DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[Docket No. EERE–2014–BT–TP–0010]

RIN 1904–AC80

Energy Conservation Program: Test Procedures for Dehumidifiers

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

ACTION: Notice of proposed rulemaking.

SUMMARY: The U.S. Department of Energy (DOE) proposes to revise its test procedures for dehumidifiers, by adding clarifications for equipment setup during testing and correcting the calculations of active mode energy use and an efficiency metric, integrated energy factor (IEF). The proposed amendments would also create a new appendix which would require certain active mode testing at a lower ambient temperature, add a measure of fan-only mode energy consumption in the IEF metric, and include testing methodology and measures of performance for whole-home dehumidifiers. Finally, DOE proposes to add clarifying definitions of covered products, amend the certification requirements, add verification instructions for the capacity measurement, and make certain editorial corrections.

DATES: DOE will hold a public meeting on Friday, June 13, 2014 from 9 a.m. to 12 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section V, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than August 4, 2014. See section V, ''Public Participation,'' for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 8E–089, 1000 Independence Avenue SW., Washington, DC 20585. To attend, please notify Ms. Brenda Edwards at (202) 586–2945. Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Edwards to initiate the necessary procedures. Please also note that those wishing to bring laptops into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes. Persons can attend the public meeting via webinar. For more information, refer to the Public Participation section near the end of this document.

Any comments submitted must identify the NOPR for Test Procedures for Dehumidifiers, and provide docket number EE–2014–BT–TP–0010 and/or regulatory information number (RIN) number 1904–AC80. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal: www.regulations.gov.* Follow the instructions for submitting comments.
2. *Email: Dehumidifier2014TP0010@ee.doe.gov.* Include the docket number and/or RIN in the subject line of the message.
3. *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue SW., Washington, DC 20585–0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.
4. *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza SW., Suite 600, Washington, DC 20024. Telephone: (202) 586–2945. If possible, please submit all items on a CD. It is not necessary to include printed copies.

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

Docket: The docket, which includes **Federal Register** notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at regulations.gov. All documents in the docket are listed in the 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.

A link to the docket Web page can be found at: *http://www.regulations.gov/#!docketDetail;D=EERE-2014-BT-TP-0010.* This Web page contains a link to the docket for this document on the regulations.gov site. The regulations.gov Web page contains instructions on how to access all documents, including public comments, in the docket. See section V for information on how to submit comments through regulations.gov.

For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov.*

FOR FURTHER INFORMATION CONTACT:

Mr. Bryan Berringer, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies, EE–5B, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 586–0371. Email: *bryan.berringer@ee.doe.gov.*

Ms. Elizabeth Kohl, U.S. Department of Energy, Office of the General Counsel, GC–71, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 586–7796. Email: *elizabeth.kohl@hq.doe.gov.*

SUPPLEMENTARY INFORMATION:

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I. Authority and Background

Title III of the Energy Policy and Conservation Act of 1975 (42 U.S.C. 6291, et seq.; ''EPCA'' or, ''the Act'') sets forth a variety of provisions designed to improve energy efficiency. (All references to EPCA refer to the statute as amended through the American Energy Manufacturing Technical Corrections Act (AEMTCA), Public Law 112–210 (Dec. 18, 2012).) Part B of title III, which for editorial reasons was redesignated as Part A upon incorporation into the U.S. Code (42 U.S.C. 6291–6309, as codified), establishes the ''Energy Conservation Program for Consumer Products Other Than Automobiles.'' These include dehumidifiers, the subject of this proposed rule. (42 U.S.C. 6292(a)(11))

Under EPCA, the energy conservation program consists essentially of four parts: (1) Testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. The testing requirements consist of test procedures that manufacturers of covered products must use as the basis for (1) certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA, and (2) making representations about the efficiency of those products. Similarly, DOE must use these test procedures to determine whether the products comply with any relevant standards promulgated under EPCA.

A. General Test Procedure Rulemaking Process

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

In addition, if DOE determines that a test procedure amendment is warranted, it must publish proposed test procedures and offer the public an opportunity to present oral and written comments on them. (42 U.S.C. 6293(b)(2)) Finally, in any rulemaking to amend a test procedure, DOE must determine to what extent, if any, the proposed test procedure would alter the measured energy efficiency of any covered product as determined under the existing test procedure. (42 U.S.C. 6293(e))

B. Test Procedure for Dehumidifiers

EPCA specifies that the dehumidifier test criteria used under the ENERGY STAR [1] program in effect as of January 1, 2001,[2] must serve as the basis for the DOE test procedure for dehumidifiers, unless revised by DOE. (42 U.S.C. 6293(b)(13)) The ENERGY STAR test criteria required that American National Standards Institute (ANSI)/Association of Home Appliance Manufacturers (AHAM) Standard DH–1, ''Dehumidifiers,'' be used to measure capacity while the Canadian Standards Association (CAN/CSA) standard CAN/CSA–C749–1994 (R2005), ''Performance of Dehumidifiers,'' be used to calculate the energy factor (EF). The version of AHAM Standard DH–1 in use at the time the ENERGY STAR test criteria were adopted was AHAM Standard DH–1–1992. DOE adopted these test criteria, along with related definitions and tolerances, as its test procedure for dehumidifiers at 10 CFR part 430, subpart B, appendix X in 2006. 71 FR 71340, 71347, 71366, 713667–68 (Dec. 8, 2006).

On October 31, 2012, DOE published a final rule to establish a new test procedure for dehumidifiers that references ANSI/AHAM Standard DH–1–2008, ''Dehumidifiers,'' (ANSI/AHAM DH–1–2008) for both energy use and capacity measurements. 77 FR 65995 (Oct. 31, 2012). The final rule also adopted standby and off mode provisions that satisfy the requirement in EPCA for DOE to include measures of standby mode and off mode energy consumption in its test procedures for residential products, if technically feasible. (42 U.S.C. 6295(gg)(2)(A)) This new DOE test procedure, codified at that time at 10 CFR part 430, subpart B, appendix X1 (appendix X1), established a new metric, integrated energy factor (IEF), which incorporates measures of active, standby, and off mode energy use.

DOE subsequently removed the existing test procedures at appendix X and redesignated the test procedures at appendix X1 as appendix X. 79 FR 7366, Feb. 7, 2014. After August 6, 2014, any representations of energy use, including standby mode or off mode energy consumption, or efficiency of portable dehumidifiers must be made in accordance with the results of testing pursuant to the redesignated appendix X. In this NOPR, DOE proposes further amendments to the redesignated appendix X.

DOE also initiated a rulemaking to consider amending the energy conservation standards for dehumidifiers. As part of this rulemaking, DOE is considering standards for whole-home, including refrigerant-desiccant, dehumidifiers. Any amended standards for both portable and whole-home dehumidifiers would be based on the efficiency metrics as determined from a new DOE test procedure at appendix X1 that DOE is proposing to establish in this document. DOE published a document announcing the availability of the Energy Conservation Standards Rulemaking Framework Document for Dehumidifiers on August 17, 2012 (the ''August 2012 Framework Document'') 77 FR 49739 (Aug. 17, 2012). The August 2012 Framework Document, also published on the DOE Web site, discusses the analyses DOE intends to conduct throughout the standards rulemaking. In response to the August 2012 Framework Document and at the public meeting held on September 24, 2012, DOE received a number of comments related to the dehumidifier test procedure. DOE considered these comments in its analysis for this NOPR, and provides responses in this document.

II. Summary of the Notice of Proposed Rulemaking

In this NOPR, DOE proposes to establish in 10 CFR 430.2 definitions for different categories of residential dehumidifiers: Portable dehumidifiers and whole-home dehumidifiers. The proposal includes a definition for whole-home dehumidifiers that incorporate moisture removal by means of either a refrigeration system and a desiccant, which require specific testing methodology. The provisions in appendix X1 proposed in this NOPR would include test equipment and methodology for measuring the capacity and IEF of whole-home dehumidifiers under conditions representative of typical ducted installations.

DOE also proposes amending the dehumidifier test procedure to provide a more accurate representation of active mode performance in new appendix X1. The active mode provisions currently in

[1] For more information on the ENERGY STAR program, please visit *www.energystar.gov.*

[2] ''Energy Star Program Requirements for Dehumidifiers'', Version 1.0, U.S. Environmental Protection Agency, available online at: *www.energystar.gov/products/specs/system/files/DehumProgReqV1.0.pdf.*

appendix X require testing under ambient conditions consisting of a dry-bulb temperature of 80 degrees Fahrenheit (°F) and a wet-bulb ambient temperature of 69.6 °F; however, DOE's recent analysis and information from interested parties suggest that this set of test conditions may not be representative of residential installation locations, and that dehumidifier performance varies according to the ambient temperature and humidity. Therefore, DOE is proposing amendments to be incorporated in the new appendix X1 that would reduce the required ambient dry-bulb and wet-bulb temperatures during the test to better reflect the energy use and capacity of dehumidifiers in real-world conditions.

DOE further proposes to incorporate into appendix X1 measures of energy use in fan-only mode for dehumidifiers that operate the fan either continuously or cyclically without activating the refrigeration system when the ambient relative humidity is lower than the setpoint, rather than entering off-cycle mode.

Because appendix X does not provide instructions regarding the proper control settings, including the fan speed to be used for testing dehumidifiers with multiple fan-speed options and the relative humidity control setting, DOE is proposing to conduct active mode testing in appendix X and appendix X1 using the setting for continuous operation for dehumidifiers equipped with such an option. For dehumidifiers without a setting for continuous operation, DOE proposes to require testing at the highest possible fan speed and lowest relative humidity setting to achieve the maximum possible moisture removal rate, which is the primary function of the product. DOE also proposes in appendix X and appendix X1 to define this primary operating mode as ''dehumidification mode'' to distinguish it from fan-only mode, which is also an active mode, and to clarify that the definition of ''product capacity'' is a measure of the moisture removed under the specified ambient conditions.

Finally, DOE also is proposing in this document to: (1) Add specifications in appendix X and appendix X1 for psychrometer setup for multiple air intakes, which would require the use of a separate sampling tree for each intake grille, and require that when testing multiple portable dehumidifiers at the same time, each dehumidifier be provided with a separate psychrometer centered in front of each of its air intake grille(s); (2) specify in appendix X and appendix X1 that the condensate must be collected in a substantially closed vessel placed on the weight-measuring instrument if means are provided on the dehumidifier for draining condensate away from the cabinet; if not, any condensate in excess of the amount that the internal collection bucket can hold should be collected in an overflow pan for the condensate weight measurement without the use of any internal pump (unless the use of such a pump is provided by the manufacturer by default during dehumidification mode); (3) correct the definition of ''dehumidifier'' in 10 CFR 430.2 and clarify that it does not cover portable air conditioners or room air conditioners; (4) provide a technical correction and clarifications within the IEF equation in appendix X and appendix X1; (5) correct typographical errors in the number of annual hours for inactive mode and off mode in appendix X and appendix X1; (6) provide instructions for the dates of use of appendix X and appendix X1; and (7) add capacity to the sampling requirements used for dehumidifier certification, along with clarification in 10 CFR 430.23(z) regarding how capacity is measured.

III. Discussion

A. Products Covered by This Test Procedure Rulemaking

EPCA defines a dehumidifier as a self-contained, electrically operated, and mechanically encased assembly consisting of—

- A refrigerated surface (evaporator) that condenses moisture from the atmosphere;
- A refrigerating system, including an electric motor;
- An air-circulating fan; and
- Means for collecting or disposing of the condensate.

42 U.S.C. 6291(34); 10 CFR 430.2.

DOE is aware of two general categories of residential dehumidifiers, classified according to the primary installation configuration: Portable dehumidifiers and whole-home dehumidifiers. Portable dehumidifiers are the most common category of dehumidifier sold in the United States, representing more than 95 percent of residential dehumidifier shipments. Consumers typically purchase portable dehumidifiers to reduce the relative humidity in one room or area of a living space less than 2,500 square feet, and may move these units from room to room to selectively reduce humidity where necessary. These units may also be located in an unconditioned space where moisture control is desired. Portable units currently on the market have rated capacities ranging from 22 pints of moisture removed per day (pints/day) to more than 120 pints/day. Portable units are standalone appliances designed to operate independent of any other air treatment devices, and do not require attachment to ducting, although certain models may have optional components to do so (*i.e.,* ''convertible portable'' units).

Whole-home dehumidifiers are designed to be attached to ducting that supplies dehumidified air to multiple or large living spaces in a residence and that returns humid air from the same spaces to the dehumidifier inlet. Whole-home dehumidifiers are often installed in conjunction with an existing heating, ventilation, or central air-conditioning (HVAC) system, and may utilize certain components of the HVAC equipment such as the air-handling blower, but can operate independently as well. Whole-home dehumidifiers typically use the same dehumidification system as portable units; however, to effectively dehumidify a large area, these units are manufactured with larger components than portable dehumidifiers, and may include additional features, such as pre-coolers or desiccant wheels, which may be difficult to incorporate into portable units due to volume and weight constraints. Whole-home product capacities range from approximately 65 pints/day to more than 200 pints/day when tested without ducting. The lack of ducting, however, allows higher airflow through the dehumidifier than would be experienced in real-world installations, which in turn results in higher measured values for capacity and IEF.

In the August 2012 Framework Document, DOE considered whether whole-home dehumidifiers as well as portable dehumidifiers should be considered covered products for the purposes of energy conservation standards. In response, Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric Company (SDG&E), and Southern California Edison (SCE), (hereafter the ''California Investor-Owned Utilities (IOUs)'') expressed support for DOE's proposal to cover whole-home dehumidifiers and recommended that DOE acquire additional data on both the performance and market saturation of these units. (California IOUs, No. 11 at p. 4) [3]

[3] A notation in the form ''California IOUs, No. 11 at p. 4'' identifies a written comment: (1) Made by Pacific Gas and Electric Company, San Diego Gas and Electric Company, and Southern California Edison (''the California IOUs''); (2) recorded in document number 11 that is filed in the docket of the residential dehumidifier energy conservation standards rulemaking (Docket No. EERE–2012–BT–STD–0027) and available for review at *www.regulations.gov;* and (3) which appears on page 4 of document number 11.

AHAM requested clarification regarding coverage and requirements for testing with ducted installation, particularly with portable products that can be optionally ducted as compared to dehumidifiers with manufacturer instructions that specify ducting. (AHAM, Public Meeting Transcript, No. 10 at p. 28) [4] DOE research of the residential dehumidifier market revealed models that can be used as either a portable dehumidifier or as a ducted (*i.e.,* whole-home) dehumidifier. Several manufacturers refer to these products as ''convertible'' dehumidifiers. These convertible products have optional ducting kits that can either be installed or removed to accommodate free standing portable operation or ducted installations. Therefore, these products would meet the proposed definitions of both portable and whole-home dehumidifiers. Accordingly, DOE proposes in this document that if a given model meets both the proposed definition of a portable dehumidifier and a whole-home dehumidifier, with conversion achieved by means of optional ducting ducting kits, the product must be tested as both product categories, must meet both applicable standards, and must be certified as meeting both standards, if DOE ultimately establishes standards for whole home units.

The Southern Company noted that dehumidification technologies other than those based on refrigeration systems, such as desiccant dehumidifiers, are available on the market, and questioned whether products that do not use a refrigeration system and do not collect a liquid condensate would be covered. (Southern Company, Public Meeting Transcript, No. 10 at p. 45) Dehumidifiers that remove moisture using a desiccant but with no refrigeration system would not meet the statutory definition set forth by EPCA, and thus would not be covered products. (42 U.S.C. 6291(34)) However, certain whole-home dehumidifiers incorporate desiccant technology along with refrigeration systems, hereafter referred to as refrigerant-desiccant dehumidifiers. Some of the moisture in the ''process'' air (*i.e.,* the air that is supplied from and returned to the dehumidified space) is condensed on the evaporator as with typical dehumidifiers, while additional moisture is removed via a porous desiccant material that adsorbs moisture when damp air passes through or over it. The desiccant material is typically configured in a circular or wheel structure. A portion of the wheel adsorbs moisture from the process air entering the unit, which is then delivered to the dehumidified space. As the wheel rotates, the moisture in that segment is released into a separate heated reactivation air stream and exhausted out of the home. In addition to removing some moisture from the process air directly, the refrigeration system boosts the temperature of the reactivation air to more effectively remove moisture from the desiccant wheel, and cools the incoming air to improve the adsorptivity of the desiccant material. Because refrigerant-desiccant dehumidifiers have separate process and reactivation air streams and associated ducting, DOE proposes provisions in appendix X1 to test such whole-home units.

In this NOPR, to clarify which provisions in the dehumidifier test procedure apply to the different categories of dehumidifiers, DOE is proposing to amend 10 CFR 430.2 to include definitions of portable, whole-home, and refrigerant-desiccant dehumidifiers as follows:

Portable dehumidifier: A dehumidifier designed to operate within the dehumidified space without the attachment of additional ducting, although means may be provided for optional duct attachment.

Whole-home dehumidifier: A dehumidifier designed to be installed with ducting to deliver return process air to its inlet and to supply dehumidified process air from its outlet to one or more locations in the dehumidified space.

Refrigerant-desiccant dehumidifier: A whole-home dehumidifier that removes moisture from the process air by means of a desiccant material in addition to a refrigeration system.

DOE also proposes in this NOPR to adopt the following definition for ''process air'' in appendix X1:

Process air: The air supplied to the dehumidifier from the dehumidified space and discharged to the dehumidified space after moisture has been removed by means of the refrigeration system.

DOE requests comment on the proposed definitions for portable, whole-home, and refrigerant-desiccant dehumidifiers, and whether there are additional dehumidifier product categories that should be considered as covered products, consistent with the statutory definition of dehumidifier.

B. Determination, Classification, and Testing Provisions for Dehumidifier Active Modes

Appendix X defines ''active mode'' as a mode in which a dehumidifier is performing the main functions of removing moisture from ambient air by drawing moist air over a refrigerated coil using a fan, circulating air through activation of the fan without activation of the refrigeration system, or defrosting the refrigerant coil. In the course of testing conducted for this proposal, DOE observed that dehumidifiers may operate in different modes that would be classified as part of active mode, depending on whether the humidity setpoint has been reached.

When the dehumidifier is operating in active mode and the ambient relative humidity is higher than the humidity setpoint, the unit may perform any of the main functions listed under the active mode definition. Further, DOE observed during its tests that a dehumidifier may alternate among these main functions, with the unit activating a particular main function for a period of minutes or hours before switching to a different main function. The pattern of activation of these functions may vary, depending on the programming of the particular model and the ambient conditions. DOE notes that none of the 17 portable and 8 whole-home dehumidifiers in its test sample exhibited such variable behavior under the ambient conditions currently specified in appendix X, nominally 80 °F dry-bulb temperature and 69.6 °F wet-bulb temperature, and instead continuously removed moisture from the ambient air. However, when the ambient temperature was lower than 80 °F and the relative ambient humidity was higher than the setpoint, certain units in the test sample periodically operated the fan without activating the refrigeration system. This action may have been taken to prevent the formation of frost or to remove any ice build-up from the evaporator to continue the main function of moisture removal. Therefore, DOE proposes to add the following definition of ''dehumidification mode'' to appendix X and appendix X1 to describe all dehumidifier operations during the

[4] A notation in the form ''AHAM, Public Meeting Transcript, No. 10 at p. 28'' identifies an oral comment that DOE received during the September 24, 2012, residential dehumidifier energy conservation standards framework public meeting, was recorded in the public meeting transcript in the docket for the residential dehumidifier energy conservation standards rulemaking (Docket No. EERE–2012–BT–STD–0027), and is maintained in the Resource Room of the Building Technologies Program. This particular notation refers to a comment (1) made by AHAM during the public meeting; (2) recorded in document number 10, which is the public meeting transcript that is filed in the docket of this energy conservation standards rulemaking; and (3) which appears on page 28 of document number 10.

period when the humidity setpoint is lower than the ambient relative humidity and the dehumidifier is engaged in the main function of moisture removal:

Dehumidification mode: An active mode in which a dehumidifier (1) has activated the main moisture removal function according to the humidistat or humidity sensor signal and (2) has either activated the refrigeration system or activated the fan or blower without activation of the refrigeration system.

The energy use for all main functions, including periods of fan operation with and without activation of the refrigeration system that may occur when the ambient relative humidity is above the setpoint, would be measured according to the proposed provisions for dehumidification mode testing in appendix X1, as discussed in section III.B.1 of this document, and for active mode testing in appendix X.

