DOE received, DOE

[27] Air Innovations, Vinotheque Wine Cellars, Cellar Pro Cooling Systems, Vinotemp International Corp., and LRC Coil Company, respectively, submitted petitions for waivers and interim waivers for basic models of wine cellar walk-in refrigeration systems. (Air Innovations, EERE–2019–BT–WAV–0029, No. 6; Vinotheque, EERE–2019–BT–WAV–0038, No. 6; CellarPro, EERE–2019–BT–WAV–0028, No. 6; Vinotemp, EERE–2020–BT–WAV–0022, No. 10; LRC Coil, EERE–2020–BT–WAV–0040, No. 1).

engaged with AHRI, the industry trade association, to discuss how to develop a consistent alternate test approach for wine cellars that would be applicable to all impacted manufacturers. Ultimately, AHRI submitted a memorandum on behalf of its wine cellar members supporting (1) a 45 °F minimum operating temperature for wine cellar refrigeration systems, and (2) testing at 50 percent of maximum external static pressure, with manufacturers providing maximum external static pressure values to DOE.[28] After reviewing manufacturer websites, product specification sheets, suggested alternate test approaches provided by each manufacturer and by AHRI, and after soliciting and reviewing feedback from the public, DOE has granted interim waivers or waivers as summarized in Table II.3.

These waivers have addressed testing for single-package, matched-pair, and unit-cooler-only wine cellar refrigeration systems. The alternative test procedures prescribed in these waivers address a number of differences in operation between wine cellar refrigeration systems and other walk-in refrigeration systems, including the following:

- Unit cooler air inlet condition of 55 °F and 55 percent RH, compared to 35 °F and less than 50 percent RH for medium-temperature refrigeration systems in the DOE test procedure;
- For single-package wine cellar systems, capacity measurement is conducted using a primary and a secondary capacity measurement method as specified in AHRI 1250–2020, using two of the following: The indoor air enthalpy method; the outdoor air enthalpy method; the compressor calibration method; the indoor room calorimeter method; the outdoor room calorimeter method; or the balanced ambient room calorimeter method.
- Options for ducting on the condenser side, evaporator side, or both with specifications for setting the external static pressure.
- For calculating AWEF, the wine cellar box load level is set equal to half of the refrigeration system capacity at the 95 °F test condition (for outdoor refrigeration systems) or 90 °F (for indoor refrigeration systems), rather than using a two-tiered set of high- and low-load period box load levels, as prescribed in AHRI 1250–2009. For calculating AWEF, the evaporator fan is assumed to operate for one-tenth of the compressor off-cycle period at the same wattage as applies for the compressor on-cycle. This contrasts with varying assumptions used for other WICF refrigeration systems, depending on the type of evaporator fan controls they use.

Issue 30: DOE requests comment on the alternative test procedure for wine cellar walk-in refrigeration systems that it has granted in the interim waivers and waivers listed in Table II.3. DOE additionally seeks comment on whether the alternative test procedure prescribed for the specified basic models identified in the waivers would be appropriate for similar refrigeration equipment.

As noted previously, wine cellar refrigeration systems are designed for both ducted and non-ducted air delivery; the DOE test procedure does not address the testing of ducted systems. For systems that can be installed with (1) ducted evaporator air, (2) with or without ducted evaporator air, (3) ducted condenser air, or (4) with or without ducted condenser air, the alternate test approach requires testing to be conducted at 50 percent of the maximum external static pressure (''ESP''), subject to a tolerance of −0.00/+0.05 in. DOE understands that maximum ESP is generally not published in available literature such as installation instructions, but manufacturers do generally specify the size and maximum length of ductwork that is acceptable for any given unit in such literature. The duct specifications determine what ESP would be imposed on the unit in field operation.[29] The provision of allowable duct dimensions is more convenient for installers than maximum ESP, since it relieves the installer from having to perform duct pressure drop calculations to determine ESP. This approach differs from the approach used in related products/equipment, *e.g.,* air conditioners, where ESP is a function of capacity—ESP does not correlate well with capacity for wine cellar refrigeration systems.

Issue 31: DOE requests feedback on its approach for testing ducted units in its alternate test procedure for wine cellar refrigeration systems. Specifically, DOE requests comment and supporting data on whether testing at 50 percent of maximum ESP provides representative performance values, or whether other fractions of maximum ESP may be more appropriate. Additionally, DOE seeks comment on other industry test methods that include the testing of ducted units. Finally, DOE is interested in other alternative approaches for testing ducted units that have been demonstrated to provide repeatable and representative results.

The above discussion assumes that wine cellar refrigeration systems are either a single-package system or a matched-pair.[30] However, DOE has also received a petition for waiver for unit coolers that are distributed into commerce without a paired condensing system.[31] DOE recognizes that these unit cooler-only models will need to be tested according to the provisions in AHRI 1250–2020 for unit coolers tested alone, for which calculation of AWEF requires use of an appropriate EER based on the suction dew point temperature. Table 18 in AHRI 1250–2020 provides EER values for medium and low temperature unit coolers tested alone. However, these values may not be appropriate for calculating AWEF for wine cellar unit coolers because this equipment likely operates with different suction dew point temperature and the counterpart condensing units likely use different compressor designs than those considered when developing the current EER values.

Issue 32: DOE requests data and information on appropriate EER values for use in calculating AWEF for wine cellar unit coolers tested alone, and how these EER values might depend on refrigerant and/or capacity. DOE requests that commenters provide background explanation regarding how any such EER recommendations have been developed.

Issue 33: Since unit coolers for wine cellar systems are sold alone, DOE seeks information on the characteristics of condensing units that would typically be paired with these unit coolers (*e.g.,* make/model, compressor style, capacity range, manufacturers).

[28] Memorandum from AHRI, ''Department of Energy (DOE) Wine Cellar Cooling Systems Test Procedure Waiver Industry Comments from AHRI Membership'', August 18, 2020. (EERE–2019–BT–WAV–0028, No. 5 (CellarPro); EERE–2019–BT–WAV–0029, No. 5 (Air Innovations); EERE–2019–BT–WAV–0038, No. 5 (Vinotheque); EERE–2019–BT–WAV–022, No. 2 (Vinotemp))

[29] The duct material, length, diameter, shape, and configuration are used to calculate the ESP generated in the duct, along with the temperature and flow rate of the air passing through the duct. The conditions during normal operation that result in a maximum ESP are used to calculate the reported maximum ESP values, which are dependent on individual unit design and represent manufacturer-recommended installation and use.

[30] A ''matched refrigeration system'' is also called a ''matched pair'' and is a refrigeration system where the condensing system is distributed into commerce with a specific unit cooler(s). See 10 CFR 431.302.

[31] LRC Coil Company submitted a petition for waiver and interim waiver for specific basic models of unit cooler only walk-in wine cellar refrigeration systems. (LRC Coil, EERE–2020–BT–WAV–0040, No. 1) In reviewing another petition for waiver and interim waiver from Vinotheque for single-package system and matched-pair system basic models (Vinotheque, EERE–2019–BT–WAV–0038, No. 6), DOE noted that the manufacturer also offered unit cooler only systems distributed without a paired condensing system.

Additionally, DOE notes that its definitions for ''single-packaged system'' and ''unit cooler'' may not appropriately define ducted units. DOE currently defines a ''single-packaged dedicated system'' as ''a refrigeration system (as defined in this section) that is a single-package system assembly that includes one or more compressors, a condenser, a means for forced circulation of refrigerated air, and elements by which heat is transferred from air to refrigerant, without any element external to the system imposing resistance to flow of the refrigerated air. 10 CFR 431.302. Similarly, DOE defines a ''unit cooler'' as ''an assembly, including means for forced air circulation and elements by which heat is transferred from air to refrigerant, thus cooling the air, without any element external to the cooler imposing air resistance. *Id.* Both definitions describe a single-package or unit cooler system, respectively, that is not ducted (*i.e.,* there is no element external to the unit that imposes air resistance).