A dehumidifier fan may also operate without activation of the refrigeration system after the humidity setpoint has been reached or when selected by the consumer. Under these conditions, the fan may be operated to ensure that air is drawn over the humidistat to monitor ambient conditions, or for air circulation in the dehumidified space. It is also possible that immediately following a period of dehumidification mode, this fan operation may be initiated to remove any remaining frost from the evaporator. Such functions would classify this ''fan-only mode'' as an active mode, and it is distinct from any periods of fan-only operation in dehumidification mode because the setpoint has been reached or the product is not being used for the main purpose of moisture removal. For this reason, DOE proposes to include the following definition of ''fan-only mode'' in appendix X1:

Fan-only mode: An active mode in which the dehumidifier (1) has cycled off its main moisture removal function by humidistat or humidity sensor, (2) has activated its fan or blower to operate either cyclically or continuously, and (3) may reactivate the main moisture removal function according to the humidistat or humidity sensor signal.

In this document, DOE also proposes in appendix X1 to measure the energy consumption during fan-only mode according to methodology discussed in section III.B.2 of this document.

1. Dehumidification Mode

In appendix X, DOE adopted the ANSI/AHAM DH–1–2008 test procedure to determine dehumidifier active mode performance while performing its main function of removing moisture from ambient air. According to this methodology, the dehumidifier is operated continuously in a test room with nominal ambient temperature and humidity conditions of 80 ± 2.0 °F dry-bulb temperature and 69.6 ± 1.0 °F wet-bulb temperature. Following a stabilization period during which three consecutive measurements at 10-minute intervals of dry-bulb temperature, wet-bulb temperature, and applied voltage must remain within allowable tolerances, the dehumidifier is operated continuously for 6 hours while collecting the condensate and recording the energy consumption. At the end of the test, the condensate is weighed and this value is used to calculate the unit's capacity, in pints per day. The calculation incorporates equations to normalize the results to nominal ambient conditions, accounting for variability in ambient conditions from test to test. The ANSI/AHAM DH–1–2008 test procedure includes a calculation for EF, expressed in liters per kilowatt hour (L/kWh), with corrections to normalize the data to nominal ambient conditions. Appendix X additionally includes the calculation of IEF, also expressed in L/kWh, which combines active mode energy consumption with the combined low-power mode energy consumption based on annual usage estimates for each mode.

a. Ambient Temperature

As noted previously, the active mode provisions in appendix X that measure the moisture removal rate and energy consumption during dehumidification mode specify ambient conditions at a nominal 80 °F dry-bulb temperature and 69.6 °F wet-bulb temperature, which correspond to 60-percent relative humidity, for the duration of the 6-hour test. This section discusses proposed ambient temperature options for both portable and whole home dehumidifiers. The proposals in this section are based on ambient and ground temperature for specific geographical locations that represent the majority of national dehumidifier use, and testing of a market representative sample of dehumidifiers. DOE tested 13 portable and 14 whole-home dehumidifiers according to ANSI/AHAM DH–1–2008 at varying temperatures.

In response to the August 2012 Framework Document, AHAM commented that, although representative values for dehumidifier ambient conditions are difficult to specify due to variability in factors such as geographical locations and locations within the living space, the existing ambient conditions in the test procedure adequately address these differences and should not be amended. However, AHAM requested that if DOE does consider amending the test conditions, it should conduct studies on average geographical locations and average living space locations in which dehumidifiers are used and the ambient conditions in those spaces. Furthermore, AHAM commented that DOE would need to consider the effect of amended ambient conditions on measured energy use and on repeatability and reproducibility of the test procedure. (AHAM, No. 8 at pp. 4–5)

Appliance Standards Awareness Project (ASAP), American Council for an Energy-Efficient Economy (ACEEE), Consumers Union (CU), Natural Resources Defense Council (NRDC), and Northwest Energy Efficiency Alliance (NEEA), (hereafter the ''Joint Commenters'') and the California IOUs commented that the current single rating condition specified in ANSI/AHAM DH–1–2008 is not representative of field conditions where dehumidifiers are used, and that testing at 80 °F and 60-percent relative humidity may overstate EF compared to operation in the field over a range of ambient conditions. ASAP and the Joint Commenters referenced a study conducted by the Cadmus Group (hereafter referred to as the Cadmus Group Study)[5] that found the measured EFs of units in the field to be significantly lower than rated, and that attributed the difference, in part, to the ambient conditions (temperature and relative humidity) in the field being significantly lower than the current test conditions. ASAP and the Joint Commenters also referenced a National Renewable Energy Laboratory (NREL) study[6] that summarized testing on six dehumidifiers and showed significant decreases in EF as either ambient temperature or relative humidity decreased. (ASAP, Public Meeting Transcript, No. 10 at pp. 19–21; Joint Commenters, No. 9 at pp. 1–5; California IOUs, No. 11 at pp. 1–3)

The Joint Commenters and ASAP further stated that the test procedure

[5] L. Mattison and D. Korn, ''Dehumidifiers: A Major Consumer of Residential Electricity,'' The Cadmus Group, Inc., *2012 ACEEE Summer Study on Energy Efficiency in Buildings,* August 2012, Pacific Grove, CA. Available online at: *www.aceee.org/files/proceedings/2012/data/papers/0193-000291.pdf*.

[6] J. Winkler, D. Christensen, and J. Tomerlin, ''Laboratory Test Report for Six ENERGY STAR® Dehumidifiers,'' National Renewable Energy Laboratory, NREL/TP–5500–52791, December 2011. Available online at: *www.nrel.gov/docs/fy12osti/52791.pdf*.

does not capture dehumidifier performance under frost conditions (*i.e.,* when ice accumulates on the evaporator as the dry-bulb temperature drops below 65 °F, for most units), which a dehumidifier operating in a basement is likely to experience. ASAP commented that data from the *Residential Energy Consumption Survey* (*RECS*) [7] indicate that 75 percent of homes with dehumidifiers have basements, where temperatures are lower than 80 °F. The Joint Commenters referenced the ''Building Foundations Design Handbook'' to suggest that the typical temperatures of unconditioned basements range between 55 °F and 70 °F.[8] The Joint Commenters also stated that both ANSI/AHAM DH–1–2008 and *Consumer Reports* [9] testing of dehumidifiers reflect the importance of adequate operation under frost conditions. The Joint Commenters noted that the ''low temperature test'' in ANSI/AHAM DH–1–2008, which includes recommended levels of performance related to unit operation and frost accumulation, is conducted at 65 °F, and that *Consumer Reports* ratings of dehumidifiers include ''cool room performance,'' which is conducted at 50 °F. The Joint Commenters urged DOE to amend the test procedures to more accurately reflect field conditions and performance by including at least one low-temperature rating point (*e.g.,* 60 °F), which is likely to occur in basements and at which frost accumulation can affect operation. (ASAP, Public Meeting Transcript, No. 10 at pp. 20–22; Joint Commenters, No. 9 at pp. 2–5)

In response to these comments and as described in the following paragraphs, DOE conducted additional research regarding the typical ambient conditions under which residential portable and whole-home dehumidifiers operate. In its analysis, DOE investigated regional and time-of-year usage patterns as well as likely installation locations within the home.

Ambient Operating Conditions

The ''Builder's Foundation Handbook,'' published in 1998 by Oak Ridge National Laboratory as an update to its 1988 ''Building Foundation Design Handbook,'' states that ambient temperatures in unconditioned basements in most climates in the United States typically range between 55 °F and 70 °F. A field study by the Energy Center of Wisconsin (hereafter referred to as the Wisconsin Study),[10] conducted in various homes across Wisconsin in 2010, assessed the net electricity savings from sub-slab ventilation systems installed in ENERGY STAR Homes [11] that use basement dehumidifiers. Appendix B of this field study presents the basement temperature in 49 homes between June and November. Based on these data, the typical basement temperatures in Wisconsin, which is part of the region that represents the largest dehumidifier market, are between 60 °F and 75 °F for these months.

In addition to considering the findings in these studies, DOE conducted further analysis based on consumer and climate data to determine the most representative dehumidifier test conditions. DOE reviewed the 2009 *RECS* database to identify the geographic regions that account for the majority of dehumidifier usage. DOE found that of the 15 million homes that reported using dehumidifiers, 5.1 million were located in the Northeast region and 6.5 million were in the Midwest region. *RECS* includes additional dehumidifier usage data for two sub-regions within each of these regions, but does not disaggregate the data by state within the sub-regions.

DOE noted that, in response to a March 27, 2006 framework document (71 FR 15059), AHAM submitted estimated dehumidifier monthly usage data.[12] AHAM's medium estimate indicated 1,095 annual active mode operating hours from April to October. The majority of dehumidifier annual operation, 73.5 percent, occurs in the summer months between June and August, while the other 26.5 percent occurs in April, May, September, and October. Table III.1 lists the AHAM-estimated active mode operation hours per month.

TABLE III.1—AHAM MEDIUM ESTIMATE OF MONTHLY OPERATING HOURS

Month	Operating hours
Jan	0
Feb	0
Mar	0
Apr	14
May	86
Jun	231
Jul	288
Aug	288
Sep	130
Oct	58
Nov	0
Dec	0
Total	1,095

The AHAM usage estimates vary as a function of the month. DOE therefore analyzed available temperature data on a monthly basis, and then calculated a weighted average based on the monthly usage estimates. DOE analyzed 2012 hourly temperature and relative humidity data from the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA), collected at weather stations in each of the states in the two regions with significant dehumidifier ownership, as identified by *RECS*.

For the reasons discussed in section III.B.1.b of this document, DOE estimated that consumers are likely to operate dehumidifiers when the ambient relative humidity is at or above 60 percent. From the NCDC data, DOE calculated the average ambient temperature for each state within the regions with significant dehumidifier ownership for the hours with at least 60-percent relative humidity during the months of dehumidifier usage. DOE then averaged the individual states' ambient temperatures to determine a representation of the average monthly ambient temperatures with at least 60-percent relative humidity for each sub-region represented by the *RECS* data. Using the *RECS* dehumidifier ownership data for each sub-region, DOE used a weighted average to determine the representative average monthly ambient temperature for each of the regions (*i.e.,* Northeast and Midwest) that represent significant dehumidifier use. DOE then combined the regional data, using a similar weighted-average approach with the *RECS* dehumidifier ownership data, into overall monthly average ambient temperatures with at least 60-percent relative humidity. DOE then combined these average monthly temperatures into a single weighted-average annual

[7] *RECS* data are available online at: *www.eia.gov/consumption/residential/data/2009/.*

[8] ''Builder's Foundation Handbook,'' Oak Ridge National Laboratory. May 1998, page 11. Available online at: *www.ornl.gov/sci/roofs+walls/foundation/ORNL_CON-295.pdf.*

[9] *www.consumerreports.org/cro/best-dehumidifiers.htm.*

[10] ''Dehumidification and Subslab Ventilation in Wisconsin Homes,'' Energy Center of Wisconsin. ECW Report Number 258–1, June 2010. Appendix B, pp. 29–42. Available online at: *www.ecw.org/ecwresults/258-1.pdf.*

[11] Wisconsin ENERGY STAR Homes Program is a voluntary program promoting building practices that address combustion safety, building durability, occupant comfort, indoor air quality, and energy efficiency. According to the ENERGY STAR Web site, over 15,000 homes are certified to the program to date. Additional information is available online at: *www.energystar.gov/index.cfm?fuseaction=new_homes_partners.showStateResults&s_code=WI.*

[12] ''AHAM Data on Dehumidifiers for Efficiency Standards Rulemaking,'' Association of Home Appliance Manufacturers, August 23, 2006. Docket No. EE–2006–STD–0127, Comment Number 17.

temperature using the AHAM-estimated monthly hours of operation. From this analysis, DOE determined that the average annual ambient temperature, in regions where the majority of dehumidifiers are used during the months of dehumidifier usage and when the relative humidity is at least 60 percent, is 64.1 °F. DOE notes that this temperature is close to the dry-bulb temperature specified in the low-temperature test in ANSI/AHAM DH–1–2008 (65 °F). ANSI/AHAM DH–1–2008 also states that this ambient condition was selected based on manufacturer surveys that have shown that for areas typically dehumidified (*i.e.,* basements or other sub-ground level areas), a significant portion of users want to operate their dehumidifier at temperatures as low as 65 °F. Due to the similarity between this temperature and the average annual ambient temperature determined from DOE's analysis (64.1 °F), DOE tentatively concludes that 65 °F is a representative dry-bulb temperature at which to conduct dehumidification mode testing.

DOE further investigated whether the 65 °F ambient temperature is more representative of actual conditions than 80 °F by comparing the number of annual hours within the regions with significant dehumidifier use that experienced at least 60-percent relative humidity within the test tolerance of 80 °F ± 2 °F (78–82 °F) with the number of hours within 65 °F ± 2 °F (63–67 °F). Using the same region-based weighted-average approach described above but only for the hours within the temperatures of interest at which the relative humidity is at least 60 percent, DOE determined that a total of 112 hours annually, on average, are at the nominal 80 °F conditions, while 433 hours annually, on average, are spent at the nominal 65 °F conditions. Figure III.1 presents the entire distribution of weighted-average annual hours as a function of ambient temperature, and shows that the number of annual hours when the relative humidity is above the 60-percent threshold decreases significantly at 70 °F and higher. In addition, the annual hours decrease at ambient temperatures below 60 °F.

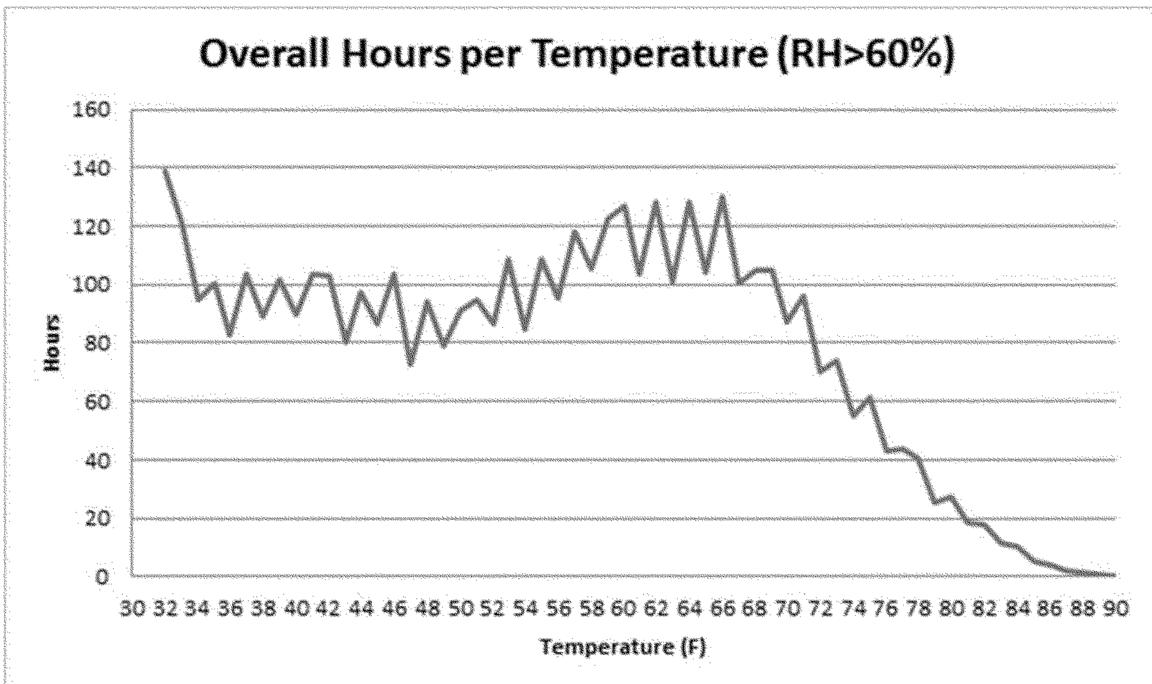

Figure III.1 Overall Weighted-Average Annual Hours at Different Ambient Temperatures and a Relative Humidity of at Least 60-Percent

This analysis suggests that dehumidifier operation occurs most frequently when the ambient temperature is in the range of 60–70 °F, and that dehumidifiers likely operate nearly four times more frequently at a 65 °F ambient temperature than at 80 °F, which further indicates that testing in dehumidification mode at 65 °F dry-bulb temperature is more representative of typical dehumidifier use than testing at 80 °F.

As ANSI/AHAM DH–1–2008 noted, areas that are typically dehumidified include basements and other sub-ground level locations. Because the ambient conditions in some of these locations may be more dependent on the ground temperature than the outside air temperature, DOE conducted further investigation of the representative ambient temperature for these cases. As a proxy for the typical basement temperature, DOE considered the NCDC data for the hourly soil temperature, measured at a depth of 40 inches (about 1 meter). DOE conducted an analysis similar to the analysis conducted for the average outside air temperature, calculating the sub-region, region, and overall weighted-average monthly soil temperatures based on the *RECS* usage data. DOE then calculated the weighted-average annual soil temperature based on the AHAM estimated monthly usage patterns. This analysis resulted in a weighted-average annual soil temperature of 65.2 °F for regions with significant dehumidifier use during the months in which dehumidifiers are operated. This temperature, which may be representative of basement and crawl-space ambient conditions, closely matches the weighted-average annual outside air temperature.

Based on this analysis and comments from interested parties, DOE determined that the most appropriate and representative dehumidification mode testing conditions is likely 65 °F dry-bulb temperature and 60-percent relative humidity. As discussed previously, these conditions are identical to those specified in the ''Low Temperature Test'' in ANSI/AHAM DH–1–2008, which manufacturers may already be conducting, thereby reducing testing burden because manufacturers will not need to conduct tests at a temperature other than that specified in the industry-accepted low temperature test. Accordingly, DOE is proposing to require dehumidification mode testing in appendix X1 at nominal ambient conditions of 65 °F dry-bulb temperature and 56.6 °F wet-bulb temperature, which corresponds to 60-percent relative humidity, for both portable and whole-home dehumidifiers.

Although the analysis above identifies 65 °F as the most representative dry-bulb temperature during testing, DOE acknowledges that a portion of annual dehumidifier operation likely occurs at a higher ambient temperature. As an alternate approach to the proposal for testing at 65 °F in appendix X1, testing at both 65 °F and 80 °F, with 60-percent relative humidity for each, may be appropriate. The IEF and capacity results from the two test conditions would be combined to form single values of IEF and capacity by, for example, calculating a weighted average based on the number of annual hours associated with each test condition as described above. In this example, the weighting factors would be 79 percent for the 65 °F test conditions (433 annual hours at 65 °F ± 2 °F divided by 545 total annual hours at nominal both conditions) and 21 percent for the 80 °F conditions (112 annual hours at 80 °F ± 2 °F divided by 545 total annual hours at both conditions). Other weighting factors could be considered as well. DOE notes there would be additional burden associated with this alternate approach of testing at two different conditions and then combining results into one metric because two stabilization periods and two 6-hour test periods would be required for each dehumidification mode test.

Whole-Home Dehumidifiers

The Joint Commenters suggested that typical operating conditions for whole-home dehumidifiers are different than those for portable units. They stated that for whole-home units, the dry-bulb temperature of the entering air will be close to the thermostat setting in the home. (Joint Commenters, No. 9 at p. 5)

RECS contains information on average indoor temperature for three different times of the day: (1) during the day when the residence is occupied, (2) during the day when the residence is unoccupied, and (3) during the night. Table III.2 below contains the results of DOE's investigation of summer average indoor temperatures for 1,735 homes in the Northeast and Midwest regions, considered by *RECS* to be the regions with the heaviest use of dehumidification.

TABLE III.2—*RECS* INDOOR TEMPERATURE

Time of day	Occupied	Season	Temperature (°F)
Day	Yes	Summer	72.3
Day	No	Summer	73.7
Night	Yes	Summer	72.2
Average			72.7
Number of Homes			1,735

As an alternative to the 65 °F inlet condition and the weighted combination of the 65 °F and 80 °F inlet conditions discussed above for portable dehumidifiers, DOE may consider requiring in appendix X1 ducted testing for whole-home dehumidifiers with the inlet air temperature equal to the average indoor temperature in the regions requiring the most dehumidification. To date, the data available to DOE suggest that this alternative inlet temperature would be 73 °F. DOE requests any additional information on typical indoor temperatures and comment on this proposed approach.

Performance Impacts at Reduced Temperature

Similar to other refrigeration-based systems, when a dehumidifier operates at lower ambient temperatures, the air flowing over the evaporator (*i.e.,* intake air) does not provide as much heat transfer to the refrigerant to evaporate it, thereby reducing the compressor power and overall dehumidifier capacity. In addition, at ambient temperatures of 65 °F or below, the water condensing on the evaporator may freeze, limiting air flow and further reducing efficiency and capacity. Dehumidifiers often incorporate a thermocouple attached to the refrigerant tubing in the evaporator to determine if icing has occurred. The dehumidifier then either shuts down all active mode operation to allow the ice to passively melt, or ceases compressor operation and operates the fan to pass ambient air over the evaporator to melt the ice. This fan operation is more energy consumptive than a passive defrost approach, but is more effective at removing ice, allowing the compressor to be reactivated more quickly. DOE considers such fan operation to be part of dehumidification mode, distinct from fan-only mode operation wherein the humidity setpoint has been reached.

To investigate the performance and efficiency impacts of varying ambient temperature conditions, DOE selected a test sample of 13 portable dehumidifiers spanning a range of manufacturers, capacities, and efficiencies. In addition, DOE selected one representative whole-home unit for which to assess initial impacts of varying temperature. These units are listed in Table III.3. DOE performed dehumidification mode testing on these 14 dehumidifiers at three dry-bulb temperatures: (1) 80 °F, the temperature currently specified for active mode testing according to appendix X; (2) 65 °F, the temperature required for the low temperature test in ANSI/AHAM DH–1–2008; and (3) 55 °F, the lowest operating setpoint which could be met for all test units per manufacturer documentation. The relative humidity was set at 60 percent for all tests. Because these tests focused on determining the effect of reduced ambient temperature on active mode energy use independent of standby power considerations, DOE measured EF rather than IEF for this test series.

After testing this range of temperatures on the sample of 14 dehumidifiers and conducting analysis which suggests that 65 °F is a representative ambient temperature for dehumidifiers generally, DOE conducted additional whole-home dehumidifier testing to investigate the impact of reducing the test temperature from 80 °F to 65 °F. DOE selected 13 more whole-home models for ambient temperature and ducted installation testing (discussed in section III.B.1.c of this document), of which nine units were chosen for unducted testing at both 80 °F and 65 °F ambient conditions to further understand the effects of ambient temperature. For the purposes of this testing, DOE included in the whole-home test sample those units that could be optionally ducted or unducted. Table III.3 lists the additional whole-home units tested.

TABLE III.3—DEHUMIDIFIER INVESTIGATIVE TEST SAMPLE

Initial ambient temperature test sample		Additional whole-home dehumidifier test sample	
Test unit	Reported capacity (pints/day)	Test unit	Reported capacity (pints/day)
P1	30	W1	70
P2	40	W2	70
P3	40	W3 [a]	90
P4	45	W4 [a]	90
P5	50	W5 [a]	100
P6	50	W6	105
P7	50	W7 [a]	120
P8	50	W8 [a]	120
P9	60	W9 [a]	135
P10	65	W10 [a]	155
P11	70	W11	155
P12	70	W12 [a]	200
P13	110	W13 [a]	205
W14 [b]	105		

[a] Tested for ambient temperature investigation as well as ducting configuration.
[b] Tested only for ambient temperature investigation.

During ambient temperature testing, DOE observed that for all test units at 80 °F, the compressor and fan operated continuously for the entire test period. At the lower temperatures, certain dehumidifiers in the test sample had cyclic or intermittent periods of fan-only operation for defrosting or frost prevention, with the duration and frequency of such periods increasing at the lowest temperature (55 °F).

All dehumidifiers in DOE's investigative test sample performed at lower EFs and capacities during low-temperature investigative tests conducted at the 65 °F and 55 °F dry-bulb temperatures than at the 80 °F condition specified in appendix X. Because, as discussed above, the 65 °F dry-bulb temperature condition appears to more accurately reflect actual installations than the current test procedure ambient temperature requirement, the EF and capacity measured at this temperature, while lower than the values that would be measured under the current appendix X, should more accurately represent dehumidifier performance in the field.

Table III.4 shows the impacts on capacity and EF that were measured by reducing the ambient test temperature from 80 °F to 65 °F and 55 °F.

TABLE III.4—PER-UNIT AND PRODUCT CLASS AVERAGE PERFORMANCE IMPACTS AT REDUCED AMBIENT TEMPERATURES

Product class (pints/day)	Test unit	Percent change in capacity from 80 °F (%)		Percent change in EF from 80 °F (%)	
		65 °F	55 °F	65 °F	55 °F
<35.00	P1	−35	−74	−26	−57
	Class Average	−35	−74	−26	−57
35.01–45.00	P2	−77	−91	−61	−79
	P3	−48	−73	−32	−53
	P4	−33	−69	−15	−46
	Class Average	−53	−78	−36	−59
45.01–54.00	P5	−39	−91	−25	−81
	P6	−33	−78	−21	−62
	P7	−36	−76	−21	−59
	Class Average	−36	−82	−22	−67
54.01–75.00	P8	−61	−78	−39	−67
	P9	−39	−86	−32	−63
	P10	−65	−83	−36	−60
	P11	−59	−83	−35	−64
	P12	−36	−81	−14	−64
	Class Average	−52	−82	−31	−63
>75.00	P13	−27	−96	−15	−90
	W3	−35	....	−21	....
	W4	−42	....	−29	....
	W5	−49	....	−26	....
	W7	−27	....	−15	....

TABLE III.4—PER-UNIT AND PRODUCT CLASS AVERAGE PERFORMANCE IMPACTS AT REDUCED AMBIENT TEMPERATURES—Continued

Product class (pints/day)	Test unit	Percent change in capacity from 80 °F (%)		Percent change in EF from 80 °F (%)	
		65 °F	55 °F	65 °F	55 °F
	W8	−24		5	
	W9	−49		−33	
	W10	−20		−4	
	W12	−42		−35	
	W13	−45		−35	
	W14	−39	−94	−25	−80
	Class Average	−36	−95	−21	−85

As shown in Table III.4, DOE testing demonstrates a significant percentage reduction in both capacity and EF at temperatures lower than 80 °F. At 65 °F, capacity drops per product class average by as much as 53 percent and EF by up to 36 percent. DOE notes that at 55 °F, the units in the test sample show an even greater reduction in capacity and EF as the units approach their lowest operating temperature and perform frequent defrost functions.

Under DOE's alternate approach, which would combine results from testing at 80 °F and 65 °F using a weighted average, there would still be a significant reduction in capacity and EF, as well as IEF when used, because the results of the 65 °F test would receive a 79-percent weighting in the combined calculation. Therefore, a modification in the test procedure conditions for appendix X1 would likely result in significant reductions in measured capacity, EF, and IEF under either the proposed approach or alternate combined calculation. DOE would consider the effects of any reduction to capacity and active mode energy use resulting from the proposed test procedure amendments when determining appropriate energy conservation standards for dehumidifiers.

DOE also numerically estimated whole-home dehumidifier performance under the alternative proposal for testing these units at 73 °F using data measured for whole-home units at 80 °F, 65 °F, and 55 °F ambient temperatures. DOE first developed generalized curves relating dehumidifier normalized capacity and EF (*i.e.,* capacity at the test ambient temperature divided by capacity measured at 80 °F, and EF at the test ambient temperature divided by EF measured at 80 °F) to ambient temperature, which will define these relationships independent of rated capacity. DOE determined that the best curve fit for both capacity and EF as a function of temperature and relative humidity is a biquadratic equation, which is typically used for HVAC equipment. However, since relative humidity was held constant at 60 percent, the biquadratic equations reduce to quadratic equations with terms that scale with temperature and the square of the temperature, in the form of f(temperature) = [A×(temperature^2) + B×(temperature) +C]. Using data for capacity and EF measured at the three ambient temperatures, DOE calculated the coefficients for the normalized capacity versus temperature function and the normalized EF versus temperature function. From these coefficients, DOE estimated capacity and EF at the proposed alternative ambient temperature of 73 °F, as shown in Table III.5.

TABLE III.5—ESTIMATED WHOLE-HOME DEHUMIDIFIER PERFORMANCE IMPACT AT 73 °F AMBIENT TEMPERATURE

Test unit	Dehumidification technology	Capacity change (%)	EF Change (%)
W3	Refrigerant	−15	−6
W4	Refrigerant	−18	−9
W5	Refrigerant	−21	−8
W7	Refrigerant-Desiccant	−12	−5
W8	Refrigerant	−10	2
W9	Refrigerant	−21	−10
W10	Refrigerant	−9	−1
W12	Refrigerant-Desiccant	−18	−11
W13	Refrigerant	−19	−11
Average		−16	−7

Due to the expected effects on capacity at the proposed reduced ambient temperature in appendix X1, DOE also proposes to amend the definition of ''product capacity'' in appendix X1 to clarify that it is a measure of the amount of moisture removed per 24-hour period under the specified ambient conditions. For consistency and clarity, DOE also proposes to similarly amend the definition of product capacity in appendix X.

Summary and Request for Comments

DOE requests comment on its analysis of representative ambient conditions and the proposal to require dehumidification mode testing in appendix X1 at 65 °F dry-bulb temperature and 56.6 °F wet-bulb temperature (*i.e.,* 60-percent relative humidity). DOE welcomes input on the reductions to active mode energy use and capacity that would occur as a result of the proposed modifications to the test procedure ambient dry-bulb conditions. DOE also welcomes comment on the alternate approach of conducting dehumidification mode testing at both 65 °F and 80 °F ambient temperatures, with IEF and capacity calculated from the combined results of the two tests. For such a combined approach, DOE invites input on appropriate weighting factors. DOE additionally seeks comment on the alternate approach for whole-home dehumidifiers, in which dehumidification mode testing would be conducted at 73 °F ambient temperature to be representative of average residential thermostat settings. DOE also seeks comment on the testing burden associated with the proposal for testing at 65 °F and the alternate approaches.

b. Relative Humidity

In response to the August 2012 Framework Document, DOE received comments regarding the applicability and appropriateness of the relative humidity conditions specified in the dehumidifier test procedure. The Joint Commenters and California IOUs expressed concerns regarding the current test procedure relative humidity conditions, citing several studies and other sources of information. These interested parties claimed that:

(1) Adverse health effects, such as respiratory infections and allergies, are minimized by maintaining ambient relative humidity between 40 percent and 60 percent. (Joint Commenters, No. 9 at p. 3)

(2) While people generally cannot sense fluctuations in relative humidity levels between 25 percent and 60 percent, most people can sense when the relative humidity rises above 60 percent. (*Id.*)

(3) Units in the Cadmus Group study were being operated at a 50-percent relative humidity setpoint, lower than the 60-percent relative humidity ambient condition required in the test procedure. (California IOUs, No. 11 at p. 2; Joint Commenters, No. 9 at p. 3)

(4) According to the Wisconsin Study, nearly half of the basements monitored maintained an average relative humidity of less than 50 percent during the summer months, and only five dehumidifiers were being operated in relative humidity levels of at least 60 percent. (*Id.*)

The Joint Commenters, ASAP, and California IOUs believe that the current rating condition of 60-percent relative humidity represents the upper bound of both recommended levels and levels that consumers are likely to select, and that a lower relative humidity level for the test procedure would likely encourage good performance in the field where units have to work harder to remove moisture at lower relative humidity levels. Therefore, these commenters urged DOE to change the relative humidity level for the portable dehumidifier test from 60 percent to a lower value. The Joint Commenters also recommended that whole-home dehumidifier testing be conducted at a lower relative humidity level than 60 percent. (ASAP, Public Meeting Transcript, No. 10 at p. 20; California IOUs, No. 11 at pp. 1–3; Joint Commenters, No. 9 at pp. 1–5) The California IOUs also stated that ENERGY STAR suggests that the optimum relative humidity level for a building is between 30 percent and 50 percent, which, according to the California IOUs, would suggest that dehumidifiers are likely to be less efficient in real-world operation than in their test results. (California IOUs, No. 11 at p. 2)

DOE reviewed the studies cited in the above comments, and conducted additional research on the appropriate level of relative humidity for the dehumidification mode testing. Regarding potential health impacts outside a certain range of relative humidity, DOE notes that ANSI/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 55–2013, ''Thermal Environmental Conditions for Human Occupancy'' (ASHRAE 55), states that that there is an acceptable range of indoor relative humidity for thermal comfort, with an upper limit of 0.012 humidity ratio (pounds of water divided by pounds of dry air) at standard pressure, which corresponds to a relative humidity of approximately 55 percent at a dry-bulb temperature of 80 °F. At lower dry-bulb temperatures, 60-percent relative humidity would correspond to a humidity ratio below the upper comfort limit.[13] DOE further notes that the Occupational Safety and Health Administration (OSHA) Technical Manual recommends that employers control humidity and maintain a range of 20 to 60 percent.[14]

This information, in aggregate, indicates that 60-percent relative humidity is a representative upper bound for an ambient humidity condition that consumers would find acceptable. In addition, among the 21 sampled homes metered in the Cadmus Group study, DOE observes that the average consumer-selected setpoint was for 50-percent relative humidity, with values ranging from 35 percent to 65 percent. However, the average dehumidifier setpoint is not representative of the average ambient relative humidity during dehumidification mode, because dehumidifiers operate only when the ambient air relative humidity is higher than the setpoint and shut off dehumidification when the controls detect that the target relative humidity level has been reached. DOE gathered information on the actual ambient relative humidity during dehumidification mode from a metering study conducted in 20 homes in Houston, Texas, over approximately a year for various categories of dehumidifiers, both portable and whole-home.[15] During this study, the homeowners were not required to set a specific relative humidity setpoint; it was recommended to them, however, to maintain a relative humidity of around 55 percent. The subsequent metering found that, in homes with dehumidification separate from cooling, on average 5 percent of metered hours were spent at relative humidity levels greater than 60 percent, although three out of the 10 units exceeded 60-percent relative humidity 15 to 25 percent of the time. The Cadmus Group study, referenced by ASAP, the California IOUs, and the Joint Commenters, also observed varying accuracy of humidity controls in maintaining the relative humidity at the setpoint. In the Wisconsin Study of basement relative humidity levels, 11 out of 40 participating sites had daily averages that exceeded 60-percent humidity for at least 25 percent of the summer season, while 16 sites experienced daily averages ranging from 50 to 60 percent for at least 25 percent of the summer season.

DOE additionally examined manufacturer literature for portable dehumidifiers to ascertain what default relative humidity settings are provided by manufacturers. DOE observed that, among manufacturers and brands that specified to the consumer what the initial default relative humidity level is, the most common setting was 60 percent. However, the majority of

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[13] Further information on thermal comfort may be found in Appendix F of ASHRAE Standard 55–2013. Available for purchase online at *www.ashrae.org.*

[14] ''OSHA Technical Manual,'' U.S. Department of Labor, Occupational Safety and Health Administration, TED 01–00–015, Section III, Chapter 2, January 20, 1999. Available online at: *www.osha.gov/dts/osta/otm/otm_iii/otm_iii_2.html#5.*

[15] A.F. Rudd, J.W. Lstiburek, P. Eng, and K. Ueno. ''Residential Dehumidification Systems Research for Hot-Humid Climates,'' Conducted by Building Science Corporation for the U.S. Department of Energy Building Technologies Program, NREL/SR–550–36643, February 2005.

portable dehumidifiers are equipped with electronic controls and an automatic restart feature, in which the previous settings are retained when the unit is powered off or disconnected from the supply power. If portable dehumidifiers operate in dehumidification mode largely at a consumer-selected relative humidity setting, that setting, as seen in the Cadmus Group study, would be on average approximately 50 percent.

These data characterize the relative humidity levels and dehumidifier settings experienced in real-world dehumidifier installations. While dehumidifiers may operate under a range of ambient relative humidity levels, the average setpoint observed in the Cadmus Group study and the recommended relative humidity level from ASHRAE 55 suggest that consumers use dehumidifiers to achieve relative humidity levels from 50 to 55 percent. For a unit to operate in dehumidification mode, the ambient relative humidity must be higher than the setpoint. Therefore, DOE proposes that the ambient relative humidity level maintained throughout dehumidification mode testing remain at 60 percent, as specified in ANSI/AHAM DH–1–2008.

DOE also notes that each of the three different ambient temperature tests in ANSI/AHAM DH–1–2008, including the test at the 65 °F dry-bulb temperature that DOE is proposing for appendix X1, is conducted at 60-percent relative humidity. Maintaining this 60-percent relative humidity test condition would minimize manufacturer testing burden, as manufacturers may already be conducting the low-temperature test in ANSI/AHAM DH–1–2008. For the above reasons, DOE is not proposing to amend the ambient relative humidity in appendix X1. To achieve 60-percent relative humidity at the proposed 65 °F dry-bulb temperature, the wet-bulb temperature would be specified as 56.6 °F. DOE requests comment on this proposed determination to maintain the 60-percent ambient relative humidity requirement.

c. Ducted Test Installation for Whole-Home Dehumidifiers

This section discusses proposed modifications to the dehumidifier test setup and additional required instrumentation for whole-home dehumidifiers. DOE based its proposals on research of current industry practices for testing ducted air treatment devices and investigative testing of 13 whole-home dehumidifiers under various testing configurations.

As discussed in section III.A of this document, whole-home dehumidifiers are intended to be installed and operated as part of a ducted air-delivery system. These units are designed with standard-size collars to interface with the home's HVAC ducting, and typically require two ducts for the process air stream: a supply air intake for return air from the dehumidified space and an air outlet for delivery of the dehumidified air to the same space. Certain whole-home dehumidifiers also provide an option to connect an additional fresh air duct to the inlet to dilute indoor pollutants and maintain high oxygen content in the air. The amount of fresh air ventilation can be regulated by a variety of dampers and controls. In addition, some whole-home dehumidifiers are designed to operate attached to multiple outlet ducts to allow for the distribution of dry air to multiple rooms or multiple sections in a home's air delivery system.

The California IOUs expressed concern that the existing test procedure is not appropriate for measuring the efficiency of whole-home units and requested that DOE consider a modified test procedure for these units. (California IOUs, No. 11 at p. 4)

The test setup currently provided in appendix X for dehumidification mode testing does not specify the attachment of ducting to the inlet or outlet of the unit. The ducting in a typical installation imposes an external static pressure (ESP) which reduces airflow and affects the capacity and efficiency. To evaluate these impacts as a function of ducting configurations, DOE conducted investigative dehumidification mode testing on a sample of 13 whole-home dehumidifiers, including the two refrigerant-desiccant units. Table III.6 provides characteristics of the units selected for investigative testing. All units were first tested according to appendix X to establish baseline unducted performance. DOE subsequently conducted additional investigative testing to determine the potential impacts of modifying the appendix X conditions to measure whole-home dehumidifier performance in a ducted installation.

TABLE III.6—DOE WHOLE-HOME DEHUMIDIFIER INVESTIGATIVE TEST SAMPLE

Sample No.	Duct collar configuration	Dehumidifier technology	Rated capacity (pint/day)	Rated EF (L/kWh)
W1	Single Outlet	Refrigerant	70	2.37
W2	Single Outlet	Refrigerant	70	2.37
W3	Single Outlet	Refrigerant	90	2.50
W4	Single Outlet	Refrigerant	90	2.53
W5	Single Outlet	Refrigerant	100	2.60
W6	Dual Outlet	Refrigerant	105	4.20
W7	Dual Airstreams	Refrigerant-Desiccant	120	3.30
W8	Single Outlet	Refrigerant	120	2.70
W9	Single Outlet	Refrigerant	135	1.80
W10	Single Outlet	Refrigerant	155	3.50
W11	Dual Outlet	Refrigerant	155	3.50
W12	Dual Airstreams	Refrigerant-Desiccant	200	2.47
W13	Single Outlet	Refrigerant	205	2.70

Ratings are based on testing according to appendix X.

Refrigerant-desiccant dehumidifiers also incorporate the supply air intake and dehumidified air outlet for the process air stream, but have additional intake and outlet ducts for the reactivation air. The reactivation air is drawn from and discharged to a location outside of the dehumidified space, typically outdoors.

For clarity, DOE proposes in this NOPR to adopt the following definitions for ''reactivation air'' in appendix X1:

Reactivation air: The air drawn from unconditioned space to remove moisture from the desiccant wheel of a refrigerant-desiccant dehumidifier and discharged to unconditioned space.

Capacity Measurement for Refrigerant-Desiccant Dehumidifiers

Product capacity represents the amount of moisture a dehumidifier would remove in a 24-hour period of operation at the specified ambient conditions. Appendix X's current capacity measurement methodology involves weighing the amount of water collected during the 6-hour dehumidification mode test and adjusting the recorded weight to account for slight variations from nominal ambient temperature, relative humidity, and barometric pressure. This value is then multiplied by 24 and divided by the test duration in hours to determine the pints of moisture that would be removed per day.

The majority of whole-home dehumidifiers rely solely on a refrigeration system to remove moisture, for which capacity can be accurately measured by the current appendix X methodology, and thus DOE proposes to retain this methodology for whole-home dehumidifiers other than refrigerant-desiccant dehumidifiers. Refrigerant-desiccant dehumidifiers, however, use both a refrigeration system to remove some moisture from the process air (in liquid form) and a desiccant wheel to remove additional moisture from the process air by transferring it (in vapor form) to the reactivation airstream.