Issue 34: DOE seeks comment on whether, and if so how, it should modify its definitions for ''single-packaged dedicated system'' and ''unit cooler'' to address units that are designed to be installed with ducts.

Issue 35: DOE requests comment on any other issues regarding testing of wine cellar refrigeration systems that may not be fully addressed by the current DOE test procedure.

3. CO_2 Systems

DOE has also become aware of WICF unit coolers that are being used in CO_2 transcritical booster systems that cannot be tested using the current set of test conditions. DOE has received several test procedure waiver petitions regarding CO_2 unit coolers used in transcritical booster systems.

Heat Transfer Product Group (''HTPG''), Hussmann, and Keeprite submitted petitions for waivers and interim waivers from Appendix C for specific basic models of CO_2 direct expansion unit coolers).[32] The DOE test procedure for unit coolers requires testing with liquid inlet saturation temperature of 105 °F and liquid inlet subcooling temperature of 9 °F, as specified by Tables 15 and 16 of AHRI 1250–2009. However, CO_2 has a critical temperature of 87.8 °F; therefore, it does not coexist as saturated liquid and gas above this temperature. The liquid inlet saturation temperature of 105 °F and the liquid inlet subcooling temperature of 9 °F specified in Appendix C are not achievable by CO_2 unit coolers. The three petitioners requested that DOE modify the test condition values to reflect typical operating conditions for a transcritical CO_2 booster system (*i.e.*, a liquid inlet saturation temperature of 38 °F and a liquid inlet subcooling temperature of 5 °F). After reviewing manufacturer websites, product specification sheets, and suggested alternate test approaches provided by each manufacturer, DOE has granted waivers or interim waivers to the manufacturers listed in Table II.3.

DOE is seeking comment on how to address CO_2 system testing in a way that is representative of the average use cycle for these units and is not unduly burdensome to conduct.

Issue 36: DOE requests comment on test conditions that would be most appropriate for evaluating the energy use of CO_2 unit coolers. Additionally, DOE requests feedback on any additional changes that would need to be made to the DOE test procedure to accurately evaluate energy use of these systems, while minimizing test burden.

While all CO_2 refrigerant waiver petitions DOE has thus far received address unit coolers for use in transcritical booster systems, it is possible that other CO_2 refrigeration system configurations may be relevant in the future, *e.g.,* dedicated condensing units (''DCUs''), matched pairs, or single-package systems. DOE reviewed product literature and other information for CO_2 systems having some of these alternative configurations. Most of this information pertains to manufacturers operating in Europe.

Issue 37: DOE requests comment on the present and future expected use of walk-in refrigeration systems using CO_2. DOE requests specific information about these systems that would suggest a need to modify the DOE test procedure to address such equipment. Specifically, DOE requests information on whether such equipment is sold in the U.S., whether this equipment is sold as matched pairs or individual components, and to what extent dedicated condensing units are configured to supply subcritical liquid (rather than supercritical gas) to the unit coolers.

4. Defrost Test Method

The April 2011 TP final rule incorporated AHRI 1250–2009 as DOE's WICF refrigeration system test procedure, including that standard's requirement that both frosted and dry coil defrost tests be conducted. Appendix C, Section 3. DOE later noted in the February 2014 AEDM TP SNOPR that this requirement may be overly burdensome for manufacturers to conduct, due to the difficulty of maintaining the moist air infiltration conditions for the frosted coil test in a repeatable manner. 79 FR 9818, 9831. Accordingly, in DOE's May 2014 AEDM TP final rule, DOE adopted a set of nominal values for calculating defrost energy use for a frosted coil, number of defrosts per day if the unit has an adaptive defrost system, and daily contribution of heat load.[33] 79 FR 27388, 27401. To address testing low-temperature condensing units alone, the May 2014 AEDM TP final rule established nominal values for the defrost energy use and thermal load. In addressing refrigeration systems with hot gas defrost, the May 2014 AEDM TP final rule established nominal values for calculating hot gas defrost energy use and heat load. *Id.*

The December 2016 TP final rule removed the method for calculating the defrost energy and defrost heat load of systems with hot gas defrost and established a new method to evaluate hot gas defrost refrigeration systems. That new method treated these hot gas defrost refrigeration systems as if they used electric defrost rather than hot gas defrost. This method relied on the same nominal values for defrost energy use and thermal load that the test procedure prescribes for electric-defrost condensing units that are tested alone. 81 FR 95758, 95774–95777. This approach was modified in the March 2021 hot gas defrost TP final rule that amended the test procedure to rate hot gas defrost unit coolers using modified default values for energy use and heat load contributions that would make their ratings more consistent with those of electric defrost unit coolers. 86 FR 16027. The scope of the March 2021 hot gas defrost TP final rule is limited to unit coolers only. 86 FR 16027, 16030.

a. Moisture Addition

DOE is considering whether using a test method—possibly similar to the one detailed in section C11.3 of AHRI 1250–2009—to measure the energy use associated with the defrosting of frosted coils would provide a reasonably accurate accounting of defrost energy

[32] Heat Transfer Products Group, Hussmann Corporation, and Keeprite Refrigeration, respectively, submitted petitions for waivers and interim waivers for basic models of CO_2 unit coolers used in transcritical booster systems. (HTPG, EERE–2020–BT–WAV–0025, No. 1; Hussmann, EERE–2020–BT–WAV–0026, No. 1; Keeprite, EERE–2020–BT–WAV–0028, No. 1).

[33] In a ''hot gas'' defrost system, high-temperature, high-pressure hot refrigerant gas from the discharge side of the compressor is introduced into the evaporator, where it condenses, thereby releasing latent heat into the evaporator. This heat is used to melt the frost that has accumulated on the outside of the evaporator coil.

usage and savings associated with technologies such as adaptive defrost and hot gas defrost. DOE is also considering adopting a test method to assess and confirm defrost adequacy. Any test method used to measure defrost energy use and adequacy would have to provide consistent, repeatable methods for (1) delivering a frost load to the test coil and (2) measuring the thermal load released into the refrigerated space during the defrost cycle, regardless of the method of defrost (*e.g.,* electric or hot gas defrost), all while ensuring that the procedure provides results reflecting energy usage during a representative average use cycle and not be unduly burdensome to conduct.

In AHRI 1250–2009, the moisture to provide a frost load is introduced through the infiltration of air at 75.2 °F dry-bulb temperature and 64.4 °F wet-bulb temperature into the walk-in freezer at a constant airflow rate that depends on the refrigeration capacity of the tested freezer unit (equations C11 and C12 in section C11.1.1 of AHRI 1250–2009). A key issue with this approach is the difficulty in ensuring repeatable frost development on the unit under test, despite specifying the infiltration air dry-bulb and wet-bulb temperatures. For example, in addition to frost accumulating on the evaporator of the unit under test, frost may also accumulate on the evaporator of other cooling equipment used to condition the room, which could subsequently affect the rate of frost accumulation on the unit under test (by affecting the amount of moisture remaining in the air).

ASHRAE-supported research—including a series of projects exploring frost loads and defrosting dynamics—suggest the possibility of alternative methods of creating a frost load. This work includes ASHRAE Project No. 622–RP ''A Study to Determine Heat Loads Due to Coil Defrosting'' [34] (''622–RP'') and Project No. 1094–RP ''A Study to Determine Heat Loads Due to Coil Defrosting-Phase II'' [35] (''1094–RP''). For the experiments discussed in these reports, the researchers created a frost load by introducing steam directly into the refrigerated space. However, as discussed in 1094–RP, this approach can result in the suspension of ice crystals in the saturated room air and the formation of snow-like frost on the test coils. The researchers found that this snow-like frost degrades refrigeration system performance more, and is more difficult to defrost, than the ice-like frost that forms in sub-saturated air conditions. 622–RP and 1094–RP also observed that during the defrost cycle, a significant portion (a majority for some trials) of the coil frost was sublimated (converted to water vapor) rather than melted. This finding suggests that measuring the quantity of frost melt water mass may be a poor indicator of the frost load, since a significant portion of the frost would not be captured as melt water. DOE is interested in any viable alternate frost load delivery methods that could be used to apply a known and repeatable amount and type of frost.