To address refrigerant-desiccant dehumidifiers, DOE developed a capacity calculation that determines the mass of moisture removed from the process airstream using the difference in psychrometric properties between the inlet and outlet air streams. Specifically, the measured dry-bulb temperature and relative humidity are used to determine the absolute humidity at both locations in pounds of water per cubic foot of dry air. The absolute humidity is then multiplied by the volumetric flow rate, measured in cubic feet per minute, to determine the process air inlet and outlet moisture flow rates, measured in pounds of water per minute. The difference between the inlet and outlet moisture flow rates determines the amount of moisture the unit under test removes from the process air. Unlike the current condensate collection capacity method, DOE believes that the proposed vapor capacity calculation method would accurately account for the total moisture that refrigerant-desiccant dehumidifiers remove from the process airstream.

DOE applied the vapor capacity calculation method to the whole-home dehumidifiers in its investigative sample to compare it to the method of determining capacity from condensate collection, as well as to understand the relative contributions of condensation and desiccant moisture removal for refrigerant-desiccant dehumidifiers. Nine whole-home units, including two refrigerant-desiccant units, were tested in this investigation at 65 °F dry-bulb ambient temperature, 60-percent relative humidity, and 0.5 inches of water column (in. w.c.) ESP. Six of the seven refrigeration-based samples in Table III.7 demonstrate close correlation between the vapor and condensate methods, validating the vapor capacity calculation method.

TABLE III.7—COMPARISON OF CONDENSATE COLLECTION AND VAPOR CALCULATION CAPACITY METHODS

Test unit	Dehumidification technology	Compressor operation	Capacity (pints/day)			Energy factor (L/kWh)		
			Condensate capacity	Vapor capacity	Difference (%)	Condensate capacity	Vapor capacity	Difference (%)
W3	Refrigerant	Continuous	53	52	−2	1.59	1.57	−1
W4	Refrigerant	Continuous	53	51	−4	1.43	1.38	−4
W5	Refrigerant	Cycling	49	68	39	1.89	2.66	40
W7	Refrigerant-Desiccant	Continuous	42	84	100	1.08	2.18	101
W8	Refrigerant	Continuous	58	55	−4	1.44	1.37	−4
W9	Refrigerant	Continuous	71	71	−1	1.10	1.09	−1
W10	Refrigerant	Continuous	109	113	3	2.82	2.85	1
W12	Refrigerant-Desiccant	Continuous	70	99	41	0.75	1.11	48
W13	Refrigerant	Continuous	108	104	−4	1.68	1.63	−3

One refrigerant-based unit, W5, demonstrates poor correlation between capacity calculation methods, but this unit was the only whole-home dehumidifier in DOE's sample that cycled the compressor during testing under these conditions. This may indicate accumulation of ice on the evaporator over the duration of the test, a condition for which the condensate collection method does not account. The two refrigerant-desiccant dehumidifiers have capacities measured by the vapor method that exceed the capacities determined from the condensate collection method by 41 percent and 100 percent, suggesting that these refrigerant-desiccant dehumidifiers remove approximately one-third or more of the total moisture removed by means of the desiccant. Therefore, DOE proposes that appendix X1 require that refrigerant-desiccant dehumidifiers use the vapor calculation to determine tested capacity to most accurately measure the total amount of moisture removed from the process air.

Duct Configuration

DOE reviewed research conducted for whole-home dehumidifiers to gain insight on possible ducting configurations, and noted that NREL's research on ENERGY STAR dehumidifiers [16] included testing of ducted whole-home dehumidifiers under inlet air conditions ranging from 60 °F to 98 °F dry-bulb temperature and 25-percent to 90-percent relative humidity. In its testing, NREL attached inlet and outlet ducts to the supply and return ducts of its laboratory air-handling system. The ducts incorporated laminar flow elements to measure volumetric flow rates, chilled mirror hygrometers to measure dew point temperatures, and thermocouple arrays to measure dry bulb temperatures.

To aid in developing detailed specifications for instrumented ducts, DOE reviewed the test procedure issued by the Air Movement and Control Association International, Inc. (AMCA), in association with ANSI and ASHRAE—ANSI/ASHRAE 51–2007/ANSI/AMCA 210–07, ''Laboratory Methods of Testing Fans for Certified

[16] ''Laboratory Test Report for Six ENERGY STAR Dehumidifiers.'' National Renewable Energy Laboratory. NREL/TP–5500–52791, December 2011. Available online at *www.nrel.gov/docs/fy12osti/52791.pdf*

Aerodynamic Performance Rating'' (ANSI/AMCA 210). The duct requirements specified in ANSI/AMCA 210 would allow for the accurate measurement of psychrometric and volumetric flow properties of the air entering and exiting a whole-home dehumidifier under test.

DOE proposes in this document to adopt in appendix X1 certain provisions regarding fresh air inlets, process air inlet and outlet ducts, test duct specifications, transition sections, and flow straighteners specified in ANSI/AMCA 210 for testing whole-home dehumidifiers.

1. Fresh Air Inlets

As discussed previously, fresh air from the exterior of a home may be directed to a second inlet on some whole-home dehumidifiers to improve the quality of the dehumidified air. However, DOE is not aware of information on the percentage of whole-home dehumidifiers equipped with this fresh air ducting option. DOE tentatively concludes that the added test burden of accounting for a second inlet duct with air flow that may be at a different temperature and humidity than the process air inlet temperature would be significant. Therefore, DOE proposes to require in appendix X1 that any fresh air collars be capped closed and sealed with tape during testing.

To investigate performance impacts of sealing the fresh air inlet and supplying all inlet air through the process air inlet duct, DOE tested five whole-home units with and without the fresh air inlet capped at 65 °F dry-bulb temperature, 60-percent relative humidity, and an ESP of 0.5 inches of water column (which, as discussed later in this section, was determined to be the most representative of whole-home dehumidifier installations). Table III.8 below contains the results of this series of testing.

TABLE III.8—IMPACT OF FRESH AIR CONNECTION ON WHOLE-HOME DEHUMIDIFIER PERFORMANCE AT 65 °F

Sample number	Capacity (pints/day)			Energy Factor (L/kWh)		
	No fresh air	With fresh air	Performance impact (%)	No fresh air	With fresh air	Performance impact (%)
3	53	54	2	1.59	1.63	3
5	49	49	1	1.89	1.98	5
8	58	60	4	1.44	1.50	5
10	109	114	4	2.82	2.91	3
13	108	113	5	1.68	1.75	4
Average			3			4

Based on these data, DOE tentatively determined that using the fresh air inlet at the ambient conditions proposed by this document has a slight positive impact on measured capacity and EF, less than or equal to 5 percent for all five test units. However, given the lack of information regarding consumer use of the fresh air ducting, DOE tentatively concludes that the impact is not significant enough to warrant the added test burden of providing separate fresh air inlet flow; therefore, DOE maintains its proposal that any fresh air inlet on a whole-home dehumidifier be capped and sealed during testing. DOE welcomes comment on this proposal, in particular on the burden associated with testing whole-home dehumidifiers with separate fresh air inlet flow, the representative ambient conditions for such fresh air supply, and the percentage of units in the field that incorporate the fresh air supply.

2. Process Air Inlet and Outlet Ducts

As a further means of reducing testing burden, DOE investigated the effects of dehumidification mode testing for refrigeration-based whole-home units using ducting only on the process air outlet, rather than both the inlet and outlet of the process airstream. The appropriate ESP would be achieved through flow restriction in the outlet test duct while inlet psychrometric conditions would be maintained by controlling the test chamber. DOE assessed this option by comparing data for a representative 70 pints/day unit with both inlet and outlet ducts attached and with only the outlet duct in place. Table III.9 contains the results of these tests, along with a numerical extrapolation to approximate the capacity and EF impacts at the proposed ESP of 0.5 in. w.c.

TABLE III.9—IMPACT OF WHOLE-HOME DEHUMIDIFIER TESTING WITH ONLY AN OUTLET DUCT

ESP ** (in. w.c.)	Capacity (pints/day)			Energy Factor (L/kWh)		
	Inlet and outlet ducts	Outlet duct only	Percent impact (%)	Inlet and outlet ducts	Outlet duct only	Percent impact (%)
0.01	75	77	2.7	2.39	2.40	0.3
0.11	73	74	1.2	2.25	2.31	2.4
0.19	71	73	4.1	2.15	2.26	5.0
0.50 *	63	66	6.0	1.73	2.01	16.0

* Results at this ESP are a numerical extrapolation.
** These tests were conducted at ESPs of up to 0.19 in. w.c. at 80 °F and at 60-percent relative humidity.

While the data suggest that a performance improvement may be achieved by removing the inlet test duct at an ESP of 0.5 in. w.c. and an ambient temperature of 80 °F, DOE notes that these data are limited and that there is uncertainty associated with these extrapolated results. DOE also notes that requiring both inlet and outlet test ducts would represent a significant burden to manufacturers and test laboratories that may not have testing facilities large enough to accommodate the total length of ducting. Therefore, DOE proposes in this document that whole-home dehumidifiers, other than refrigerant-desiccant dehumidifiers, would be tested under appendix X1 with only outlet ducting in place. Refrigerant-desiccant dehumidifiers would require an inlet and outlet duct for the process airstream, but may use only an inlet duct for the reactivation airstream. The inlet and outlet ducts attached to the process airstream would contain the instrumentation necessary for the proposed capacity calculation for refrigerant-desiccant dehumidifiers discussed previously. The inlet duct attached to the reactivation airstream would provide consistent means for measuring the inlet psychrometric conditions of both airstreams. DOE seeks comment and information on these proposed ducting requirements and may accordingly consider requiring both inlet and outlet ducts for all whole-home dehumidifiers.

3. Test Duct Specifications

ANSI/AMCA 210 includes various configurations of ducting that may be attached to equipment under test for measuring air flow characteristics. Upon review of these configurations, DOE determined that Figures 7A and 16 of ANSI/AMCA 210 would be the simplest and most relevant to whole-home dehumidifier testing. Other duct configurations specified in ANSI/AMCA 210 require chambers or nozzles to simulate the conditions a unit may experience during operation. However, DOE tentatively concluded that the equipment specified in Figures 7A and 16 of ANSI/AMCA 210 provide conditions representative of normal operation while requiring the fewest components. Therefore, DOE proposes to determine the lengths of the inlet and outlet ducts used for whole-house dehumidifier testing according to the dimensions provided in these figures, which specify duct lengths as a function of duct diameter. Because DOE's review of current products indicates that the majority of whole-home dehumidifiers connect to ducting via circular collars with a diameter of 10 inches, DOE proposes to require in appendix X1 that 10-inch diameter inlet and outlet ducts be used, with duct lengths and instrumentation spacing specified based on calculations using this diameter.

The material used for ducting can impact the transfer of heat and moisture through duct walls, and may include galvanized mild steel, polyurethane panels, fiberglass duct board, flexible plastics, and fabric ducting. Because galvanized mild steel ducts are commonly used in HVAC applications and are not affected by moisture, DOE proposes to require this material for the ducting specified in appendix X1. DOE further proposes to limit heat transfer by requiring that the ducts be insulated using insulation with a minimum R value of 6, with all seams and edges sealed with tape.

4. Transition Sections

DOE is aware of whole-home dehumidifiers equipped with circular collars with diameters other than 10 inches, such as 8 or 12 inches. DOE's research also determined that at least one refrigerant-desiccant dehumidifier has rectangular collars. To accommodate such designs, DOE proposes to require that transition pieces be used to connect these collars to the test ducts. To minimize turbulence caused by transition pieces, DOE proposes to require that the pieces have a maximum divergent angle of 3.5 degrees and a maximum convergent angle of 7.5 degrees, in accordance with the requirements in section 5.2.1.3, Transition Pieces, of ANSI/AMCA 210.

5. Flow Straighteners

To provide consistent and repeatable results, the air flow must be laminar upstream of sensors and inlets. DOE first examined the length of 10-inch diameter ducting that would be required to achieve laminar, fully-developed flow, based on the Reynolds number (Re) of the duct:

$$\mathrm{Re} = \frac{Dv\rho}{\mu}$$

Where:

D is the diameter of the duct;
v is the mean velocity of the fluid;
ρ is the density of the fluid; and
μ is the dynamic viscosity of the fluid.

For the units within its test sample, DOE used the range of volumetric flow rates (approximately 200 to 400 cubic feet per minute) in the above equation to determine the range of Re. For Re greater than 4000, as calculated for units within the test sample, the calculation for the effective duct length required for fully developed flow is:

Effective Length = $4.4\mathrm{Re}^{1/6}$

From this equation, DOE determined that a minimum duct length of 20 feet would be required to ensure fully developed laminar flow, a length that DOE concludes is burdensome based on associated test chamber size requirements. Instead, DOE proposes to require in appendix X1 the use of cell-type air flow straighteners in test ducts. The flow straightener dimensions would be specified according to section 5.2.1.6, Airflow Straightener, of ANSI/AMCA 210. DOE also proposes that flow straighteners be located as specified by Figures 7A and 16 of ANSI/AMCA 210. Specifically, the downstream face of an inlet duct flow straightener would be located a distance upstream of the test unit's inlet collar or any transition section equal to 6.5 times the diameter of the duct and the downstream face of an outlet duct flow straightener would be located a distance downstream of the unit's outlet collar or any transition section equal to 3.5 times the diameter of the duct.

Instrumentation

The following sections discuss the proposed instrumentation for the ducts that would be attached to whole-home dehumidifiers during testing.

1. Instrumentation for Measuring Dry-Bulb Temperature

Appendix X currently requires measurement of the dry-bulb and wet-bulb temperatures to ensure that the appropriate ambient relative humidity is maintained in the test chamber near the inlet of the dehumidifier under test. These provisions do not allow for measuring psychrometric conditions within the ducting attached to whole-home dehumidifiers. Therefore, DOE considered instrumentation specifications and installation requirements for whole-home dehumidifier testing.

For whole-home dehumidifiers other than refrigerant-desiccant units, no inlet duct would be attached according to this proposal, and therefore DOE proposes for these dehumidifiers to require the same instrumentation and equipment setup for measuring ambient conditions near the process air inlet as for portable dehumidifiers.

For dry-bulb temperature sensing within the process air inlet and outlet ducts and the reactivation air inlet duct for refrigerant-desiccant dehumidifiers, DOE proposes in appendix X1 to reference section 5.3.5, Centers of Segments—Grids, of ASHRAE Standard 41.1–2013, ''Standard Method for Temperature Measurement,'' which DOE considers to be an industry-accepted approach for temperature measurements in ducted air flow. These provisions would require that temperature measurements be made using an array of temperature sensors at different locations on the same cross-sectional plane. The locations of the individual sensors at that plane would be determined by dividing the plane into at least four segments of equal area.

A sensor would then be placed at the center of each of these segments.

ANSI/AMCA 210 specifies that temperature be measured at positions that are a distance upstream of the test unit's inlet collar and any transition section equal to half the diameter of the duct and a distance downstream of the unit's outlet collar and any transition section equal to 9.5 times the diameter of the duct. Temperature measurements at these locations within the ducting would provide accurate measurement of dry-bulb temperatures. Based on DOE's proposed specification of 10-inch diameter ducting, DOE proposes in this document to require temperature measuring instruments to be located 5 inches upstream of the inlet collar, where such ducting is used, and 95 inches downstream of the outlet collar.

2. Instrumentation for Measuring Relative Humidity

As noted previously, testing of whole-home dehumidifiers other than refrigerant-desiccant units would specify the same provisions for measuring ambient conditions near the process air inlet as for portable dehumidifiers. For refrigerant-desiccant dehumidifiers, however, the vapor calculation method for capacity measurement would require measurement of the relative humidity in the process air inlet and outlet ducts. In addition, relative humidity would be measured in the reactivation air inlet duct for these units.

For calculating relative humidity, DOE considered: (1) A cooled surface condensation hygrometer that measures dew-point temperature, which can be used in conjunction with dry-bulb temperature to determine relative humidity; and (2) an aspirating psychrometer that measures wet-bulb temperature. Chilled mirror hygrometers incorporate a cooled surface [17] that allows moisture to condense on the surface. The condensate surface is maintained electronically in vapor pressure equilibrium with the surrounding gas, while surface condensation is detected optoelectronically. The measured surface temperature is the dew-point temperature. Typical industrial versions of the instrument may be as accurate as ±0.2 °C (±0.36 °F), corresponding to ±2-percent relative humidity at 65 °F dry-bulb temperature and nominal 60-percent relative humidity. However, these instruments are costly and require a skilled operator, frequent cleaning, and regular calibration.

An aspirating psychrometer consists of two electrical or mechanical temperature sensors, one of which is dry to measure dry-bulb temperature and the other of which is wetted via a sock or wick to measure wet-bulb temperature. Evaporation of the water cools the wet-bulb sensor, with the evaporation rate dependent on the relative humidity of the air. A suction fan operating at a low flow rate provides ventilation of the sensors. An aspirating psychrometer is already required in the appendix X test procedure for unducted testing. Therefore, the dehumidifier industry is already familiar with this type of sensor. In addition, their simplicity and relatively low cost make aspirating psychrometers a favorable option for testing. Typical aspirating psychrometers have an accuracy of ±2 percent relative humidity, but higher accuracy versions are capable of achieving ±1 percent relative humidity. DOE concludes that this higher-accuracy aspirating psychrometer would provide a means for measuring relative humidity at a lower testing burden than a chilled mirror hygrometer, and therefore proposes to specify in appendix X1 that relative humidity be measured in the ducting used for whole-home dehumidifier testing using an aspirating psychrometer with an accuracy of at least ±1 percent relative humidity. Such psychrometers are likely being used already by testing laboratories for dehumidifier testing under appendix X, because the temperature accuracy requirements in ANSI/AHAM DH–1–2008 correspond to approximately ±1 percent relative humidity accuracy at the nominal ambient dry-bulb and wet-bulb temperatures. Therefore, DOE concludes that testing laboratories currently conducting dehumidifier testing already have the aspirating psychrometers proposed to be used for whole-home dehumidifier testing in a ducted configuration. DOE acknowledges that alternating this sensor between the test configuration of portable and whole-home dehumidifiers would require additional sensor calibration. Manufacturers and testing facilities may elect to purchase additional aspirating psychrometers to eliminate the need to recalibrate between switching test configurations. DOE proposes to require in appendix X1 that the relative humidity within test ducts be measured using an aspirating psychrometer with an accuracy within ±1 percent relative humidity. DOE also proposes that the aspirating psychrometer be placed at the duct's geometric centerline within 1 inch of the dry-bulb temperature measurement plane.

3. Instrumentation for Measuring External Static Pressure (ESP)

Frictional forces and head losses due to the air flowing in the ducting lead to an ESP that is imposed on the whole-home dehumidifier. As duct length and the number of elbows and other flow restrictions increases, the ESP increases as well. In a recent supplemental notice of proposed rulemaking for test procedures for residential furnace fans, DOE has proposed to define ESP as the difference in static pressure measured in the outlet and return air duct during testing. 78 FR 19606, 19618 (Apr. 2, 2013). For consistency with these testing procedures, DOE proposes to establish the following analogous definition for ESP for whole-home dehumidifier testing in appendix X1:

External static pressure (ESP): The process air outlet static pressure minus the process air inlet static pressure, measured in inches of water column (in. w.c.).

As discussed previously, ESP would be calculated by subtracting pressures losses between the dehumidifier and both static pressure tap locations from the measured static pressure differential. The blower within a whole-home dehumidifier must overcome this ESP to move air throughout a home's air delivery system. As ESP increases, the flow rate a blower can achieve at a particular rotational speed decreases, which also decreases moisture removal capacity. Therefore, DOE proposes that ducted dehumidifier testing in appendix X1 be conducted at an ESP representative of typical residential installations. DOE reviewed several sources of information to determine the appropriate ESP.

DOE's review of whole-home dehumidifier product literature revealed that rated volumetric air flow rate in cubic feet per minute (CFM) is typically provided at ESP values ranging from 0.4 to 0.8 in. w.c., as well as at zero ESP. Manufacturers likely provide the former range of values to characterize performance under conditions representative of actual installations. In addition, the Center for Energy and Environment (CEE) researched the feasibility of a residential furnace fan retrofit program, monitoring 81 Minnesota home air delivery systems during the heating season.[18] This study

[17] The cooled surface within chilled mirror hygrometers may be achieved thermoelectrically, mechanically, or chemically.

[18] Center for Energy and Environment Comment on Energy Conservation Standards for Residential Furnace Fans, July 27, 2010. Docket No. EERE–2010–BT–STD–0011, Comment Number 22.

found that the average ESP of these duct systems was 0.55 in. w.c. In addition, the median ESP fell between 0.45 and 0.55 in. w.c. For furnace fans designed to be installed in systems with an internal evaporator coil, DOE's analysis for the furnace fan test procedure indicated that a representative weighted-average ESP would be 0.50 in. w.c. 78 FR 19606, 19608 (Apr. 2, 2013).

Based on this information, DOE tentatively concluded that an ESP of 0.5 in. w.c. would, on average, represent the static pressure conditions found in a ducted whole-home dehumidifier installed in a typical home. DOE also notes that a test condition tolerance of 0.02 in. w.c. on ESP is established in appendix M to 10 CFR Part 430 subpart B for testing the energy consumption of central air conditioners and heat pumps. DOE proposes to adopt this same tolerance for average ESP throughout whole-home dehumidifier testing to maintain consistency with other covered products installed in similar ducting and with accepted industry requirements. Therefore, DOE proposes to require in appendix X1 that an ESP of 0.5 ± 0.02 in. w.c. be maintained during the dehumidification mode testing of whole-home dehumidifiers. To obtain the proposed nominal ESP of 0.5 in. w.c., DOE also proposes in this document to require that outlet test ducts contain mechanical throttling devices to adjust the ESP.

For nine whole-home units in its sample, DOE quantified the impacts of variations in ESP on capacity and EF at a process air inlet temperature of 65 °F, as shown in Table III.10.

TABLE III.10—IMPACT OF VARYING ESP ON WHOLE-HOME DEHUMIDIFIER PERFORMANCE AT 65 °F

Test unit	Capacity (pints/day)					Energy Factor (L/kWh)				
	0 in. w.c.	0.25 in. w.c.	0.5 in. w.c.	0.75 in. w.c.	1 in. w.c.	0 in. w.c.	0.25 in. w.c.	0.5 in. w.c.	0.75 in. w.c.	1 in. w.c.
W3	63	....	53	....	....	1.91	....	1.59	....	....
W4	56	54	53	49	23	1.5	1.48	1.43	1.31	0.43
W5	66	....	49	....	....	2.31	....	1.89	....	....
W8	82	73	58	0	0	2.42	2.02	1.44	....	....
W9	77	75	71	68	68	1.18	1.13	1.1	1.05	1
W7	107	98	84	....	....	2.76	2.55	2.18	....	....
W10	120	....	109	....	....	3.16	....	2.82	....	....
W12	112	105	99	....	....	1.28	1.18	1.11	....	....
W13	125	....	108	....	....	1.94	....	1.68	....	....

Compared to an ESP of 0 in. w.c., DOE's proposed test condition of 0.5 in. w.c. decreased the capacity of the models in DOE's sample by an average of 17 percent and decreased the EF by an average of 18 percent at 65 °F ambient temperature. Impacts for individual units ranged from 2 to 33 percent for capacity and 2 to 42 percent for EF.

DOE proposes to measure ESP as the difference between the inlet and outlet static pressures. If either inlet or outlet ducting is not required by the test procedure, the ambient static pressure of 0 in. w.c. shall be used to determine ESP. When ducting is required, the duct locations would be consistent with those specified in Figure 7A and Figure 15 of ANSI/AMCA 210, corrected to account for pressure losses between the measurement locations and the dehumidifier. Specifically, the static pressure differential would be measured between a location at a distance upstream of the test unit's process air inlet port or any transition section equal to 1.5 times the diameter of the duct and a location at a distance downstream of the unit's process air outlet port or any transition section equal to 8.5 times the diameter of the duct. DOE also proposes to reference in appendix X1 the provisions in section 7.5.2, Pressure Losses, of ANSI/AMCA 210 that specify how duct pressure losses between the unit under test and the plane of each static pressure measurement would be calculated. These duct pressure losses would be subtracted from the measured static pressure differential at the inlet and outlet measurement locations.

ANSI/AMCA 210 also provides an option for measuring static pressure in a duct using traverses of pitot-static tubes. Accordingly, DOE proposes to specify in appendix X1 the pitot-static tube construction in accordance with section 4.2.2, Pitot-Static Tube, of ANSI/AMCA 210, and the arrangement of pitot-static tubes in each traverse across the plane of the duct according to section 4.3.1, Pitot Traverse, of ANSI/AMCA 210. DOE further proposes that the static pressure at each point in a traverse would be measured at the static tap of the corresponding pitot-static tube, and these measurements would be averaged to calculate the static pressure at that location in the duct.

DOE considered the appropriate accuracy for the pressure sensing instruments used to measure ESP. Section 4.2.1, Manometers and Other Pressure Indicating Instruments, of ANSI/AMCA 210 specifies a pressure measurement instrument with a maximum allowable uncertainty of 1 percent of the maximum observed reading during the test or 0.005 in. w.c., whichever is larger. At the nominal test condition of 0.5 in. w.c. ESP, the maximum allowable uncertainty would be 0.005 in. w.c. DOE also observes that section 5.3.2 of the ANSI/ASHRAE Standard 37–2009, ''Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment'' (ANSI/ASHRAE 37), specifies that duct static pressures be measured with instruments that have an accuracy of ±0.01 in. w.c. This accuracy is identical to the differential pressure instrument accuracy requirements for testing central air conditioners and heat pumps according to section 2.5.3, Indoor Coil Static Pressure Difference Measurement, of DOE's test procedure for these products (appendix M to subpart B). Section 2.5.3 of appendix M also specifies that the differential pressure instrument shall have a resolution of no more than 0.01 in. w.c. DOE tentatively concludes that, for the ESP proposed for whole-home dehumidifier testing in this document, the pressure measurement specifications from ANSI/AMCA 210 could present a burden for those manufacturers that currently test central air conditioners in their testing facilities, and that the accuracy and resolution specified in ANSI/ASHRAE Standard 37 would both be feasible for test facilities and produce repeatable and reproducible results. Therefore, DOE proposes in appendix X1 that the pressure instrument used to measure the ESP shall have an accuracy within ±0.01 in. w.c. and a resolution of no more than 0.01 in. w.c. DOE welcomes comment and information on the appropriate pressure measuring instrument specifications.

4. Instrumentation for Measuring Volumetric Air Flow Rate

DOE proposes in appendix X1 that the volumetric air flow rate in ducts attached to the inlet and outlet of the process air of a refrigerant-desiccant dehumidifier would be calculated using duct diameter, dry-bulb temperature, and velocity pressure [19] measurements, using the methods for measuring air flow rates at test conditions specified in section 7.3.1, Velocity Traverse, of ANSI/AMCA 210. Average velocity pressures would be determined using the same traverses of pitot-static tubes in the process air inlet and outlet ducts as discussed above for measuring ESP. In addition, for refrigerant-desiccant dehumidifiers, average velocity pressure for the reactivation air stream would also be measured using a traverse in the reactivation air inlet duct. This traverse would be located at a distance upstream of the test unit's reactivation air inlet port or any transition section equal to 1.5 times the diameter of the duct. The velocity pressure at each point in a traverse would be calculated as the total pressure, measured at the impact tap of the pitot-static tube, minus the static pressure, measured at the static tap of the pitot-static tube. Section 7.3.1 of ANSI/AMCA 210 provides instructions for averaging these velocity pressures and calculating the air flow rate at the test conditions within the duct.

5. Measurement Frequency

The current test procedure in appendix X requires psychrometry measurements to be recorded at 10-minute intervals or less during dehumidification mode testing, which is adequate for monitoring ambient conditions in a test chamber. However, the conditions of air flowing through the ducts for whole-home dehumidifiers have the potential to vary on time scales that are shorter than 10 minutes. As a result, DOE proposes in appendix X1 that whole-home dehumidifiers be tested with measurement acquisition rates of dry-bulb temperature, velocity pressure, and relative humidity equal to or more frequently than once per minute. DOE's observation of current dehumidifier testing suggests that this sampling frequency likely can be met by existing data recording equipment in most test laboratories.

[19] ''Velocity pressure'' is defined in section 3.1.17 of ANSI/AMCA 210 as the ''portion of air pressure that exists by virtue of the rate of motion of the air.''

d. Psychrometer Requirements

The proposals discussed in this section are based on detailed analysis of industry test procedures, test laboratory observations, and comparison of different psychrometer setup configurations for portable dehumidifiers.

Appendix X requires that a psychrometer be used to measure dry-bulb and wet-bulb temperature conditions throughout dehumidification mode testing. Instructions for placement of the psychrometer are provided through reference to section 7.1.4, Psychrometer Placement, of ANSI/AHAM DH–1–2008, which specifies that the psychrometer shall be placed 1 foot in front of the intake grill of the test unit. In addition, section 5.3, Positioning of Test Unit, of ANSI/AHAM DH–1–2008 specifies that the sampling tree for use with the psychrometer shall be placed 1 foot from the air inlet side of the dehumidifier. However, through market research, DOE identified certain portable dehumidifiers with multiple air inlets on different surfaces of the unit. For these dehumidifiers, ANSI/AHAM DH–1–2008 does not provide specific instructions regarding where the sampling tree or psychrometer should be located.

DOE has identified two possible approaches for psychrometer setup for portable dehumidifiers with multiple air inlets. The first approach would be to place a single psychrometer or sampling tree at a location that is as close as possible to 1 foot in front of all intake grilles. This approach would minimize test burden by requiring only one psychrometer and possibly one sampling tree, but could lead to measurements that do not accurately reflect the conditions of the air entering each inlet and could potentially cause confusion regarding the proper sensor placement for units with unique air inlet locations. The second approach would be to place a separate sampling tree 1 foot in a perpendicular direction from the center of each air inlet grille, with the sampled air combined and connected to a single psychrometer using a minimal length of thermally insulated ducting. The thermally insulated ducting shall be installed along the shortest possible path connection between the psychrometer and sampling tree(s), minimizing excess duct length that may introduce variability between the conditions of the air when it enters the sampling tree and when it reaches the aspirating psychrometer. This approach would monitor the average conditions of the air entering the dehumidifier through each inlet, with the added testing burden of requiring one or more additional sampling trees. Because air sampling trees are commonly used for testing other products and are readily available, if the sampling tree approach is selected the additional testing burden is minimal and would result in improved reproducibility of the test procedure. Therefore, DOE proposes in this NOPR to clarify in appendix X and appendix X1 that for portable dehumidifiers with multiple intake grilles, a separate sampling tree shall be placed 1 foot away in a perpendicular direction from the center of each air inlet. DOE also proposes to clarify in both appendices that for portable dehumidifiers with only one intake grille, the psychrometer or sampling tree shall be placed 1 foot away in a perpendicular direction from the center of the air inlet. DOE requests comment on these proposed clarifications to the psychrometer setup and input on the associated test burden impacts.

In response to the October 2013 NOPR,[20] AHAM commented that some test facilities use a single psychrometer box to monitor inlet conditions for two or more test units, and that the DOE dehumidifier test procedure does not specify whether each test unit requires its own individual psychrometer box. AHAM proposed that DOE clarify that each dehumidifier under test requires its own individual psychrometer box because the test procedure's intent is that each dehumidifier in the test chamber is treated as an individual test and the temperatures should be measured as such. (AHAM, Docket No. EERE–2013–BT–TP–0044, No. 2 at p. 2) DOE notes that section 7.1.4 of ANSI/AHAM DH–1–2008, which is referenced for testing portable dehumidifiers, states to ''[p]lace the psychrometer (4.2) 1 ft. (0.30 m) in front of the intake grille.'' This instruction could be interpreted to mean that the temperature and relative humidity would be sampled specifically for that location, which in turn would require that these properties be measured individually for each of multiple portable dehumidifiers being tested concurrently. DOE also notes that using average inlet temperature and relative humidity conditions for multiple portable dehumidifiers could impact the measured capacity, EF, and IEF. Therefore, DOE proposes to add clarifying text to appendix X and appendix X1 that would allow no more

[20] The docket for the rulemaking for the October 2013 NOPR may be found online at: *www.regulations.gov/#!documentDetail;D=EERE-2013-BT-TP-0044.*

than one portable dehumidifier to be connected to a single psychrometer during testing. DOE believes this proposal would ensure consistency among test facilities and improve test result accuracy.

e. Condensate Collection

The proposals discussed in this section are based on detailed analysis of industry test procedures, test laboratory observations, and comparison of different condensate collection setup configurations.

The provisions in appendix X for measuring capacity and energy consumption in dehumidification mode require condensate to be collected for a period of 6 hours while the dehumidifier is operating under the specified ambient conditions. According to section 5.4, Condensate Collection, of ANSI/AHAM DH–1–2008, if means for collecting the condensate are provided as part of the dehumidifier, they are to be installed as provided for in normal service. In addition, the dehumidifier may be placed on the weight-measuring instrument for direct reading of condensate during the test. If the only provision is for draining the condensate away from the unit, the condensate must be collected in a substantially closed vessel to prevent re-evaporation.

These instructions do not address the use of an internal pump, which may be provided as a means to drain the condensate from the dehumidifier. In addition, DOE recognizes that a condensate collection bucket may not be sufficiently large to hold the entire amount of condensate produced during the 6-hour dehumidification mode test, and that when the bucket is full, the unit may turn off the compressor or activate a pump to empty the bucket to an external drain.

To ensure that the amount of condensate measured during the dehumidification mode test is representative of the total amount of condensate that would be produced during the 6-hour test, DOE proposes in this document to specify in appendix X and appendix X1 that if means are provided on the dehumidifier for draining condensate away from the cabinet, the condensate would be collected in a substantially closed vessel which would be placed on the weight-measuring instrument. Such an approach would minimize re-evaporation of the condensate and would isolate the condensate weight measurement from the vibration of the dehumidifier during operation. DOE further proposes that if no means for draining condensate away from the cabinet are provided, any automatic shutoff of dehumidification mode operation that would be activated when the collection container is full shall be disabled and any overflow shall be collected in a pan, completely covered to prevent re-evaporation except where allowing for collection of overflow water, that is placed beneath the dehumidifier, both of which shall be placed on the weight-measuring instrument for direct reading of the condensate weight during the test. The proposal would also clarify in appendix X and appendix X1 that any internal pump shall not be used to drain the condensate into a substantially closed vessel unless such pump is provided for use by default in dehumidification mode.

f. Control Settings

The proposal discussed in this section is based on an analysis of dehumidifier features and implications of varying control settings with respect to the representativeness of the test procedure, as well as test repeatability and reproducibility.

Certain dehumidifiers have controls that allow selection of the fan speed during dehumidification mode. The highest fan speed will produce the most rapid rate of moisture removal, while the lower fan speeds may be provided to reduce noise. Appendix X, however, does not specify a particular fan speed setting during testing.

Also, certain dehumidifiers have controls that allow consumers to select a target relative humidity level, for example by setting the desired relative humidity percentage or by adjusting a dial to a more or less dry setting. Appendix X requires test facilities to maintain a 60-percent relative humidity level during active mode testing, in which the unit must operate continuously in dehumidification mode. While appendix X does not specify a particular relative humidity setpoint, the test operator must select a control setting that corresponds to a relative humidity level lower than 60 percent to ensure that the test unit does not enter off-cycle or fan-only mode.

In comments submitted in response to the October 2013 NOPR, AHAM addressed the topic of control settings for testing in dehumidification mode by proposing that if the unit under test has a ''continuous on'' function, a setting that maintains constant dehumidification mode operation regardless of the ambient relative humidity, that such a setting should be selected. In the absence of a continuous on function, AHAM proposed that the unit be tested at the highest fan speed and lowest humidity setting. According to AHAM, these settings would correspond to the highest energy use and would be consistent with current industry practice. (AHAM, Docket No. EERE–2013–BT–TP–0044, No. 2 at p. 2)

The control settings suggested by AHAM would correspond to the highest energy use in dehumidification mode. In addition, although DOE is not aware of any dehumidifiers that operate differently at humidity setpoints below 60 percent, it is possible that certain dehumidifier controls may be programmed to do so, thereby no longer operating at the highest energy use. For this reason, DOE proposes to require in appendix X and appendix X1 that, for units with a continuous on feature, that control setting shall be selected for dehumidification mode testing. For units without a feature for continuous operation, the fan would be set at the maximum speed if the fan speed is user adjustable, and the relative humidity controls would be set to the lowest available value during dehumidification mode testing. Further, DOE's observations at third-party test facilities corroborate AHAM's comment that these fan speed requirements would be consistent with industry practice. Therefore, DOE concludes that this proposal would not impact energy consumption or capacity currently determined using appendix X.

2. Fan-Only Mode

The proposals discussed in this section are based on observations of units acquired for investigative testing and detailed analysis of industry test procedures used to determine cyclical or continuous power consumption.

Certain dehumidifier models maintain blower operation without activation of the compressor after the humidity setpoint has been reached, rather than entering off-cycle mode. Such fan-only mode operation may be intended to draw air over the humidistat to monitor ambient conditions, or may occur immediately following a period of dehumidification mode to defrost and dry the evaporator coil, which will prevent the humidistat from prematurely sensing a humidity level high enough to reactivate the compressor. The blower may operate continuously in fan-only mode, or may cycle on and off intermittently. In addition, some units allow the consumer to select operation of the blower continuously for air circulation purposes.

In their submission to DOE in response to the August 2012 Framework Document, the Joint Commenters stated that, as of October 17, 2012, there were 12 models on the ENERGY STAR

Dehumidifiers Product List, six of which had fans that could operate continuously without activation of the compressor. The Joint Commenters referenced the Wisconsin Study, which found that fan-only mode power consumption ranged from under 40 watts (W) to 120 W, suggesting that continuous fan operation could contribute significantly to dehumidifier annual energy consumption. For example, the Joint Commenters noted that an 80 W fan running in continuous fan-only mode for 1,000 hours annually would consume 80 kWh. Although the Joint Commenters asserted that continuous fan operation would circulate the air in the space being dehumidified, reducing gradients and perhaps affecting colder and more humid areas (such as adjacent to walls) such that dehumidification mode could be activated only when necessary, they believe that the same actions could be accomplished with intermittent fan operation controlled by a fixed timer initiated after each period of compressor operation or a variable timer based on past operating patterns. The Joint Commenters stated that if the annual energy consumption of continuous fan operation is not adequately captured already in the test procedure, DOE should amend it to measure the annual energy consumption of fan-only mode. (Joint Commenters, No. 9 at pp. 5–6)

As discussed in section III.B.2 of this document, appendix X does not contain provisions to measure dehumidifier energy use during fan-only mode. The existing methodology requires measurement of the power consumption in off-cycle mode and either inactive mode or off mode, depending on which mode is available on the unit under test. The test procedure then assigns the annual operating hours outside of dehumidification mode to off-cycle mode, inactive mode, or off mode according to the following: 1,840.5 hours to off-cycle mode and 1,840.5 hours to either inactive mode or off mode. These hours are multiplied by the corresponding power consumption measurements and summed to obtain the annual combined low-power mode energy consumption. Recognizing that some dehumidifiers operate in fan-only mode in place of off-cycle mode, however, DOE is proposing in this document that the 1,840.5 annual hours currently attributed to off-cycle mode in appendix X be assigned in appendix X1 to fan-only mode for those dehumidifiers. Based on investigative testing, and using this proposed calculation, DOE determined that fan-only mode may consume more than 300 times more energy than off-cycle or inactive mode. For this reason, this proposed provision in appendix X1 would more accurately reflect the typical energy consumption of dehumidifiers that operate in fan-only mode rather than off-cycle mode.

The proposed fan-only mode average power measurement would require adjusting the relative humidity setpoint during this testing to a level higher than the ambient relative humidity to ensure that the refrigeration system does not cycle on. To minimize testing burden, DOE proposes in appendix X1 that the testing may be conducted either under the same ambient conditions as for dehumidification mode, or under the test conditions specified for standby mode and off mode testing. DOE tentatively concludes that the power consumption in fan-only mode does not depend on the ambient conditions (*i.e.,* fan speed and power consumption do not change with ambient conditions) and seeks comment on whether the results from the two testing options would be comparable. To further minimize test burden, DOE also proposes that the laboratory should not perform more than one run-in period for all active mode testing. Because the term ''run-in'' is not defined in ANSI/AHAM DH–1–2008, DOE further proposes to clarify in appendix X1 that the compressor shall operate during the run-in period.

DOE has observed that the fan may operate continuously during fan-only mode or may cycle on and off periodically. In DOE's testing, the period of such cyclic operation was observed to be approximately 10 minutes, and DOE's research indicates that some units may cycle on for a period of a few minutes per hour. To obtain a representative average measure of fan-only mode power consumption in appendix X1, DOE proposes that the power be measured and averaged over a period of 1 hour for fan-only mode in which the fan operates continuously. For fan-only mode in which the fan operates cyclically, the average fan-only mode power would be measured over a period of 3 or more full cycles for no less than 1 hour. DOE also proposes to include in the IEF calculation in appendix X1 the fan-only mode energy use for those dehumidifiers that operate in fan-only mode rather than off-cycle mode. DOE further proposes to require that, for units with adjustable fan speed settings, the fan be set at the maximum speed during fan-only mode testing because the maximum speed is typically recommended to consumers as the setting that produces the maximum moisture removal rate.