Issue 38: DOE requests information regarding potential methods of providing a measurable frost load and frost type for defrost testing, including data and information demonstrating the repeatability of such a test. Additionally, DOE requests data and information indicating what a typical frost load and frost type would be—for example, whether the moist air flow of section C11.1.1 of AHRI 1250–2009 provides the appropriate amount of moisture, and if so, whether any data are available to support the use of this quantity. If such data are available, DOE asks that interested parties share it with the agency for further consideration. If such data are currently unavailable, DOE is interested in what kind and amount of testing would be needed to sufficiently validate an appropriate method to evaluate frost loads and frost types during defrost testing.

b. Hot Gas Defrost

Among its various recommendations, the Working Group recommended that DOE modify its current test procedure to account for hot gas defrost system performance. (Term Sheet Recommendation #6). As a result of this recommendation, DOE is interested in obtaining feedback on the most practicable method for measuring or otherwise accounting for hot gas defrost performance.[36] DOE recognizes that in order to assess the energy performance of a defrost cycle, the test procedure must address both the energy consumed and the heat released into the refrigerated space by the defrost system. In general, for electric resistance heating systems, all the electrical energy consumed by the heater is transformed into heat, such that the energy consumed by the heater and the heat released into the space are equivalent. The procedure outlined in AHRI 1250–2009 is based on this principle and estimates the amount of heat released into the space by measuring energy consumption and subtracting the energy associated with frost melt that drains out of the chamber (section C11.1 of AHRI 1250–2009).

Alternatively, for hot gas defrost systems, the heat energy released into the evaporator (in the form of latent heat), and ultimately into the refrigerated space, is greater than the electrical energy used by the compressor to drive the hot gas defrost system. The exact ratio of heat released to electrical energy consumed depends on the efficiency of the specific system design. Therefore, the amount of heat released into the room cannot be estimated by measuring the electrical energy consumption of the heating system. Because the procedure outlined in AHRI 1250–2009 relies on an assumption that the energy consumed by the heater equals the heat released into the space, it is not applicable to hot gas defrost systems. DOE is not aware of a test method that can reliably be used to directly measure the thermal impact of hot gas defrost without a substantial increase in test burden.

Alternatively, DOE could consider the use of a calculation method. In such an approach, rather than measure the heat released into the refrigerated space for the unit-under-test, that heat load would be calculated as a function of the refrigeration system's steady-state capacity. The heat load-to-capacity relationship could be defined based on test data from actual hot gas defrost systems. Under this approach, the energy consumed by the hot gas defrost system could be quantified either by direct testing and measurement, or by using a calculation method, as described for heat load addition. DOE is aware that AHRI has developed a calculation method to represent hot gas defrost heat load and energy use contributions. This method is provided in Section C10.1 of AHRI 1250–2020 and prescribes equations to represent energy use and heat addition associated with defrost for different system configurations (matched-pair, single-package, unit cooler, condensing unit) and with consideration of whether hot gas is used only to defrost the evaporator or

[34] Sherif, S.A., P.J. Mago, and R.S. Theen. *A Study to Determine Heat Loads Due to Coil Defrosting.* 1997. University of Florida: Gainesville, FL. ASHRAE Project No. 622–RP. Report No. UFME/SEECL–9701.

[35] Sherif, S.A., P.J. Mago, and R.S. Theen. *A Study to Determine Heat Loads Due to Coil Defrosting-Phase II.* 2003. University of Florida: Gainesville, FL. ASHRAE Project No. 1094–RP. Report No. UFME/SEECL–200201.

[36] As previously mentioned, the March 2021 hot gas defrost TP final rule updated the defrost energy use and thermal load equations for hot gas defrost unit coolers tested alone to provide a consistent performance evaluation between hot gas defrost and electric defrost unit coolers when tested alone. 86 FR 16027, 16030. However, this approach does not measure or account for actual hot gas defrost thermal load and energy use.

whether it also maintains warm temperatures in the drip pan.

Finally, if DOE were to modify its walk-in test procedure to account for hot gas defrost energy consumption and heat load, DOE would need to determine the types of refrigeration system configurations (*i.e.,* matched-pairs, stand-alone unit coolers, and stand-alone condensing units) to which a hot gas defrost-specific test procedure would apply. For each configuration, DOE would also need to consider which methods (*i.e.,* testing, calculation, or both) would be most appropriate.

Issue 39: DOE requests comment on the specific refrigeration system configurations (*i.e.,* matched-pairs, stand-alone unit coolers, and stand-alone condensing units) to which a hot gas defrost-specific test procedure would apply. DOE requests comment on which methods for determining energy and heat load (*i.e.,* testing, calculation, or both) would be most appropriate for each refrigeration system and why. DOE requests comment on the methods related to hot gas defrost systems in AHRI 1250–2020. Finally, DOE requests data to help quantify the relationship between hot gas defrost heat load addition and energy consumption versus capacity and/or to confirm the relationships provided in the AHRI 1250–2020 test methods for hot gas defrost.

c. Adaptive Defrost

In the December 2016 TP final rule, DOE established a method to address systems with adaptive defrost. That approach requires that the feature be deactivated during compliance testing but allows a manufacturer to account for a unit's improved performance with adaptive defrost activated in its market representations. 81 FR 95758, 95767, 95777, 95790. At the November 4, 2015 Working Group meeting, Southern California Edison expressed concern with the assumption that the overall energy use of traditional defrost systems significantly exceeds adaptive defrost system energy use. Southern California Edison presented data showing that, for a tested adaptive defrost system, the reduction in energy use resulting from reduced defrost frequency is largely offset by an increase in energy use during the refrigeration on-cycle, due to the thermal resistance of the increased frost accumulation (Docket EERE–2015–BT–STD–0016, No. 38 [37]). The data presented by Southern California Edison illustrates just one potential complication in properly addressing the energy use impact of adaptive defrost—specifically, that an adaptive system that waits too long (*i.e.,* when too much frost builds up on the coils) to defrost may significantly affect the on-cycle performance of the refrigeration system. On the other hand, an adaptive system that defrosts too frequently could increase defrost energy use if the defrost frequency is higher than the four defrosts per day that is typical for a conventional timed defrost. The sensitivity of the adaptive defrost savings potential to the magnitude of the moisture load also suggests that a single adaptive defrost test using a constant moisture load may not properly represent this technology's benefits. The test procedure may have to account for the differences in daily and seasonal frosting patterns experienced by installed systems (*e.g.,* frequent air infiltration during business hours and none during non-business hours—or infiltration of warm, moist air in summer and cool, dry air in winter).

Issue 40: DOE requests comment on how the performance of adaptive defrost systems should be accounted for in the walk-in test procedure and which refrigeration systems (*i.e.,* matched-pairs, stand-alone unit coolers, and stand-alone condensing units) should be evaluated under a potential adaptive defrost test procedure. Specifically, DOE requests data showing the performance of adaptive defrost systems relative to non-controlled defrost systems, including impacts to on-cycle operation. DOE requests data demonstrating seasonal and daily frosting patterns for walk-in applications.

5. Off-Cycle Energy Use

As discussed previously, the Working Group recommended that DOE amend its test procedure to address issues related to off-cycle power consumption (Term Sheet Recommendation #6). For walk-in refrigeration systems, the term "off-cycle" refers to the period when the compressor is not running and defrost (if applicable) is not active. During the off-cycle, unit cooler fans and other auxiliary equipment will typically run or cycle on and off, thereby consuming energy.

While the current DOE test procedure accounts only for fan power consumption during the off-cycle period, AHRI 1250–2020 includes requirements specific to off-cycle fan power consumption in Section C3.5, which addresses power measurements for unit coolers (including total power to the fan motor(s), pan heaters, and controls) and DCUs, in addition to prescribing off-cycle measurement intervals, operating tolerances and data collection rates. Section C4.2 provides a method for determining off-cycle power consumption. DOE is considering the incorporation of this updated industry test method into its test procedures should a rulemaking be initiated.

Issue 41: DOE requests information and data on whether the off-cycle methods included in AHRI 1250–2020 provide a representative and repeatable measure of the off-cycle power use for matched pairs, single-package systems, and also for unit coolers and/or condensing units tested alone, and if not, what modifications are recommended. DOE also seeks information on other off-cycle mode energy-consuming components that are not currently addressed by AHRI 1250–2020. In addition to identifying all off-cycle mode energy-consuming components, DOE seeks information on the patterns and magnitudes of energy use by each of these components during the off-cycle.

6. Multi-Capacity and Variable-Capacity Condensing Units

In the July 2017 ECS final rule, DOE noted that it expected the majority of refrigeration equipment within the dedicated condensing class to be certified as stand-alone condensing units, with a much smaller number of systems certified as matched-pairs. 82 FR 31808, 31832. However, the current DOE test procedure does not include a method for assessing stand-alone multi- and variable-capacity systems. To address this gap, the Working Group recommended that DOE amend its test procedure to allow for separate ratings of stand-alone variable-capacity condensing units. (Term Sheet Recommendation #6).

Historically, refrigeration systems have been designed using a single-speed compressor, which operates at full cooling capacity while the compressor is on. To match the cooling load of the space, which in most cases is less than the full cooling capacity of the compressor, a single-speed compressor cycles on and off at a particular duty cycle. This cycling behavior introduces inefficiencies due to the surge in power draw experienced at the beginning of each "on" cycle, before the compressor reaches steady-state performance. In contrast, variable-capacity systems employ an inverter compressor that can reduce its speed to match the observed cooling load. Accordingly, a variable-speed compressor runs continuously, adjusting its speed up or down as required, thereby avoiding compressor cycling when the full cooling capacity

[37] Working Group Meeting Stakeholder Presentation: Walk-in Refrigeration ASRAC Meeting, available at *https://www.regulations.gov/document?D=EERE-2015-BT-STD-0016-0038.*

of the compressor is not necessary to provide sufficient cooling to the space. Similarly, a multi-capacity compressor can ''unload'' individual cylinders within the compressor, which allows the compressor to remain on, but at a reduced capacity, to more closely match the required cooling load.

The current DOE test procedure measures the performance of a walk-in condensing unit while operating under a full cooling load at a fixed capacity; *i.e.,* the compressor is operated continuously in its ''on'' state. See AHRI 1250–2009, Tables 11 through 14 and Appendix C, section 3.0. While AHRI 1250–2009 and AHRI 1250–2020 both include test methods for multi- and variable-capacity matched pair refrigeration systems, there is no test method for multi- and variable-capacity condensing units when tested alone. As a result, any inefficiencies due to compressor cycling, and any performance benefit associated with part-load operation, are not captured during the DOE test. Consequently, the current test procedure may underestimate the efficiency benefits of multi- and variable-capacity systems. DOE is aware of some multi- or variable-capacity condensing units that are currently available on the market.[38]

Issue 42: DOE requests input on the development of test methods that would more accurately measure the energy use performance—including accounting for the potential efficiency benefits of multi- and variable-capacity systems—both for matched-pair and stand-alone condensing unit testing. DOE seeks data and information showing the potential magnitude of energy savings by reducing cycling losses in these multi and variable-capacity systems. DOE requests market information on whether there are multi- and variable-capacity condensing units available on the market (in addition to those already identified) and the brand name(s) and model numbers of those additional units.

7. Systems for High-Temperature Freezer Applications

In the June 2014 ECS final rule, DOE established equipment classes for medium- and low-temperature walk-in refrigeration systems. 79 FR 32050, 32069–32070. While the terms ''medium-temperature'' and ''low-temperature'' are not explicitly defined, the June 2014 ECS final rule, 2015 ASRAC negotiations, December 2016 TP final rule, and July 2017 ECS final rule all consistently used the term ''medium-temperature'' to refer to walk-in cooler/refrigerator refrigeration systems and the term ''low-temperature'' to refer to walk-in freezer refrigeration systems.

The current test procedure for walk-in refrigeration systems specifies rating conditions of 35 °F for refrigerator systems and −10 °F for freezer systems (see section 5 of AHRI 1250–2009, incorporated by reference at 10 CFR 431.303(b)). The 35 °F and −10 °F rating conditions produce a metric, AWEF, which is generally representative of the medium- and low-temperature refrigeration systems' energy use when installed in walk-in coolers and freezers, respectively. The AWEF metric forms the basis for energy conservation standards for medium- and low-temperature refrigeration systems. However, field usage data indicate that walk-in refrigeration systems operate at a broad range of application temperatures both above and below the respective 35 °F and −10 °F rating points.

As discussed in the December 2016 TP final rule, stakeholders commented that so-called ''high-temperature'' freezer walk-ins, which have an enclosed storage (*i.e.* room) temperature range of 10 °F to 32 °F, are refrigerated with medium-temperature condensing units. 81 FR 95758, 95790. Under the statutory definitions of ''walk-in cooler'' and ''walk-in freezer,'' this equipment would be considered a walk-in freezer because its room temperature is less than or equal to 32 °F 42 U.S.C. 6311(20). Accordingly, these refrigeration systems would be tested using a room temperature of −10 °F, as specified in Appendix C. However, stakeholders commented as to the difficulty these medium-temperature refrigeration systems have in meeting this temperature condition when using lower GWP refrigerants.[39] 81 FR 95758, 95790. Lennox offered data suggesting that medium-temperature units generally perform more efficiently at the 10 °F operating condition (*i.e.,* the low end of the cited ''high-temperature freezer'' temperature range) than low-temperature systems. (Docket EERE–2015–BT–STD–0016, Lennox, No. 89[40] at pp. 2–5) Lennox suggested that this ''high-temperature freezer'' application may justifiably represent a third class of walk-in refrigeration systems, but also noted the reporting and testing burden that establishing an additional set of classes would incur. In response, DOE noted that manufacturers of equipment that cannot be tested in a way that properly represents their performance characteristics may petition DOE for test procedure waivers, as detailed in 10 CFR 431.401. DOE also indicated that it may consider amending its regulations by establishing new equipment classes and applicable test methods. 81 FR 95758, 95790–95791.

DOE is currently considering how, if at all, to address high-temperature freezer walk-ins, including whether to establish test procedure provisions to specifically address the refrigeration systems serving such equipment. Multiple approaches are under consideration. One approach would allow walk-in manufacturers and contractors to install a medium temperature refrigeration system that is tested and certified based on the standardized 35 °F walk-in cooler temperature (or corresponding refrigerant suction conditions) as a walk-in freezer, if the walk-in refrigeration system is marketed at or above 10 °F. By extension, the approach would also allow representations of performance (*e.g.* capacity, power input) of such medium-temperature refrigeration systems for walk-in temperatures at 10 °F and higher without requiring them to be tested and certified based on the −10 °F low-temperature walk-in test condition. This approach would alleviate the need for a new high-temperature freezer equipment class (thus avoiding the associated certification test burden), while still allowing the potentially more efficient medium temperature refrigeration systems to be used for high temperature freezer applications. (Docket EERE–2015–BT–STD–0016, Lennox, No. 89 at pp. 2–5 (offering data suggesting that medium temperature units generally perform more efficiently at the 10 °F operating condition than low-temperature systems)).