DOE does not have information regarding the number of annual hours in which the consumer selects fan-only mode to circulate air, rather than operating the dehumidifier for the general purpose of moisture removal. For this reason, DOE is not proposing at this time to include an additional energy use component associated with air circulation in the IEF calculation in appendix X1. DOE welcomes data and input on consumer usage patterns related to fan-only mode for air circulation.

C. Additional Technical and Editorial Corrections

1. Definition of ''Dehumidifier''

As discussed in section III.A of this document, EPCA defines a dehumidifier in relevant part, as a ''mechanically encased assembly.'' (42 U.S.C. 6291(34)) The definition of ''dehumidifier'' codified at 10 CFR 430.2, however, incorrectly states that the product be a ''mechanically refrigerated encased assembly.'' In this document, DOE proposes to correct the definition in 10 CFR 430.2. DOE also proposes to add clarification that the definition of ''dehumidifier'' does not apply to portable air conditioners and room air conditioners. The primary function of an air conditioner is to provide cooling by removing both sensible and latent heat, while a dehumidifier removes moisture (*i.e.,* only latent heat). Therefore, DOE proposes to clarify these exclusions in the amendments to 10 CFR 430.2.

2. Referenced Section in Test Procedures at 10 CFR 430.23

DOE proposes to amend the test procedures codified at 10 CFR 430.23(z) to reference the correct sections of amended appendix X and new appendix X1 for measuring capacity, energy factor (EF), and IEF.

3. Integrated Energy Factor Calculation

The existing IEF equation in section 5.2 of appendix X incorporates the annual combined low-power mode energy consumption, E_{TLP}, in kWh per year, and the active mode energy consumption, E_{active}, in kWh as measured during the active mode test. To sum these components, the equation converts E_{TLP} into kWh/day by dividing by the number of active mode hours per year and multiplying by 24 hours per day. However, E_{active} represents the energy use measured during the course of the 6-hour dehumidification mode test. To correctly sum the combined low-power mode energy consumption and dehumidification mode energy consumption on an equivalent basis, the equation for IEF should convert E_{TLP} to kWh consumed during 6 hours. Therefore, DOE proposes in section 5.2 of appendix X to amend the IEF equation to correctly divide E_{TLP} by the number of dehumidification mode hours per year and multiply by 6 hours in accordance with the duration of the dehumidification mode test. DOE also proposes to: (1) Clarify in section 4.1 of appendix X that energy consumption as well as EF shall be measured during dehumidification mode testing; (2) redesignate E_{active} as E_{DM} to clarify that it is the energy consumption measured in dehumidification mode; and (3) redesignate S_{active} as S_{DM} to clarify that it is the annual hours spent in dehumidification mode. DOE proposes to incorporate these same clarifications and corrections in appendix X1, as well as sum the annual fan-only mode energy consumption, E_{FM}, with E_{TLP} to include the measure of fan-only mode energy consumption in the calculation of IEF.

4. Number of Annual Inactive Mode and Off Mode Hours

In section 5.1 of appendix X, the number of annual hours for inactive mode and off mode each contains a typographical error, wherein a comma is used in place of a decimal point. DOE proposes in this document to correct these typographical errors.

D. Materials Incorporated by Reference

As discussed in section III.B.1.c of this document, DOE is proposing in appendix X1 to reference certain sections of the following industry test methods to determine the product capacity and IEF of whole-home dehumidifiers in a ducted installation:

(1) ANSI/ASHRAE Standard 41.1–2013, ''Standard Method for Temperature Measurement''; and

(2) ANSI/ASHRAE 51–2007/ANSI/AMCA 210–07, ''Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating''.

DOE proposes to amend 10 CFR 430.3 to include these industry test methods.

E. Certification and Verification

In 10 CFR 429.36, DOE requires that manufacturers include dehumidifier capacity, in pints/day, in their certification reports; however, 10 CFR 429.36 does not specify how to determine the rated capacity for a basic model. The consequence of an incorrectly reported capacity may be the application of an incorrect standard for minimum required EF or, in the future, a minimum required IEF. Therefore, DOE proposes in this document to require that the average of the capacities measured for a given sample be used for certification puposes.

For verification purposes, DOE proposes to require that the test facility measurement of capacity must be within 5 percent of the rated capacity, or 1.00 pints/day, whichever is greater. DOE notes that this tolerance is the same as the tolerance allowed within AHAM's dehumidifier verification program, which suggests that manufacturers are able to comply with this requirement without undue testing burden. If DOE determines that a rated capacity is not within 5 percent of the measured capacity, or 1.00 pints/day, whichever is greater, the capacity measured by the test facility shall be used to determine the energy conservation standard applicable to the tested basic model. DOE proposes to add a new section 429.134 of 10 CFR part 429 to address this capacity verification protocol.

To ensure that the minimum EF or IEF requirements are accurately applied to each dehumidifier model, DOE proposes to clarify in the dehumidifier test procedures at 10 CFR 430.23(z) that, when using appendix X, capacity would be measured in accordance with paragraph 4.1 of that appendix, and when using appendix X1, capacity would be measured in accordance with paragraph 5.4 of that appendix for refrigerant-desiccant dehumidifiers and in accordance with paragraph 4.1.1.1 for all other dehumidifiers. DOE also proposes in this document to include rounding instructions in appendix X and appendix X1 that would clarify that the measurement of capacity is to be rounded to two decimal points, consistent with the number of significant digits in the product class definitions, and that IEF is to be rounded to two decimal places in accordance with the existing instructions in appendix X for rounding EF and IEF.

F. Compliance Dates of Amended Test Procedures

DOE is proposing amendments to its dehumidifier test procedure in appendix X that would clarify the psychrometer setup for portable dehumidifiers, the control settings for dehumidification mode testing, the provisions for collecting water for the capacity measurement, and the dates for use of the test procedures. The proposed amendments to appendix X would also include certain editorial and technical corrections. As discussed previously, DOE does not expect that these clarifications and corrections would alter the measured EF, but rather would improve the interpretation and use of the test procedure. Therefore, the proposals for appendix X would not affect a manufacturer's ability to comply with current energy conservation standards using appendix X. Manufacturers would be required to use the revised appendix X for representations 180 days after the publication of any final amended test procedures in the **Federal Register**. (Alternatively, manufacturers may certify compliance with any amended energy conservation standards prior to the compliance date of those amended energy conservation standards by testing in accordance with appendix X1.)

DOE is also proposing to amend the dehumidifier test procedure in 10 CFR part 430, subpart B to create a new appendix X1 that would include a lower ambient temperature for certain active mode testing, a new measure of fan-only mode energy consumption, and provisions for testing whole-home dehumidifiers, including ''refrigerant-desiccant'' dehumidifiers. Appendix X1 would also incorporate the same clarifications and technical corrections as proposed for appendix X. Manufacturers would be required to use the new appendix X1 for determining compliance with any amended standards adopted in the ongoing energy conservation standards rulemaking.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

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

B. Review Under the Regulatory Flexibility Act

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

DOE reviewed this proposed rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. DOE's initial regulatory flexibility analysis is set forth below. DOE seeks comment on its analysis and the economic impacts of the rule on small manufacturers.

A description of the reasons why the proposed test procedures are being considered, as well as a succinct statement of the objectives of, and legal basis for, the proposed rule is set forth elsewhere in the preamble and not repeated here. DOE is also not aware of any Federal rules that would duplicate, overlap or conflict with the proposed rule.

Description and Estimate of the Number of Small Entities to Which the Proposed Rule Would Apply

The Small Business Administration (SBA) considers a business entity to be small business, if, together with its affiliates, it employs less than a threshold number of workers specified in 13 CFR part 121. These size standards and codes are established by the North American Industry Classification System (NAICS). The threshold number for NAICS classification code 335211, ''Electric Housewares and Household Fan Manufacturing,'' is 750 employees; this classification specifically includes manufacturers of dehumidifiers.

DOE surveyed the AHAM member directory to identify manufacturers of residential dehumidifiers. DOE then consulted publicly available data, purchased company reports from vendors such as Dun and Bradstreet, and contacted manufacturers, where needed, to determine if they meet the SBA's definition of a ''small business manufacturing facility'' and have their manufacturing facilities located within the United States. Based on this analysis, DOE estimates that there are five small businesses that manufacture dehumidifiers.

Description of the Projected Reporting, Recordkeeping and Other Compliance Requirements

The proposed rule would establish a new test procedure for dehumidifiers with a revised testing temperature for certain active mode testing and the requirement that whole-home dehumidifiers be tested in active mode with ducting in place. The lower temperature test that DOE is proposing for dehumidification mode in new appendix X1 requires ambient temperature and humidity levels identical to those contained in section 8.2, Low Temperature Test, of ANSI/AHAM DH–1–2008, which some manufacturers already may be using. In addition, product specifications for dehumidifiers from each of the small businesses indicate that they produce dehumidifiers rated for operation at ambient temperatures of 65 °F or below, suggesting that these manufacturers have conducted lower temperature testing already.

DOE also considered the cost of additional ducting and associated components and instrumentation that would be required for whole-home dehumidifier active mode testing. Based on its research of retail prices for components required to construct the instrumented inlet and outlet ducts, as well as estimate for the purchase of a complete assembly from a third-party laboratory, DOE determined that the cost of each non-instrumented duct would be approximately $1,500, and that the cost of an instrumented, calibrated duct would not exceed $2,700. Therefore, the equipment cost for testing a refrigeration-only whole-home dehumidifier with no inlet duct and a non-instrumented outlet duct would be approximately $1,500, or $3,000 for whole-home dehumidifiers with two outlets. For refrigerant-desiccant dehumidifiers, which would require instrumented ducts at the inlet and outlet of the process airstream and the inlet of the reactivation air stream, the total equipment cost would be approximately $8,100. Costs of test ducts could be reduced if existing aspirating psychrometers used for portable dehumidifiers testing are used within test ducts. However, alternating aspirating psychrometers between portable and whole-home test configurations would require additional calibration and labor that DOE estimates to cost approximately $300 per calibration. DOE also tentatively concludes that whole-home dehumidifier manufacturers already test their products in chambers that can accommodate comparably-sized ducting, since product literature indicates that performance has been measured at non-zero ESP.

For dehumidifiers capable of operating in fan-only mode, the proposed rule would also require in appendix X1 measuring power input when the product is in fan-only mode. These tests could be conducted either in the same facilities used for the dehumidification mode testing of these products, or in facilities in which standby mode and off mode testing is conducted, so there would be no additional facilities costs required by the proposed rule. In addition, the requirements for the wattmeter specified for these tests would be the same as used for standby mode and off mode testing, so manufacturers would likely be able to use the same equipment for fan-only mode testing as they would already use for standby mode and off mode testing. In the event that an additional wattmeter would be required for testing in the facilities used for the current dehumidifier active mode testing, the investment required for a possible instrumentation upgrade would likely be relatively modest. An Internet search of equipment that specifically meets the proposed requirements reveals a cost of approximately $2,000.

Test facilities that use a single psychrometer box to test multiple units simultaneously that do not already own additional psychrometer boxes would need to purchase an additional psychrometer box for each additional unit that would be tested concurrently. Based on DOE research and input from test laboratories, DOE estimates that test facilities may purchase and calibrate the required equipment for approximately $1,000 each.

Additionally, test laboratories with only one sampling tree for each psychrometer box may be required to purchase additional sampling trees to account for units with multiple air inlets. In this document, DOE proposes that a sampling tree be placed in front of each air inlet on a test unit. DOE expects laboratories may purchase additional sampling trees at an estimated cost of $300 each to comply with the proposed test requirements.

Alternatives to the Proposed Rule

As discussed above, DOE considered alternate test approaches for both portable and whole-home dehumidifiers.

Although DOE proposed modifying the dehumidification mode ambient temperature conditions from 80 °F dry-bulb temperature and 69.6 °F wet-bulb temperature to 65 °F dry-bulb temperature and 55 °F wet-bulb temperature, DOE's alternate proposal for dehumidification mode would require combining results from testing at both of these conditions. This alternate proposed approach would increase test burden by requiring testing each unit in dehumidification mode at two test conditions, although only a single run-in period, fan-only mode test, and combined low-power mode test would be required.

DOE considered testing at an alternate ambient relative humidity if a more representative condition was determined. However, for the reasons discussed in section III.1.b of this document, DOE proposes to maintain the current ambient relative humidity of 60 percent. DOE tentatively concludes that test laboratories are familiar with the overall condition requirements and additional humidifying equipment would not be required to increase test chamber capabilities.

For the proposed testing methodology for whole-home dehumidifiers, DOE examined the accuracy and repeatability of available relative humidity sensors. Although DOE is proposing the use of psychrometers to measure dry-bulb and wet-bulb temperature conditions, DOE also considered chilled mirror hygrometers as an alternate instrument for measuring relative humidity. For the reasons discussed in section III.1.dIII.B.1.d of this document, DOE decided to propose the use of psychrometers to avoid the burden associated with chilled mirror hygrometers (*i.e.,* the requirements for a skilled operator, frequent cleaning, and regular calibration).

In addition, for whole-home dehumidifiers, DOE's proposals specify the minimum number of test ducts that, according to its investigative testing, would produce representative results for capacity and integrated energy factor. If instrumented test ducts were required on all inlet and outlet ports, testing facilities could incur an additional $3000 cost for the equipment.

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of residential dehumidifiers must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for dehumidifiers, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including residential dehumidifiers. (76 FR 12422 (March 7, 2011)). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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

D. Review Under the National Environmental Policy Act of 1969

In this proposed rule, DOE proposes test procedure amendments that it expects will be used to develop and implement future energy conservation standards for residential dehumidifiers. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this proposed rule would amend the existing test procedures without affecting the amount, quality or distribution of energy usage, and, therefore, would not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A5 under 10 CFR part 1021, subpart D, which applies to any rulemaking that interprets or amends an existing rule without changing the environmental effect of that rule. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 4, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

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

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Pub. L. 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *energy.gov/gc/office-general-counsel.* DOE examined this proposed rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of $100 million or more in any year, so these requirements do not apply.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

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

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

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed this proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OMB, a Statement of Energy Effects for any proposed significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgated or is expected to lead to promulgation of a final rule, and that: (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

This regulatory action to amend the test procedure for measuring the energy efficiency of residential dehumidifiers is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

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

Under section 301 of the Department of Energy Organization Act (Pub. L. 95–91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

As discussed in section III.1.c of this document, the proposed rule incorporates testing methods contained in the following commercial standards: ANSI/ASHRAE Standard 41.1–2013, Standard Method for Temperature Measurement; and ANSI/ASHRAE 51–2007/ANSI/AMCA 210–07, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating. While this proposed test procedure is not exclusively based on these standards, one component of the test procedure, namely ducted installation requirements for testing whole-home dehumidifiers, adopts provisions from these standards without amendment. DOE has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA, (*i.e.,* that they were developed in a manner that fully provides for public participation, comment, and review). DOE will consult with the Attorney General and the Chairwoman of the FTC concerning the impact of these test procedures on competition, prior to prescribing a final rule.

V. Public Participation

A. Attendance at Public Meeting

The time, date and location of the public meeting are listed in the **DATES** and **ADDRESSES** sections at the beginning of this document. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945 or *Brenda.Edwards@ee.doe.gov.* As explained in the **ADDRESSES** section, foreign nationals visiting DOE Headquarters are subject to advance security screening procedures.

In addition, you can attend the public meeting via webinar. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's Web site *http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/55* Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Prepared General Statements for Distribution

Any person who has plans to present a prepared general statement may request that copies of his or her statement be made available at the public meeting. Such persons may submit requests, along with an advance electronic copy of their statement in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format, to the appropriate address shown in the **ADDRESSES** section at the beginning of this document. The request and advance copy of statements must be received at least one week before the public meeting and may be emailed, hand-delivered, or sent by mail. DOE prefers to receive requests and advance copies via email. Please include a telephone number to enable DOE staff to make a follow-up contact, if needed.

C. Conduct of Public Meeting

DOE will designate a DOE official to preside at the public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA (42 U.S.C. 6306). A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. After the public meeting and until the end of the comment period, interested parties may submit further comments on the proceedings and any aspect of the rulemaking.

The public meeting will be conducted in an informal, conference style. DOE will present summaries of comments received before the public meeting, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will permit, as time permits, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this rulemaking. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the above procedures that may be needed for the proper conduct of the public meeting.

A transcript of the public meeting will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this document. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule before or after the public meeting, but no later than the date provided in the **DATES** section at the beginning of this proposed rule. Interested parties may submit comments using any of the methods described in the **ADDRESSES** section at the beginning of this document.

Submitting comments via regulations.gov. The regulations.gov Web page will require 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 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 regulations.gov cannot be claimed as CBI. Comments received through the Web site 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 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 regulations.gov provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery, or mail. Comments and documents submitted via email, hand delivery, or mail also will be posted to 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 on 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. If you submit via mail or hand delivery, please provide all items on a CD, if feasible. It is not necessary to submit printed copies. No facsimiles (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. According 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, postal mail, or hand delivery 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 or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

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

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).

E. 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:

1. The clarification of whole-home dehumidifiers, including refrigerant-desiccant dehumidifiers, as covered products, and the new definitions for portable dehumidifiers, whole-home dehumidifiers, refrigerant-desiccant dehumidifiers. (See section III.A.)

2. The new definitions for dehumidification mode and fan-only mode. (See section III.B.)

3. The revision of the ambient dry-bulb temperature for testing conditions from 80 °F to 65 °F in new appendix X1, along with the associated impacts to IEF and capacity. In addition, DOE welcomes input on the alternative approach in which dehumidifiers would be tested under both the 80 °F and 65 °F ambient temperature conditions, with the IEF and capacity calculated as weighted averages of these metrics measured at each of the two temperatures. For this alternative approach, DOE seeks input on appropriate weighting factors. DOE also seeks further comment on alternatively testing whole-home dehumidifiers at 73 °F ambient dry-bulb temperature to represent the average residential thermostat setting during dehumidifier usage. (See section III.B.1.a.)

4. The continued specification of 60-percent relative humidity for the ambient testing conditions for dehumidification mode, even at a reduced ambient temperature. (See section III.B.1.b.)

5. The test setup and testing methodology for whole-home dehumidifiers in appendix X1, including refrigerant-desiccant dehumidifiers. In particular, DOE welcomes comment on the proposed ducting configurations, alternative ambient temperature, and ESP, including equipment costs and testing burden. (See section III.B.1.c.)

6. The testing burden associated with the requirement for multiple psychrometer sampling trees for portable dehumidifiers with multiple air inlets, and for connecting no more than one test unit per psychrometer. (See section III.B.1.d.)

7. The condensation collection requirements for dehumidifiers with and without means for draining the condensate, including the use of any internal pump only if it is activated by default in dehumidification mode. (See section III.B.1.e.)

8. The proposed control settings for dehumidification mode testing, which would require selecting continuous operation for those units with such a function. Otherwise the lowest relative humidity setting and, for units with user-adjustable fan speed, the highest fan speed would be selected. (See section III.B.1.f.)

9. The provisions for measuring energy consumption in fan-only mode in appendix X1, including the use of the maximum speed setting for those units with adjustable fan speed settings, the measurement period specifications, and the inclusion of fan-only mode energy consumption in the calculation of IEF. DOE also seeks comment on whether fan-only mode energy consumption is independent of ambient conditions. (See section III.B.2.)

VI. Approval of the Office of the Secretary

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

List of Subjects

10 CFR Part 429

Confidential business information, Energy conservation, Household appliances, Imports, Reporting and recordkeeping requirements.

10 CFR Part 430

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

Issued in Washington, DC, on May 2, 2014.

Kathleen B. Hogan,

Deputy Assistant Secretary for Energy Efficiency, Energy Efficiency and Renewable Energy.

For the reasons stated in the preamble, DOE proposes to amend parts 429 and 430 of Chapter II of Title 10, Code of Federal Regulations as set forth below:

PART 429—CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291–6317.

■ 2. Section 429.36 is amended by adding paragraph (a)(3) to read as follows:

§ 429.36 Dehumidifiers.

(a) * * *

(3) The value of capacity of a basic model reported in accordance with paragraph (b)(2) of this section shall be the mean of the measured capacity for each tested unit of the basic model. Round the mean capacity value to two decimal places as follows:

(i) A fractional number at or above the midpoint between two consecutive decimal places shall be rounded up to the higher of the two decimal places; or

(ii) A fractional number below the midpoint between two consecutive decimal places shall be rounded down to the lower of the two decimal places.