DOE could establish new definitions for the terms ''low-temperature refrigeration system'' and ''medium-temperature refrigeration system,'' that implement this potential structure. For example, ''low-temperature refrigeration system'' could be defined as ''a refrigeration system used to cool the interior of walk-in freezers and maintain a refrigerated room temperature of 10 °F or less,'' while ''medium-temperature refrigeration system'' could be defined

[38] Multi-capacity product information from one manufacturer can be found at *http://www.regulations.gov* Docket No. EERE–2017–BT–TP–0010–0004.

[39] Lennox commented that the industry was moving to low-GWP refrigerants in response to the Environmental Protection Agency final rule under the Significant New Alternatives Policy (''SNAP'') program that prohibited the use of R–404A in certain retail food refrigeration applications, including WICF refrigeration systems starting July 20, 2016. (Docket EERE–2016–BT–TP–0030, Lennox, No. 13 at p. 2) For further discussion of the SNAP rule, see section II.E.8 of this document.

[40] Available at *https://www.regulations.gov/document?D=EERE-2015-BT-STD-0016-0089.*

as ''a refrigeration system used to cool the interior of a walk-in cooler or a walk-in freezer operating above 10 °F.''

Alternatively, another approach would allow medium-temperature refrigeration systems used in high-temperature freezer walk-in applications to be tested and certified at their lowest application temperature conditions. This approach would be similar to that taken for commercial refrigerators, freezers, and refrigerator-freezers, for which manufacturers report the lowest application product temperature, *i.e.* the lowest average compartment temperature at which the equipment is capable of operating during testing (section 2.2 of appendix B to 10 CFR part 431 subpart C). For walk-ins, this concept could be based on the lowest evaporator return air temperature for matched-pair refrigeration systems and the lowest saturated suction temperature (and a suitable corresponding return gas temperature) for condensing units tested separately. This approach would result in ratings for the units in high-temperature freezer applications that are directly representative of field performance, as the refrigeration system would be tested at a representative box temperature for such an application. Further, this approach would not presuppose what the optimal high-temperature freezer operating condition would be, *i.e.,* it avoids selecting a standardized condition that may be unachievable by some units. However, AWEF ratings obtained from the lowest application temperature for different units, which would be rated for different box temperatures, would not be directly comparable. The approach would also add testing and reporting burden associated with the additional test condition.

DOE is also considering a third approach that would establish a single standardized test condition at which high-temperature freezer refrigeration equipment would be tested. This approach would result in AWEF ratings that are slightly less representative of field performance than the lowest application temperature approach, while still creating the potential need to establish a new equipment class (or classes) for low-temperature refrigeration systems. However, under a standardized test condition approach, all high-temperature freezer refrigeration systems would be rated at the same condition, providing directly comparable ratings for models that serve similar applications.

DOE is investigating if and how the calculations used for determining the AWEF of WICF condensing units tested alone and with matched systems would need to be modified for products certified with the latter two approaches discussed previously—for example, whether any potential changes to the specified duty cycle at 95 °F ambient temperature for an outdoor system would be necessary.

Issue 43: DOE requests feedback on the three approaches discussed in this section to address high-temperature freezer walk-ins, as well as any other potential approaches not raised in this RFI.

Issue 44: DOE also requests information that would help inform the development of test procedures for high-temperature freezer refrigeration systems, should such an approach be necessary. Additionally, DOE requests whether there are specific characteristics that distinguish a high-temperature freezer refrigeration system from a medium-temperature refrigeration system, in order to better define this category of equipment.

Issue 45: DOE also requests comment on whether 10 °F is the appropriate lowest end of the application range for equipment used in walk-in high-temperature freezers that cannot be tested using the −10 °F freezer test condition. Furthermore, DOE requests comment on whether all medium-temperature systems (matched-pair, condensing unit, evaporator) can be operated and tested at 10 °F (or equivalent refrigerant suction conditions), or whether there is a wide range at the low-end of the operating range that depends on the design of the system.

Issue 46: Regarding the testing of a medium-temperature refrigeration system in the high-temperature freezer range, DOE requests information on what specified test procedure parameters would need to be altered (and how) in order for the test to be representative of field operation. (In answering, DOE requests that commenters provide the supporting reasons for any suggested recommendations.) DOE requests information on whether a single standardized high-temperature freezer room condition could be appropriate for testing this group of walk-ins, and if so, what such an appropriate temperature would be.

Issue 47: Finally, DOE requests comment on what, if any, changes would be needed in the calculation of AWEF for high-temperature freezer operation, and why.

If DOE were to pursue the lowest application temperature approach or the standardized high-temperature freezer test condition approach, DOE would need to establish certain new default values to calculate the AWEF and net capacity of stand-alone high-temperature freezer dedicated condensing units. Currently, the test procedure provides equations for determining evaporator fan power, defrost energy, and defrost heat load, all of which are used in lieu of matched unit cooler test data (section 3.4.2 of Appendix C).

The current test procedure offers two separate equations that relate the cooling capacity to the evaporator fan power for medium- and low-temperature unit coolers (section 3.4.2.2 of Appendix C). Based on the condensing unit capacity at the medium temperature test condition (35 °F box temperature), using the medium-temperature equation seems to be the most appropriate approach since the condensing units in question would also be certified as medium-temperature condensing units. This approach also assumes that fan energy use at high-temperature freezer conditions will be the same as fan energy use at medium-temperature conditions, since it makes no adjustment in the calculated fan power for the high-temperature freezer application.

Issue 48: DOE requests comment on the appropriateness of using the current medium-temperature refrigeration system default fan input power equation (found at section 3.4.2.2 of Appendix C) to represent the fan input power of high-temperature freezer refrigeration systems. If the current medium-temperature refrigeration system default fan input power equation is not representative of the fan input power for high-temperature freezer refrigeration systems, DOE requests suggestions for a more appropriate equation, or alternative relationships to consider, as well as any relevant data.

In the current test procedure, defrost energy and defrost heat load for stand-alone dedicated condensing units are estimated based on the condenser capacity using an equation in section 3.4.2 of Appendix C. The calculations apply only to freezer models, since they assume that refrigeration systems serving walk-in coolers are not equipped for defrost capability and thus have no defrost energy or heat load. However, medium-temperature refrigeration systems designed for high-temperature freezer applications require defrost capability because frost that collects on the evaporator during the compressor off-cycle will not melt in the sub-freezing walk-in temperature conditions. The energy and heat load of these high-temperature freezer defrost systems may differ significantly from those of −10 °F freezers. Therefore, proper accounting for defrost of high-temperature freezer refrigeration systems requires developing a modified calculation. The equation found in section 3.4.2.4 of Appendix C used to calculate freezer equipment daily defrost energy use (''DF'') uses as inputs the condenser capacity (''$q_{mix,cd}$'') and the number of defrost cycles per day (''N_{DF}''). The daily defrost heat load (''Q_{DF}'') is directly dependent on DF (see relevant equation in section 3.4.2.5 of Appendix C). DOE anticipates that a calculation of defrost impacts for high-temperature freezers, if adopted, would use similar equations with different magnitudes.

Issue 49: DOE requests information or data that would indicate whether and how the equations used to calculate daily defrost energy use and heat addition in the test procedure should be modified for high-temperature freezer refrigeration systems rated as stand-alone condensing units (*e.g.,* defrost heater wattage and daily energy use as a function of capacity for a 10 °F walk-in temperature). If testing at the lowest application temperature is adopted, DOE requests comment on how the defrost equations should be modified to account for each model being tested at different conditions, and why. DOE requests information on whether frost loads and/or defrost frequency are different for high- temperature freezers than for −10 °F freezers. (DOE requests that commenters include any available supporting information when responding.)

8. Consideration for Refrigerant Glide

The analysis for the June 2014 ECS final rule assumed that the refrigerant R–404A would be used in all new refrigeration equipment meeting the standard. 79 FR 32050, 32074. In its subsequent negotiated rulemaking effort in 2015, WICF Working Group members suggested that DOE revise this approach by accounting for the use of a different refrigerant, R–407A, which was expected to become more commonly used for WICF applications. Consistent with that suggestion, DOE conducted the analysis for the July 2017 ECS final rule using R–407A as the refrigerant. 82 FR 31808, 31835–31836.

On July 20, 2015, the U.S. Environmental Protection Agency (''EPA'') published a final rule under the Significant New Alternatives Policy (''SNAP'') program listing as unacceptable the use of certain hydrofluorocarbons (''HFCs''), including the use of R–404A in WICF refrigeration systems. 80 FR 42870 (''July 2015 EPA SNAP Rule''). In October 2016, the 28th Meeting of the Parties to the Montreal Protocol adopted the Kigali Amendment on HFCs, which, upon ratification, requires parties to the protocol to reduce consumption and production of HFCs.[41] On December 1, 2016, EPA published a final rule (''December 2016 EPA SNAP Rule'') that listed a number of refrigerants for use in certain refrigerant applications as unacceptable, starting January 1, 2023 for cold storage warehouse application, and January 1, 2021 for retail food refrigerant applications. 81 FR 86778. The list of unacceptable refrigerants included R–407A. The validity of the SNAP approach, however, has been the subject of a legal challenge regarding EPA's use of its SNAP authority to require manufacturers to replace HFCs with a substitute substance.

In August 2017, the U.S. Court of Appeals for the District of Columbia Circuit vacated and remanded the July 2015 EPA SNAP Rule to the extent that it required manufacturers to replace HFCs with a substitute substance.[42] *Mexichem Fluor, Inc.* v. *EPA,* 866 F.3d 451 (D.C. Cir. 2017). Subsequently, the December 2016 SNAP Rule was partially vacated by the court.[43] While the United States has not ratified the Kigali Amendment, a significant portion of walk-in refrigeration systems currently use HFC-based refrigerants and may become affected by this Amendment to the Montreal Protocol. DOE plans to consider the potential impact (if any) of both the court's decision and remand as well as the Amendment to the Montreal Protocol on the test procedure issues addressed in this RFI.

Notwithstanding these legal developments, key differences between the refrigerants used in DOE's separate analyses of walk-in refrigeration systems merit discussion. Both R–404A and R–407A are blends of refrigerants that have different boiling points. This means that, unlike pure substances such as water, the temperature of the refrigerant changes as it boils or condenses, because one of the refrigerants in the blend, having a lower boiling point, boils off sooner than the other(s). This phenomenon is called ''glide.'' The refrigerants that make up R–404A have nearly identical boiling points, so this refrigerant has very little glide. In contrast, R–407A undergoes a much more significant temperature change when it boils—the temperature can rise as much as 8 degrees between the saturated liquid condition (the temperature at which a liquid begins to boil, also called the ''bubble point'') and the saturated vapor condition (the temperature at which a vapor begins to condense, also called the ''dew point''). The average of these two temperatures, bubble point and dew point, is called the mid-point temperature.

The current DOE test procedure specifies that test conditions are based on dew point. DOE notes that if the refrigerant condition for a unit cooler is specified by dew point, the average refrigerant temperature would be significantly lower for a high-glide than for a low-glide refrigerant. As mentioned previously, DOE is considering changing its test procedure to be based on a refrigerant-neutral approach. One specific option would be to use the mid-point temperature. However, with walk-in refrigeration systems, the refrigerant entering the unit cooler is typically a two-phase refrigerant with a temperature higher than the bubble point. This scenario results in the average evaporator temperature being slightly greater than a mid-point equal to the average of bubble and dew point temperatures. To account for this difference, DOE could develop an approach to calculate and specify refrigerant temperatures in terms of a ''modified mid-point,'' which would be a calculated value slightly higher than the mid-point of the selected refrigerant.

Issue 50: DOE requests comment on the appropriateness of specifying refrigerant temperatures in terms of mid-point or a modified mid-point, rather than dew point, which is currently used. DOE seeks feedback on potential definitions to use for a modified mid-point temperature as applied to WICF refrigeration system testing. In addition, DOE requests comments on what other factors should be considered when modifying the refrigeration system test conditions from dew point to mid-point or modified mid-point specifications.

III. Submission of Comments

DOE invites all interested parties to submit in writing by the date specified

[41] *http://www.unep.org/ozonaction/Portals/105/documents/7809-e-Factsheet_Kigali_Amendment_to_MP.pdf* (last viewed February 3, 2017).

[42] The vacatur and remand in *Mexichem, Inc.* v. *EPA* was of the July 2015 EPA SNAP Rule and did not directly address the December 2016 EPA SNAP Rule. At issue was EPA's use of its SNAP authority as a means to remove HFCs from the agency's list of acceptable substitutes. On April 27, 2018, EPA published a notice stating that in the near-term it will not apply the HFC listings in the July 2015 final rule pending a rulemaking and that it plans to begin a notice-and-comment rulemaking process to address the remand. 83 FR 18431.

[43] Following the decision in the *Mexichem* case, the court vacated the December 2016 SNAP Rule to the extent it requires manufacturers to replace HFCs that were previously and lawfully installed as substitutes for ozone-depleting substances. Case No. 17–1024 (D.C. Cir. April 5, 2019).

in the **DATES** heading, comments and information on matters addressed in this RFI and on other matters relevant to DOE's early assessment of whether an amended test procedure for walk-in coolers and freezers is warranted and if so, what such amendments should be.

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

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

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

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

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

Include contact information each time you submit comments, data, documents, and other information to DOE. No telefacsimiles (faxes) will be accepted.

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

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

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

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

DOE considers public participation to be a very important part of the process for developing test procedures and energy conservation standards. DOE actively encourages the participation and interaction of the public during the comment period in each stage of this process. Interactions with and between members of the public provide a balanced discussion of the issues and assist DOE in the process. Anyone who wishes to be added to the DOE mailing list to receive future notices and information about this process should contact Appliance and Equipment Standards Program staff at (202) 287–1445 or via email at *ApplianceStandardsQuestions@ee.doe.gov.*

IV. Issues on Which DOE Seeks Comment

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

Issue 1: DOE seeks comment on how liquid-cooled refrigeration systems are (or could be) used with respect to walk-in applications. DOE requests comment on whether it should consider establishing a test procedure for liquid-cooled refrigeration systems. If test procedures were considered for liquid-cooled refrigeration systems, DOE requests information on whether there is an industry standard or standards that should be considered.

Issue 2: DOE seeks comment on how wine cellar refrigeration systems should be defined to best represent the conditions under which these systems are designed to operate and to fully distinguish these systems from systems designed to meet safe food storage requirements. Additionally, DOE requests comment on applications other than wine cellar storage for refrigeration systems that are designed to operate at temperatures warmer than typical for coolers and for which testing at 35 °F would be representative of use. If there are such additional applications, DOE seeks information regarding the specific operating requirements (*i.e.,* temperature and humidity) for these systems.

Issue 3: DOE requests comment on the current definition of ''door'' in 10 CFR 431.302. DOE seeks feedback on the terminology of door components used and whether these are consistently interpreted. DOE seeks specific feedback from manufacturers on how they use the term ''door plug'' and whether it is essential to the definition of a WICF ''door''.

Issue 4: DOE requests comment on whether height and width or surface area are distinct attributes that effectively distinguish between passage and freight doors. DOE seeks information on any building codes, standards, or industry practices to support or refute maintaining the dimensions of a door as the defining characteristic which separates freight and passage doors.

Issue 5: Regarding a door that meets the freight door definition but does so only because it has a multi-door configuration in which the individual component doors each would by themselves not meet the freight door definition, DOE seeks comment on how such doors should be classified, and whether such classification should depend on other factors, such as whether one or more frame members divides the door opening into smaller openings.

Issue 6: DOE seeks comment on whether any attribute, or combination of attributes, other than size, would affect energy use and could be used to distinguish between freight doors and passage doors. If so, DOE requests data and comment on such attributes.