* * * * *

■ 3. Add § 429.134 to read as follows:

§ 429.134 Product-specific enforcement provisions.

(a) *General.* The following provisions apply to assessment and enforcement testing of the relevant products.

(b)–(e) [Reserved]

(f) *Dehumidifiers.* (1) *Verification of capacity.* The capacity of the basic model will be measured pursuant to the test requirements of 10 CFR part 430 for each unit tested. The results of the measurement(s) will be averaged and compared to the value of capacity certified by the manufacturer. The certified capacity will be considered valid only if the measurement is within five percent, or 1.00 pint per day, whichever is greater, of the certified capacity.

(i) If the certified capacity is found to be valid, the certified capacity will be used as the basis for determining the minimum energy factor allowed for the basic model.

(ii) If the certified capacity is found to be invalid, the mean of the measured capacity of each unit in the sample will be used as the basis for determining the minimum energy factor allowed for the basic model.

(2) [Reserved]

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

■ 5. Section 430.2 is amended by
■ a. Revising the definition of ''Dehumidifier''; and
■ b. Adding the definitions for ''Portable dehumidifier'', ''Refrigerant-desiccant dehumidifier'', and ''Whole-home dehumidifier'' in alphabetical order;

The revisions and additions read as follows:

§ 430.2 Definitions.

* * * * *

Dehumidifier means a product, other than a portable air conditioner or room air conditioner, which is a self-contained, electrically operated, and mechanically encased assembly consisting of:

(1) A refrigerated surface (evaporator) that condenses moisture from the atmosphere;

(2) A refrigerating system, including an electric motor;

(3) An air-circulating fan; and

(4) Means for collecting or disposing of the condensate.

* * * * *

Portable dehumidifier means a dehumidifier designed to operate within the dehumidified space without the attachment of additional ducting, although means may be provided for optional duct attachment.

* * * * *

Refrigerant-desiccant dehumidifier means a whole-home dehumidifier that removes moisture from the process air by means of a desiccant material in addition to a refrigeration system.

* * * * *

Whole-home dehumidifier means a dehumidifier designed to be installed with ducting to deliver return process air to its inlet and to supply dehumidified process air from its outlet to one or more locations in the dehumidified space.

■ 6. Section 430.3 is amended by:
■ a. Redesignating paragraphs (f)(10) and (f)(11) as paragraphs (f)(12) and (f)(13);
■ b. Redesignating paragraphs (f)(6) through (f)(9) as paragraphs (f)(7) through (f)(10); and
■ c. Adding new paragraphs (f)(6) and (f)(11) to read as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(f) * * *

(6) ANSI/ASHRAE Standard 41.1–2013, *Standard Method for Temperature Measurement,* ASHRAE approved January 29, 2013, ANSI approved January 30, 2013, IBR approved for appendix X1 to subpart B.

* * * * *

(11) ANSI/ASHRAE 51–07/ANSI/AMCA 210–07, (''ANSI/AMCA 210'') *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating,* AMCA approved July 28, 2006, ASHRAE approved March 17, 2008, IBR approved for appendix X1 to subpart B.

* * * * *

■ 7. Section 430.23 is amended by revising paragraph (z) to read as follows:

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

* * * * *

(z) *Dehumidifiers.* When using appendix X, the capacity, expressed in pints per day (pints/day), and the energy factor for dehumidifiers, expressed in liters per kilowatt hour (L/kWh), shall be measured in accordance with section 4.1 of appendix X of this subpart. When using appendix X1, the capacity, expressed in pints/day for dehumidifiers other than refrigerant-desiccant dehumidifiers and the energy factor for dehumidifiers, expressed in L/kWh, shall be measured in accordance with section 4.1.1.1 of appendix X1 of this subpart, and the integrated energy factor, expressed in L/kWh, shall be determined according to section 5.3 of appendix X1 to this subpart. When using appendix X1, the capacity, expressed in pints/day, for refrigerant-desiccant dehumidifiers shall be measured in accordance with section 5.4 of appendix X1 of this subpart.

* * * * *

■ 8. Appendix X to subpart B of part 430 is amended:
■ a. By revising the note after the heading;
■ b. In section 2, Definitions, by redesignating sections 2.4 through 2.10 as sections 2.5 through 2.11, adding new section 2.4, and revising newly redesignated section 2.10;
■ c. In section 3, Test Apparatus and General Instructions, by revising section 3.1 and adding new sections 3.1.1, 3.1.2, 3.1.3, and 3.1.4;
■ d. In section 4, Test Measurement, by revising sections 4.1, 4.2.1, and 4.2.2; and
■ e. In section 5, Calculation of Derived Results From Test Measurements, by revising sections 5.1 and 5.2;

The additions and revisions read as follows:

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

Note: After November 17, 2014, any representations made with respect to the energy use or efficiency of portable dehumidifiers must be made in accordance with the results of testing pursuant to this appendix. Alternatively, manufacturers may certify compliance with any amended energy conservation standards prior to the compliance date of those amended energy conservation standards by testing in accordance with appendix X1. Any representations made with respect to the energy use or efficiency of such portable dehumidifiers must be in accordance with whichever version is selected.

Any representations made on or after the compliance date of any amended energy conservation standards, with respect to the energy use or efficiency of portable or whole home dehumidifiers, must be made in accordance with the results of testing pursuant to appendix X1.

* * * * *

2. Definitions

* * * * *

2.4 *Dehumidification mode* means an active mode in which a dehumidifier:

(1) Has activated the main moisture removal function according to the humidistat or humidity sensor signal; and

(2) Has either activated the refrigeration system or activated the fan or blower without activation of the refrigeration system.

* * * * *

2.10 *Product capacity for dehumidifiers* means a measure of the ability of the dehumidifier to remove moisture from its surrounding atmosphere, measured in pints collected per 24 hours of operation under the specified ambient conditions.

* * * * *

3. Test Apparatus and General Instructions

3.1 *Active mode.* The test apparatus and instructions for testing dehumidifiers in dehumidification mode shall conform to the requirements specified in Section 3, ''Definitions,'' Section 4, ''Instrumentation,'' and Section 5, ''Test Procedure,'' of ANSI/AHAM DH–1 (incorporated by reference, see § 430.3), with the following exceptions.

3.1.1 *Psychrometer placement.* The psychrometer shall be placed perpendicular to, and 1 ft. in front of, the center of the intake grille. For dehumidifiers with multiple intake grilles, a separate sampling tree shall be placed perpendicular to, and 1 ft. in front of, the center of each intake grille, with the samples combined and connected to a single psychrometer using a minimal length of insulated ducting. The psychrometer shall be used to monitor inlet conditions of one test unit only.

3.1.2 *Condensate collection.* If means are provided on the dehumidifier for draining condensate away from the cabinet, the condensate shall be collected in a substantially closed vessel to prevent re-evaporation and shall be placed on the weight-measuring instrument. If no means for draining condensate away from the cabinet are provided, any automatic shutoff of dehumidification mode operation that is activated when the collection container is full shall be disabled and any overflow shall be collected in a pan, covered as much as possible to prevent re-evaporation and not impede collection of overflow water, that is placed beneath the dehumidifier, all of the condensate (i.e., the condensate collected in the vessel/collection container and the overflow pan) shall be placed on the weight-measuring instrument for direct reading of the condensate weight during the test. Any internal pump shall not be used to drain the condensate into a substantially closed vessel unless such pump is activated by default in dehumidification mode.

3.1.3 *Control settings.* If the dehumidifier has a control setting for continuous operation in dehumidification mode, that setting shall be selected. Otherwise, the controls shall be set to the lowest available relative humidity level, and, if the dehumidifier has a user-adjustable fan speed, the maximum fan speed setting shall be selected.

3.1.4 *Recording and rounding.* Record measurements at the resolution of the test instrumentation. Round off calculations to the same number of significant digits as the previous step. Round the final energy factor and integrated energy factor values to two decimal places as follows:

(i) A fractional number at or above the midpoint between two consecutive decimal places shall be rounded up to the higher of the two decimal places; or

(ii) A fractional number below the midpoint between two consecutive decimal places shall be rounded down to the lower of the two decimal places.

Round the final capacity value to two decimal places as follows:

(i) A fractional number at or above the midpoint between two consecutive decimal places shall be rounded up to the higher of the two decimal places; or

(ii) A fractional number below the midpoint between two consecutive decimal places shall be rounded down to the lower of the two decimal places.

* * * * *

4. Test Measurement

4.1 *Active mode.* Measure the energy consumption in dehumidification mode, E_{DM}, expressed in kilowatt-hours (kWh), the energy factor, expressed in liters per kilowatt-hour (L/kWh), and product capacity, expressed in pints per day (pints/day), in accordance with the test requirements specified in Section 7, ''Capacity Test and Energy Consumption Test,'' of ANSI/AHAM DH–1 (incorporated by reference, see § 430.3).

* * * * *

4.2.1 If the dehumidifier has an inactive mode, as defined in section 2.7 of this appendix, but not an off mode, as defined in section 2.8 of this appendix, measure and record the average inactive mode power of the dehumidifier, P_{IA}, in watts. Otherwise, if the dehumidifier has an off mode, as defined in section 2.8 of this appendix, measure and record the average off mode power of the dehumidifier, P_{OM}, in watts.

4.2.2 If the dehumidifier has an off-cycle mode, as defined in section 2.9 of this appendix, measure and record the average off-cycle mode power of the dehumidifier, P_{OC}, in watts.

5. Calculation of Derived Results From Test Measurements

5.1 *Annual combined low-power mode energy consumption.* Calculate the annual combined low-power mode energy consumption for dehumidifiers, E_{TLP}, expressed in kilowatt-hours per year, according to the following:

$$E_{TLP} = [(P_{IO} \times S_{IO}) + (P_{OC} \times S_{OC})] \times K$$

Where:

P_{IO} = P_{IA}, dehumidifier inactive mode power, or P_{OM}, dehumidifier off mode power, in watts, as measured in section 4.2.1 of this appendix.
P_{OC} = dehumidifier off-cycle mode power, in watts, as measured in section 4.2.2 of this appendix.
S_{IO} = 1,840.5 dehumidifier inactive mode or off mode annual hours.
S_{OC} = 1,840.5 dehumidifier off-cycle mode annual hours.
K = 0.001 kWh/Wh conversion factor for watt-hours to kilowatt-hours.

5.2 *Integrated energy factor.* Calculate the integrated energy factor, IEF, expressed in liters per kilowatt-hour, rounded to two decimal places, according to the following:

$$IEF = L_W/[E_{DM} + ((E_{TLP} \times 6)/S_{DM})]$$

Where:

L_W = water removed from the air during the 6-hour dehumidification mode test, in liters, as measured in section 4.1 of this appendix.
E_{DM} = dehumidifier mode test energy consumption during the 6-hour dehumidification mode test, in kilowatt-hours, as measured in section 4.1 of this appendix.
E_{TLP} = standby mode and off mode annual energy consumption, in kilowatt-hours per year, as calculated in section 5.1 of this appendix.
6 = hours per dehumidification mode test, used to convert annual standby and off mode energy consumption for integration with dehumidification mode energy consumption.
S_{DM} = 1,095 dehumidification mode annual hours.

■ 9. Appendix X1 is added to subpart B of part 430 to read as follows:

Appendix X1 to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Dehumidifiers

Note: After November 17, 2014, any representations made with respect to the energy use or efficiency of portable dehumidifiers must be made in accordance with the results of testing pursuant to Appendix X. Alternatively, manufacturers may certify compliance with any amended energy conservation standards prior to the compliance date of those amended energy conservation standards by testing in accordance with this appendix. Any representations made with respect to the energy use or efficiency of such portable dehumidifiers must be in accordance with whichever version is selected.

Any representations made on or after the compliance date of any amended energy conservation standards, with respect to the energy use or efficiency of portable or whole home dehumidifiers, must be made in accordance with the results of testing pursuant to this appendix.

1. Scope

This appendix covers the test requirements used to measure the energy performance of dehumidifiers.

2. Definitions

2.1 *ANSI/AHAM DH–1* means the test standard published by the American National Standards Institute and the Association of Home Appliance

Manufacturers, titled ''Dehumidifiers,'' ANSI/AHAM DH–1–2008 (incorporated by reference; see § 430.3).

2.2 *ANSI/AMCA 210* means the test standard published by ANSI, the American Society of Heating, Refrigeration and Air-Conditioning Engineers, and the Air Movement and Control Association International, Inc., titled ''Laboratory Methods of Testing Fans for Aerodynamic Performance Rating,'' ANSI/ASHRAE 51–07/ANSI/AMCA 210–07 (incorporated by reference; see § 430.3).

2.3 *ANSI/ASHRAE 37* means the test standard published by ANSI and ASHRAE titled ''Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment'', ANSI/ASHRAE 37–2009, (incorporated by reference; see § 430.3).

2.4 *ANSI/ASHRAE 41.1* means the test standard published by ANSI and ASHRAE, titled ''Standard Method for Temperature Measurement,'' ANSI/ASHRAE 41.1–2013 (incorporated by reference; see § 430.3).

2.5 *Active mode* means a mode in which a dehumidifier is connected to a mains power source, has been activated, and is performing the main functions of removing moisture from air by drawing moist air over a refrigerated coil using a fan, or circulating air through activation of the fan without activation of the refrigeration system.

2.6 *Combined low-power mode* means the aggregate of available modes other than active mode.

2.7 *Dehumidification mode* means an active mode in which a dehumidifier:

(1) Has activated the main moisture removal function according to the humidistat or humidity sensor signal; and

(2) Has either activated the refrigeration system or activated the fan or blower without activation of the refrigeration system.

2.8 *Energy factor for dehumidifiers* means a measure of energy efficiency of a dehumidifier calculated by dividing the water removed from the air by the energy consumed, measured in liters per kilowatt-hour (L/kWh).

2.9 *External static pressure (ESP)* means the process air outlet static pressure minus the process air inlet static pressure, measured in inches of water column (in. w.c.).

2.10 *Fan-only mode* means an active mode in which the dehumidifier:

(1) Has cycled off its main moisture removal function by humidistat or humidity sensor;

(2) Has activated its fan or blower to operate either cyclically or continuously; and

(3) May reactivate the main moisture removal function according to the humidistat or humidity sensor signal.

2.11 *IEC 62301* means the test standard published by the International Electrotechnical Commission, titled ''Household electrical appliances–Measurement of standby power,'' Publication 62301 (Edition 2.0 2011–01) (incorporated by reference; see § 430.3).

2.12 *Inactive mode* means a standby mode that facilitates the activation of active mode by remote switch (including remote control), internal sensor, or timer, or that provides continuous status display.

2.13 *Off mode* means a mode in which the dehumidifier is connected to a mains power source and is not providing any active mode or standby mode function, and where the mode may persist for an indefinite time. An indicator that only shows the user that the dehumidifier is in the off position is included within the classification of an off mode.

2.14 *Off-cycle mode* means a standby mode in which the dehumidifier:

(1) Has cycled off its main moisture removal function by humidistat or humidity sensor;

(2) Does not have its fan or blower operating; and

(3) Will reactivate the main functions according to the humidistat or humidity sensor signal.

2.15 *Product capacity for dehumidifiers* means a measure of the ability of the dehumidifier to remove moisture from its surrounding atmosphere, measured in pints collected per 24 hours of operation under the specified ambient conditions.

2.16 *Process air* means the air supplied to the dehumidifier from the dehumidified space and discharged to the dehumidified space after some of the moisture has been removed by means of the refrigeration system.

2.17 *Reactivation air* means the air drawn from unconditioned space to remove moisture from the desiccant wheel of a refrigerant-desiccant dehumidifier and discharged to unconditioned space.

2.18 *Standby mode* means any modes where the dehumidifier is connected to a mains power source and offers one or more of the following user-oriented or protective functions which may persist for an indefinite time:

(1) To facilitate the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, or timer;

(2) Continuous functions, including information or status displays (including clocks) or sensor-based functions. A timer is a continuous clock function (which may or may not be associated with a display) that provides regular scheduled tasks (*e.g.,* switching) and that operates on a continuous basis.

3. Test Apparatus and General Instructions

3.1 *Active mode.*

3.1.1 *Portable dehumidifiers and whole-home dehumidifiers other than refrigerant-desiccant dehumidifiers.* The test apparatus and instructions for testing in dehumidification mode and fan-only mode shall conform to the requirements specified in Section 3, ''Definitions,'' Section 4, ''Instrumentation,'' and Section 5, ''Test Procedure,'' of ANSI/AHAM DH–1 (incorporated by reference, see § 430.3), with the following exceptions. Note that if a product is able to operate as both a portable and whole-home dehumidifier by means of installation or removal of an optional ducting kit, it shall be tested and rated for both configurations.

3.1.1.1 *Testing configuration for whole-home dehumidifiers other than refrigerant-desiccant dehumidifiers.* Dehumidifiers other than refrigerant-desiccant dehumidifiers shall be tested with ducting attached to the process air outlet port. The duct configuration and component placement shall conform to the requirements specified in section 3.1.3 of this appendix and Figure 1 or Figure 3 in section 3.1.3, except that the flow straightener and dry-bulb temperature and relative humidity instruments shall not be required. External static pressure in the process air flow shall be measured as specified in section 3.1.2.2.3.1 of this appendix.

3.1.1.2 *Psychrometer placement.* The psychrometer shall be placed perpendicular to, and 1 ft. in front of, the center of the process air intake grille. For dehumidifiers with multiple process air intake grilles, a separate sampling tree shall be placed perpendicular to, and 1 ft. in front of, the center of each process air intake grille, with the samples combined and connected to a single psychrometer using a minimal length of insulated ducting. The psychrometer shall be used to monitor inlet conditions of one test unit only.

3.1.1.3 *Condensate collection.* If means are provided on the dehumidifier for draining condensate away from the cabinet, the condensate shall be collected in a substantially closed vessel to prevent re-evaporation and shall be placed on the weight-measuring instrument. If no means for draining condensate away from the cabinet are provided, any automatic shutoff of dehumidification mode operation that is activated when the collection container is full shall be disabled and any overflow shall be collected in a pan, covered as much as possible to prevent re-evaporation and not impede collection of overflow water, and that is placed beneath the dehumidifier, both of which shall be placed on the weight-measuring instrument for direct reading of the condensate weight during the test. Any internal pump shall not be used to drain the condensate into a substantially closed vessel unless such pump is provided for use by default in dehumidification mode.

3.1.1.4 *Control settings.* If the dehumidifier has a control setting for continuous operation in dehumidification mode, that setting shall be selected. Otherwise, the controls shall be set to the lowest available relative humidity level, and if the dehumidifier has a user-adjustable fan speed, the maximum fan speed setting shall be selected.

3.1.1.4 *Run-in period.* A single run-in period during which the compressor operates shall be performed before active mode testing. No additional run-in period shall be conducted between dehumidification mode testing and fan-only mode testing.

3.1.2 *Refrigerant-desiccant dehumidifiers.* The test apparatus and instructions for testing refrigerant-desiccant dehumidifiers in dehumidification mode and fan-only mode shall conform to the requirements specified in Section 3, ''Definitions,'' Section 4, ''Instrumentation,'' and Section 5, ''Test Procedure,'' of ANSI/AHAM DH–1 (incorporated by reference, see § 430.3), except as follows. No weight-measuring instruments are required.

3.1.2.1 *Testing configuration.* Refrigerant-desiccant dehumidifiers shall be tested with ducting attached to the process air inlet and outlet ports and the reactivation air inlet port. The duct configuration and components shall conform to the requirements specified in section 3.1.3 of this appendix and Figure 1 through Figure 3 in section 3.1.3. A cell-type airflow straightener that conforms with the specifications in Section 5.2.1.6, ''Airflow straightener'', and Figure 6A, ''Flow Straightener—Cell Type'', of ANSI/AMCA 210 (incorporated by reference, see § 430.3) shall be installed in each duct consistent with Figure 1 through Figure 3 in section 3.1.1 of this appendix.

3.1.2.2 *Instrumentation.*

3.1.2.2.1 *Temperature.* Dry-bulb temperature sensors shall be installed in a grid centered in the duct, with the plane of the grid perpendicular to the axis of the duct. The number and locations of the sensors within the grid shall be determined according to Section 5.3.5, ''Centers of Segments—Grids,'' of ANSI/ASHRAE Standard 41.1 (incorporated by reference, see § 430.3).

3.1.2.2.2 *Relative humidity.* Relative humidity shall be measured with an aspirating psychrometer with an accuracy within ±1 percent relative humidity. The relative humidity sensor shall be placed at the duct centerline within 1 inch of the dry-bulb temperature grid plane.