Issue 7: DOE requests comment on the accuracy of the computational method in NFRC 100 to predict U-factor for display and non-display doors. DOE seeks feedback regarding the differences in results (if any) between those obtained using the NFRC 100 computational method and those obtained when conducting physical testing using NFRC 102 for display and non-display doors. DOE is also interested in the magnitude of these differences and whether the computational method can be modified to yield results that more closely match the results obtained from actual physical testing. If manufacturers are aware of other methods to predict U-factor for either display doors or non-display doors besides NFRC 100, DOE requests how the results from these methods compare to physical testing.

Issue 8: DOE seeks information from manufacturers and other interested parties regarding how the industry currently rates individual door models, including the prevalence within the industry of using the computational method from NFRC 100. DOE also requests information on the costs associated with the computational method of NFRC 100 or an alternative computational method compared to physically testing the thermal transmittance of walk-in doors using NFRC 102.

Issue 9: DOE requests comment on what issues, if any, would be present if ASTM C518–17 were to be referenced in the Appendix B test procedure for measuring panel K-factor, or average thermal conductivity. While not exhaustive, primary areas of interest to DOE include any differences between the currently referenced version of the industry standard (ASTM C518–04) and ASTM C518–17 that would result in a difference in the determined R-value and/or test burden (whether an increase or decrease), and if there are such differences, the magnitude of impact to the determined R-value and/or test burden.

Issue 10: DOE requests comment on what issues, if any, would be present if AHRI 1250–2020 were to be referenced in the Appendix C test procedure for measuring walk-in refrigeration system AWEF. While not exhaustive, primary areas of interest to DOE include any differences between the currently referenced version of the industry standard (AHRI 1250–2009) and AHRI 1250–2020 that would result in a difference in the determined AWEF and/or test burden (whether an increase or decrease), and if there are such differences, the magnitude of impact to the determined AWEF and/or test burden.

Issue 11: DOE requests comment on how manufacturers determine surface area for the purpose of evaluating compliance with the standards for both display doors and nondisplay doors. DOE seeks input on any distinction between display doors and nondisplay doors, especially the door frames, which may warrant surface area for each to be determined differently.

Issue 12: DOE seeks feedback on how manufacturers interpret and measure door opening as it relates to prescriptive standards for antisweat heaters, including whether or not manufacturers agree that the door opening considered for antisweat heat should be consistent with the surface area used to determine maximum energy consumption.

Issue 13: DOE requests feedback on specifying the surface area used to determine thermal conduction through a walk-in door from the surface area used to determine the maximum energy consumption of a walk-in door.

Issue 14: DOE seeks comment on whether, and if so how, an option for direct component power measurement could be included in the test procedure or compliance, certification, and enforcement (''CCE'') provisions to allow more accurate accounting for the direct electrical energy consumption of WICF doors. DOE also seeks input on whether specific provisions should be provided for determining power input from the information that is typically provided on nameplates, noting the limitations that were described above.

Issue 15: DOE requests comment on the current PTO values and whether DOE should consider amending any of the current values or adding specific values for additional electrical components, specifically motorized door openers. DOE requests data from field studies or similar sources to support any proposed amendments (or additions) to these PTO values.

Issue 16: DOE seeks feedback on whether the current PTO of 50 percent is appropriate for evaluating direct energy consumption of anti-sweat heaters with controls for walk- in cooler doors marketed for high humidity applications. DOE seeks feedback on the average amount of time per day or per year that anti-sweat heaters with controls are off for these high humidity doors and how this compares to standard (*i.e.,* non-high humidity) walk-in cooler display doors.

Issue 17: DOE seeks feedback on the current EER values specified in Appendix A used to calculate daily energy consumption for walk-in doors and the values used in testing of unit coolers alone, as specified in Appendix C. Specifically, DOE requests comment on which of these sets of EER values is more representative, whether DOE should make the values used for door testing and unit cooler testing consistent with each other, and if so, which of the sets of values should be used.

Issue 18: DOE requests comment on how frequently test laboratories perform each of the calibration procedures referenced in ASTM C1199 and ASTM C1363, *e.g.,* those used to determine calibration coefficients that are used to calculate metering box wall loss and surround panel flanking loss. DOE also requests comment on the magnitude of variation in the calibration coefficients measured during successive calibrations.

Issue 19: DOE requests feedback on whether the tolerances in section 5.3(a)(1) of Appendix A applied to the surface heat transfer coefficients used to measure thermal transmittance are achievable for all walk-in doors and if not, whether the tolerances should be increased or omitted. Specifically, DOE seeks data to support any changes to the tolerances on the surface heat transfer coefficients.

Issue 20: DOE requests comment on how panel thickness is currently measured for determining the panel's R-value per the DOE test procedure, including number of measurements, measurement location, and any steps that are routinely followed for the removal of the protective skins or facers to obtain the full panel thickness. DOE requests that commenters identify any specific guidelines, practices or standardized approaches that are followed, as well as their date of publication, if applicable.

Issue 21: DOE requests comment on how flatness and parallelism of the test specimen surfaces that contact the hot plate assemblies described in ASTM C518 are typically determined by test laboratories and whether the test procedure should be revised to clarify how to determine these parameters, *e.g.,* what type of instruments are used to measure these values, how many measurements are made for a given specimen, and other details that could affect conclusions regarding compliance with the test procedure.

Issue 22: DOE requests comment on the extent to which manufacturers of insulation specify conditioning for insulation materials that differ from the typical conditioning approach described in ASTM C518. DOE also seeks feedback on whether more than one 24-hour conditioning period is ever needed to complete the conditioning (*i.e.,* the change in specimen mass is less than 1 percent after the first 24 hours of conditioning) for a specimen extracted from a WICF panel or door. Finally, DOE requests information or data on how specimen conditioning times less than or equal to 24 hours impacts the accuracy, repeatability, and representativeness of the test.

Issue 23: DOE requests information about panel construction factors that would affect thermal transmission and the magnitude of the energy efficiency-related impacts of thermal bridges in the panel assembly. Additionally, DOE requests comment on alternative test methods that measure the overall thermal transmittance of walk-in panels and the relative advantages and disadvantages of each. DOE also seeks feedback on the number and location of labs that have the facilities and are qualified to run ASTM C1363–05.

Issue 24: DOE seeks feedback on the current test procedure for display panels in Appendix A and what amendments should be made, if any, to it.

Issue 25: DOE requests comment on whether the single-package system test and calculation methods described in AHRI 1250–2020 provide representative energy use. DOE also requests comment on whether DOE should incorporate by reference AHRI 1250–2020 as the test procedure for single-package systems.

Issue 26: DOE requests any data or calculations quantifying the additional thermal losses associated with testing single-package systems due to the exposure of their cold sides to the exterior air (*i.e.,* surface and infiltration losses). DOE additionally requests comment on whether the AHRI 1250–2020 test methodology for single-package systems fully accounts for these additional losses.

Issue 27: DOE requests comment and data on the use of water, glycol, or other heat transfer liquid in maintaining test compartment temperature using the calorimeter methods referenced in AHRI 1250–2020 for the testing of single-package refrigeration systems. DOE requests comment on whether the description and requirements for calorimetric testing as provided in AHRI 1250–2020 should be modified or enhanced in order to better ensure that measurements are accurate and repeatable.

Issue 28: DOE requests comment on whether calorimeter test methods for single-package systems should implement a pressure-equalizing device, as included in ASHRAE 16–2016. DOE requests information on any additional cost and resource burdens, if any, manufacturers would face when employing these methods to evaluate single-package systems.

Issue 29: DOE seeks comment regarding any alternative test methods not mentioned in this document that could be used to measure single-package system capacity. To the extent that any alternative test methods could be used for this purpose, DOE requests information on their advantages and disadvantages in measuring single-package system capacity.

Issue 30: DOE requests comment on the alternative test procedure for wine cellar walk-in refrigeration systems that it has granted in the interim waivers and waivers listed in Table II.3. DOE additionally seeks comment on whether the alternative test procedure prescribed for the specified basic models identified in the waivers would be appropriate for similar refrigeration equipment.

Issue 31: DOE requests feedback on its approach for testing ducted units in its alternate test procedure for wine cellar refrigeration systems. Specifically, DOE requests comment and supporting data on whether testing at 50 percent of maximum ESP provides representative performance values, or whether other fractions of maximum ESP may be more appropriate. Additionally, DOE seeks comment on other industry test methods that include the testing of ducted units. Finally, DOE is interested in other alternative approaches for testing ducted units that have been demonstrated to provide repeatable and representative results.

Issue 32: DOE requests data and information on appropriate EER values for use in calculating AWEF for wine cellar unit coolers tested alone, and how these EER values might depend on refrigerant and/or capacity. DOE requests that commenters provide background explanation regarding how any such EER recommendations have been developed.

Issue 33: DOESince unit coolers for wine cellar systems are sold alone, DOE seeks information on the characteristics of condensing units that would typically be paired with these unit coolers (*e.g.,* make/model, compressor style, capacity range, manufacturers).

Issue 34: DOE seeks comment on whether, and if so how, it should modify its definitions for ''single-packaged dedicated system'' and ''unit cooler'' to address units that are designed to be installed with ducts.

Issue 35: DOE requests comment on any other issues regarding testing of wine cellar refrigeration systems that may not be fully addressed by the current DOE test procedure.

Issue 36: DOE requests comment on test conditions that would be most appropriate for evaluating the energy use of CO^2 unit coolers. Additionally, DOE requests feedback on any additional changes that would need to be made to the DOE test procedure to accurately evaluate energy use of these systems, while minimizing test burden.

Issue 37: DOE requests comment on the present and future expected use of walk-in refrigeration systems using CO_2. DOE requests specific information about these systems that would suggest a need to modify the DOE test procedure to address such equipment. Specifically, DOE requests information on whether such equipment is sold in the U.S., whether this equipment is sold as matched pairs or individual components, and to what extent dedicated condensing units are configured to supply subcritical liquid (rather than supercritical gas) to the unit coolers.

Issue 38: DOE requests information regarding potential methods of providing a measurable frost load and frost type for defrost testing, including data and information demonstrating the repeatability of such a test. Additionally, DOE requests data and information indicating what a typical frost load and frost type would be—for example, whether the moist air flow of section C11.1.1 of AHRI 1250–2009 provides the appropriate amount of moisture, and if so, whether any data are available to support the use of this quantity. If such data are available, DOE asks that interested parties share it with the agency for further consideration. If such data are currently unavailable, DOE is interested in what kind and amount of testing would be needed to sufficiently validate an appropriate method to evaluate frost loads and frost types during defrost testing.

Issue 39: DOE requests comment on the specific refrigeration system configurations (*i.e.,* matched-pairs, stand-alone unit coolers, and stand-alone condensing units) to which a hot gas defrost-specific test procedure would apply. DOE requests comment on which methods for determining energy and heat load (*i.e.,* testing, calculation, or both) would be most appropriate for each refrigeration system and why. DOE requests comment on the methods related to hot gas defrost systems in AHRI 1250- 2020. Finally, DOE requests data to help quantify the relationship between hot gas defrost heat load addition and energy consumption versus capacity and/or to confirm the relationships provided in the AHRI 1250–2020 test methods for hot gas defrost.

Issue 40: DOE requests comment on how the performance of adaptive defrost systems should be accounted for in the walk-in test procedure and which refrigeration systems (*i.e.,* matched-pairs, stand-alone unit coolers, and stand-alone condensing units) should be evaluated under a potential adaptive defrost test procedure. Specifically, DOE requests data showing the performance of adaptive defrost systems relative to non-controlled defrost systems, including impacts to on-cycle operation. DOE requests data demonstrating seasonal and daily frosting patterns for walk-in applications.

Issue 41: DOE requests information and data on whether the off-cycle methods included in AHRI 1250–2020 provide a representative and repeatable measure of the off-cycle power use for matched pairs, single-package systems, and also for unit coolers and/or condensing units tested alone, and if not, what modifications are recommended. DOE also seeks information on other off-cycle mode energy-consuming components that are not currently addressed by AHRI 1250–2020. In addition to identifying all off-cycle mode energy-consuming components, DOE seeks information on the patterns and magnitudes of energy use by each of these components during the off-cycle.

Issue 42: DOE requests input on the development of test methods that would more accurately measure the energy use performance—including accounting for the potential efficiency benefits of multi- and variable-capacity systems—both for matched-pair and stand-alone condensing unit testing. DOE seeks data and information showing the potential magnitude of energy savings by reducing cycling losses in these multi and variable-capacity systems. DOE requests market information on whether there are multi- and variable-capacity condensing units available on the market (in addition to those already identified) and the brand name(s) and model numbers of those additional units.

Issue 43: DOE requests feedback on the three approaches discussed in this section to address high-temperature freezer walk-ins, as well as any other potential approaches not raised in this RFI.

Issue 44: DOE also requests information that would help inform the development of test procedures for high-temperature freezer refrigeration systems, should such an approach be necessary. Additionally, DOE requests whether there are specific characteristics that distinguish a high-temperature freezer refrigeration system from a medium-temperature refrigeration system, in order to better define this category of equipment.

Issue 45: DOE also requests comment on whether 10 °F is the appropriate lowest end of the application range for equipment used in walk-in high-temperature freezers that cannot be tested using the −10 °F freezer test condition. Furthermore, DOE requests comment on whether all medium-temperature systems (matched-pair, condensing unit, evaporator) can be operated and tested at 10 °F (or equivalent refrigerant suction conditions), or whether there is a wide range at the low-end of the operating range that depends on the design of the system.

Issue 46: Regarding the testing of a medium-temperature refrigeration system in the high-temperature freezer range, DOE requests information on what specified test procedure parameters would need to be altered (and how) in order for the test to be representative of field operation. (In answering, DOE requests that commenters provide the supporting reasons for any suggested recommendations.) DOE requests information on whether a single standardized high-temperature freezer room condition could be appropriate for testing this group of walk-ins, and if so, what such an appropriate temperature would be.

Issue 47: Finally, DOE requests comment on what, if any, changes would be needed in the calculation of AWEF for high-temperature freezer operation, and why.

Issue 48: DOE requests comment on the appropriateness of using the current medium-temperature refrigeration system default fan input power equation (found at section 3.4.2.2 of Appendix C) to represent the fan input power of high-temperature freezer refrigeration systems. If the current medium-temperature refrigeration system default fan input power equation is not representative of the fan input power for high-temperature freezer refrigeration systems, DOE requests suggestions for a more appropriate equation, or alternative relationships to consider, as well as any relevant data.

Issue 49: DOE requests information or data that would indicate whether and how the equations used to calculate daily defrost energy use and heat addition in the test procedure should be modified for high-temperature freezer refrigeration systems rated as stand-alone condensing units (*e.g.,* defrost heater wattage and daily energy use as a function of capacity for a 10 °F walk-in temperature). If testing at the lowest application temperature is adopted, DOE requests comment on how the defrost equations should be modified to account for each model being tested at different conditions, and why. DOE requests information on whether frost loads and/or defrost frequency are different for high-temperature freezers than for −10 °F freezers. (DOE requests that commenters include any available supporting information when responding.)

Issue 50: DOE requests comment on the appropriateness of specifying refrigerant temperatures in terms of mid-point or a modified mid-point, rather than dew point, which is currently used. DOE seeks feedback on potential definitions to use for a modified mid-point temperature as applied to WICF refrigeration system testing. In addition, DOE requests comments on what other factors should be considered when modifying the refrigeration system test conditions from dew point to mid-point or modified mid-point specifications.

Signing Authority

This document of the Department of Energy was signed on June 3, 2021, by Kelly Speakes-Backman, Principal Deputy Assistant Secretary and Acting Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on June 4, 2021.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

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