3.1.2.2.3 *Pressure.* The pressure instruments used to measure the external static pressure and velocity pressures shall have an accuracy within ±0.01 in. w.c. and a resolution of no more than 0.01 in. w.c.

3.1.2.2.3.1 *External static pressure.* Static pressures in ducts shall be measured using pitot-static tube traverses that conform with the specifications in Section 4.3.1, ''Pitot Traverse,'' of ANSI/AMCA 210 (incorporated by reference, see § 430.3), with pitot-static tubes that conform with the specifications in Section 4.2.2, ''Pitot-Static Tube,'' of ANSI/AMCA 210. Static pressures at each pitot-static tube in a traverse shall be measured at the static pressure tap and averaged. Duct pressure losses between the unit under test and the plane of each static pressure measurement shall be calculated in accordance with section 7.5.2, ''Pressure Losses,'' of ANSI/AMCA 210. The external static pressure shall be the difference between the measured inlet and outlet static pressure measurements, minus the sum of the inlet and outlet duct pressure losses. For any port with no duct attached, a static pressure of 0.00 in. w.c. with no duct pressure loss shall be used in the calculation of external static pressure. During dehumidification mode testing, the external static pressure shall equal 0.5 in. w.c. ± 0.02 in. w.c.

3.1.2.2.3.2 *Velocity pressure.* Velocity pressures shall be measured using the same pitot traverses as used for measuring external static pressure, and which are specified in section 3.1.2.2.3.1 of this appendix. Velocity pressures shall be determined at each pitot-static tube in a traverse as the difference between the pressure at the impact pressure tap and the pressure at the static pressure tap. Volumetric flow rates in each duct shall be calculated in accordance with Section 7.3.1, ''Velocity Traverse,'' of ANSI/AMCA 210 (incorporated by reference, see § 430.3).

3.1.2.3 *Control settings.* If the dehumidifier has a control setting for continuous operation in dehumidification mode, that setting shall be selected. Otherwise, the controls shall be set to the lowest available relative humidity level, and if the dehumidifier has a user-adjustable fan speed, the maximum fan speed setting shall be selected.

3.1.2.4 *Run-in period.* A single run-in period during which the compressor operates shall be performed before active mode testing. No additional run-in period shall be conducted between dehumidification mode testing and fan-only mode testing.

3.1.3 *Ducting for whole-home dehumidifiers.* Any port designed for intake of air from outside or unconditioned space, other than for supplying reactivation air for refrigerant-desiccant dehumidifiers, shall be covered and sealed with tape. Ducting shall be constructed of galvanized mild steel and shall be 10 inches in diameter. Inlet and outlet ducts shall be positioned either horizontally or vertically to accommodate the default dehumidifier port orientation. All ducts shall be installed with the axis of the section interfacing with the dehumidifier perpendicular to plane of the collar to which each is attached. If manufacturer-recommended collars do not measure 10 inches in diameter, transitional pieces shall be used to connect the ducts to the collars. The transitional pieces shall not contain any converging element that forms an angle with the duct axis greater than 7.5 degrees or a diverging element that forms an angle with the duct axis greater than 3.5 degrees. Mechanical throttling devices shall be installed in each outlet duct consistent with Figure 1 and Figure 3 of this section to adjust the external static pressure. The ducts shall be covered with thermal insulation having a minimum R value of 6 h-ft^2-°F/Btu (1.1 m^2-K/W). Seams and edges shall be sealed with tape.

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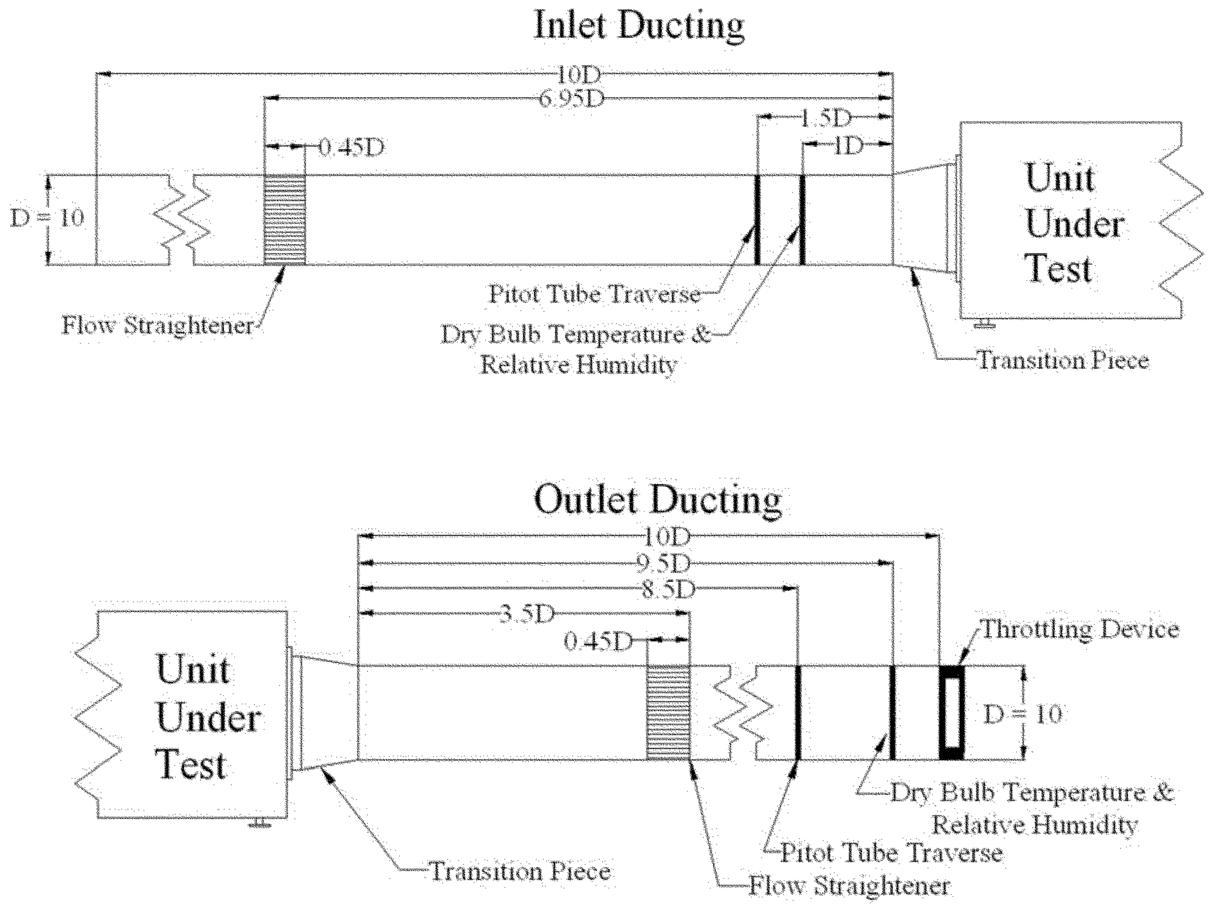

Figure 1. Inlet and Outlet Horizontal Duct Configurations and Instrumentation Placement

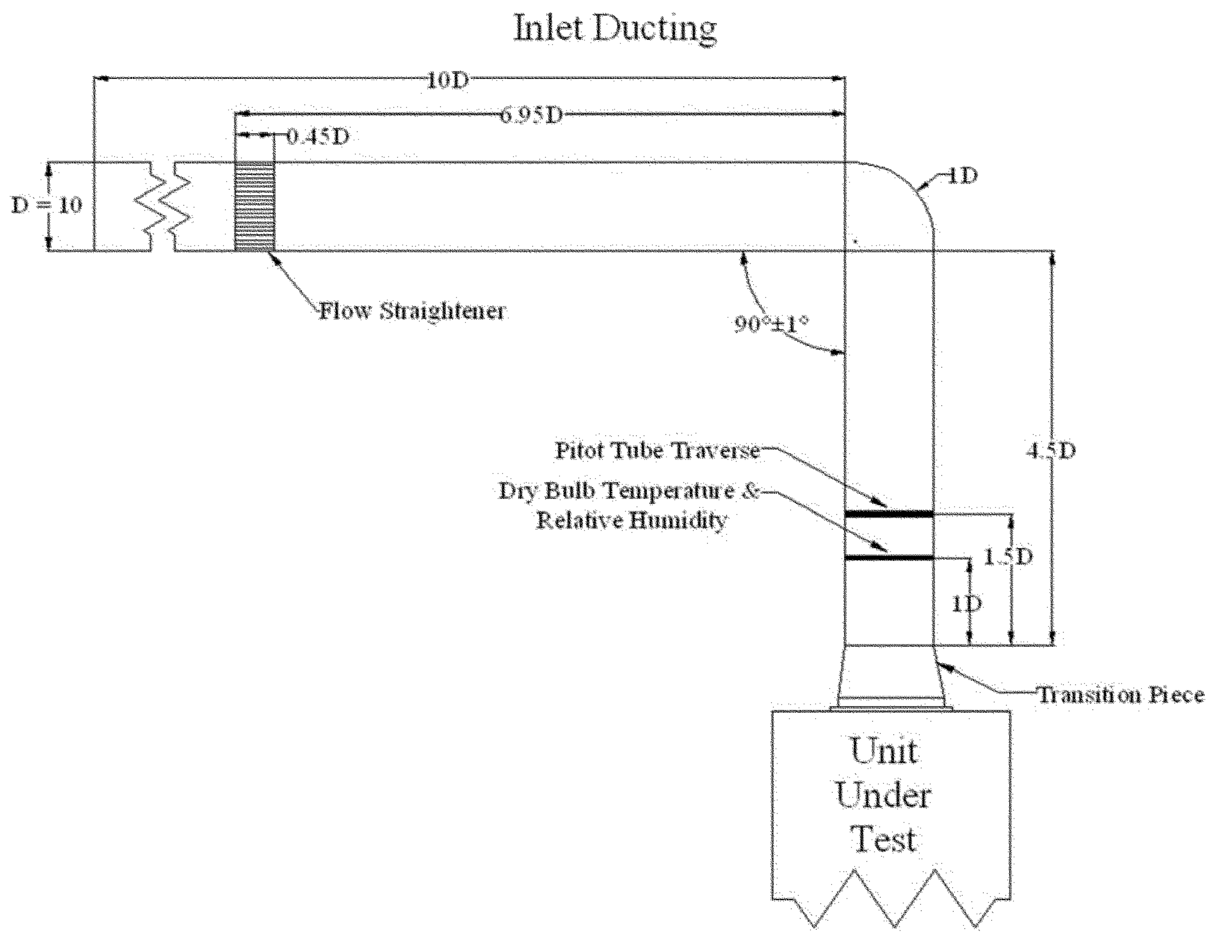

Figure 2: Inlet Vertical Duct Configuration and Instrumentation Placement

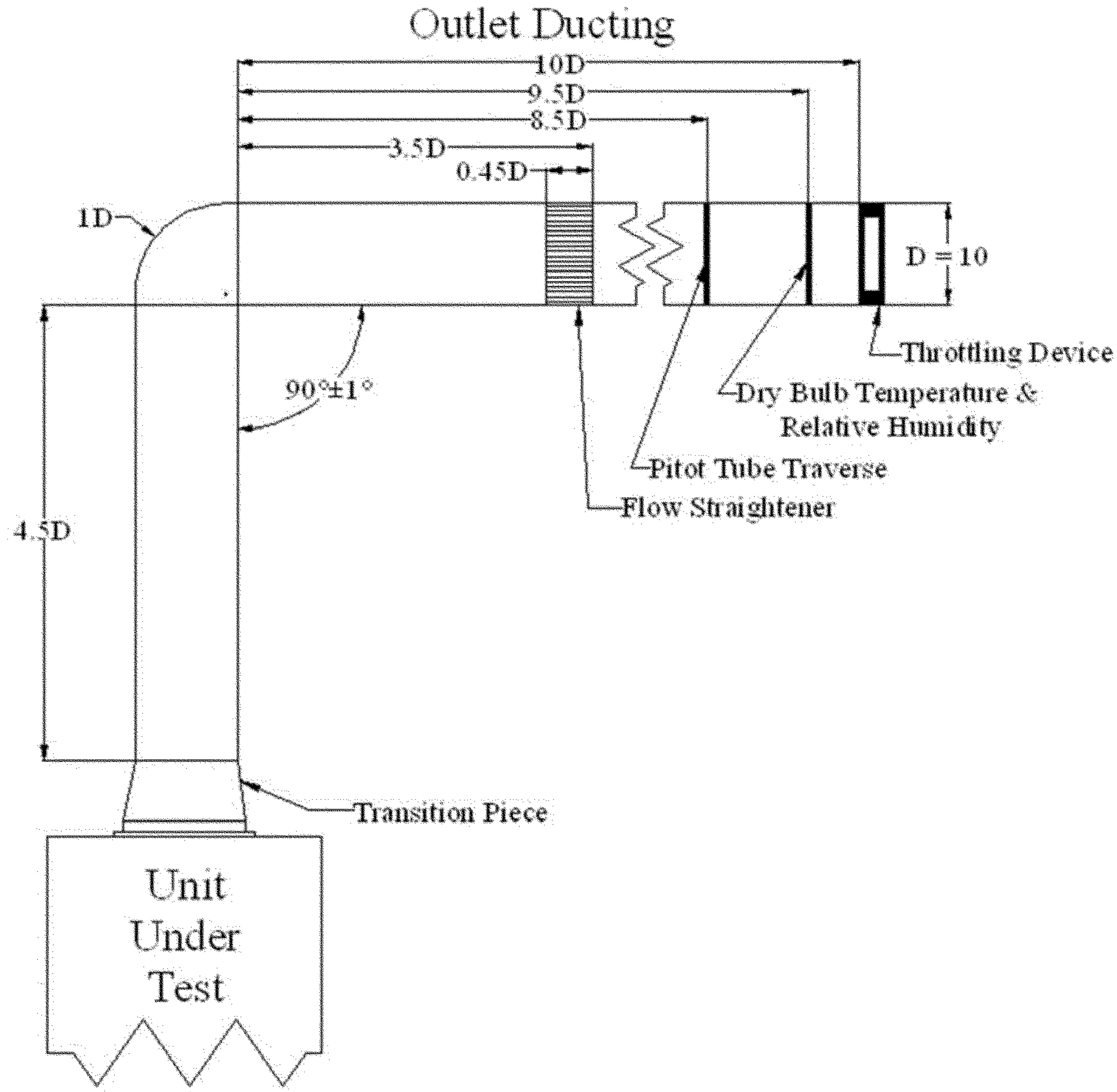

Figure 3: Outlet Vertical Duct Configurations and Instrumentation Placement

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3.1.4 *Recording and rounding.* When testing either a portable dehumidifier or a whole-home dehumidifier, record measurements at the resolution of the test instrumentation. Measurements for portable dehumidifiers and whole-home dehumidifiers other than refrigerant-desiccant dehumidifiers shall be recorded at intervals no greater than 10 minutes. Measurements for refrigerant-desiccant dehumidifiers shall be recorded at intervals no greater than 1 minute. Round off calculations to the same number of significant digits as the previous step. Round the final energy factor and integrated energy factor values to two decimal places as follows:

(i) A fractional number at or above the midpoint between two consecutive decimal places shall be rounded up to the higher of the two decimal places; or

(ii) A fractional number below the midpoint between two consecutive decimal places shall be rounded down to the lower of the two decimal places.

Round the final capacity value to two decimal places as follows:

(i) A fractional number at or above the midpoint between two consecutive decimal places shall be rounded up to the higher of the two decimal places; or

(ii) A fractional number below the midpoint between two consecutive decimal places shall be rounded down to the lower of the two decimal places.

3.2 *Standby mode and off mode.*

3.2.1 *Installation requirements.* For the standby mode and off mode testing, the dehumidifier shall be installed in accordance with Section 5, Paragraph 5.2 of IEC 62301 (incorporated by reference, see § 430.3), disregarding the provisions regarding batteries and the determination, classification, and testing of relevant modes.

3.2.2 *Electrical energy supply.*

3.2.2.1 *Electrical supply.* For the standby mode and off mode testing, maintain the electrical supply voltage and frequency indicated in Section 7.1.3, ''Standard Test Voltage,'' of ANSI/AHAM DH–1 (incorporated by reference, see § 430.3). The electrical supply frequency shall be maintained ±1 percent.

3.2.2.2 *Supply voltage waveform.* For the standby mode and off mode testing, maintain the electrical supply voltage waveform indicated in Section 4, Paragraph 4.3.2 of IEC 62301 (incorporated by reference, see § 430.3).

3.2.3 *Standby mode and off mode wattmeter.* The wattmeter used to measure standby mode and off mode power consumption shall meet the requirements specified in Section 4, Paragraph 4.4 of IEC 62301 (incorporated by reference, see § 430.3).

3.2.4 *Standby mode and off mode ambient temperature.* For standby mode and off mode testing, maintain room ambient air temperature conditions as specified in Section 4, Paragraph 4.2 of IEC 62301 (incorporated by reference, see § 430.3).

4. Test Measurement

4.1 *Active mode.*

4.1.1 *Dehumidification mode.*

4.1.1.1 *Portable dehumidifiers and whole-home dehumidifiers other than refrigerant-desiccant dehumidifiers.* Establish the testing conditions set forth in section 3.1.1 of this appendix. Measure the energy consumption in dehumidification mode, E_{DM}, expressed in kilowatt-hours (kWh), the energy factor, expressed in liters per kilowatt-hour (L/kWh), and product capacity, expressed in pints per day (pints/day), in accordance with the test requirements specified in Section 7, ''Capacity Test and Energy Consumption Test,'' of ANSI/AHAM DH–1 (incorporated by reference, see § 430.3), except that the standard test conditions shall be maintained at 65 °F ± 2.0 °F dry-bulb temperature and 56.6 °F ± 1.0 °F wet-bulb temperature, and psychrometer placement shall be as specified in section 3.1.1.2 of this appendix.

4.1.1.2 *Refrigerant-desiccant dehumidifiers.* Establish the testing conditions set forth in section 3.1.2 of this appendix. Measure the energy consumption, E_{DM}, expressed in kWh, in accordance with the test requirements specified in Section 7.1, ''Capacity Test,'' of ANSI/AHAM DH–1 (incorporated by reference, see § 430.3), except that (1) the standard test conditions at the air entering the process air inlet duct and the reactivation air inlet shall be maintained at 65 °F ± 2.0 °F dry-bulb temperature and 56.6 °F ± 1.0 °F wet-bulb temperature, (2) the instructions for psychrometer placement shall not apply, (3) the data recorded shall include dry-bulb temperatures, relative humidities, static pressures, and velocity pressures in each duct, and (4) the condensate collected during the test need not be weighed.

4.1.2 *Fan-only mode.* If the dehumidifier operates in fan-only mode, as defined in section 2.10 of this appendix, establish the testing conditions set forth in either section 4.1.2.1 of this appendix or section 4.1.2.2 of this appendix. If the dehumidifier has a user-adjustable fan speed during fan-only mode, the maximum fan speed setting shall be selected. Measure the average fan-only mode power, expressed in watts (W), for a period of 1 hour for fan-only mode in which the fan operates continuously. For fan-only mode in which the fan operates cyclically, measure the average fan-only mode power over a period of three or more full cycles for a minimum of 1 hour.

4.1.2.1 Establish the testing conditions set forth in section 3.2 of this appendix, with the dehumidifier controls set during this testing at a setpoint that is higher than the ambient relative humidity to ensure that the refrigeration system does not cycle on.

4.1.2.2 Establish the test requirements specified in Section 7.1.2, ''Standard Test Conditions,'' Section 7.1.3, ''Standard Test Voltage,'' Section 7.1.4, ''Psychrometer Placement,'' and Section 7.1.5, ''Data to be Recorded,'' of ANSI/AHAM DH–1 (incorporated by reference, see § 430.3). The dehumidifier controls shall be set during this testing at a setpoint that is higher than 60 percent relative humidity to ensure that the refrigeration system does not cycle on.

4.2 *Standby mode and off mode.* Establish the testing conditions set forth in section 3.2 of this appendix, ensuring that the dehumidifier does not enter active mode during the test. For dehumidifiers that take some time to enter a stable state from a higher power state as discussed in Section 5, Paragraph 5.1, Note 1 of IEC 62301, (incorporated by reference; see § 430.3), allow sufficient time for the dehumidifier to reach the lower power state before proceeding with the test measurement. Follow the test procedure specified in Section 5, Paragraph 5.3.2 of IEC 62301 for testing in each possible mode as described in sections 4.2.1 and 4.2.2 of this appendix.

4.2.1 If the dehumidifier has an inactive mode, as defined in section 2.12 of this appendix, but not an off mode, as defined in section 2.13 of this appendix, measure and record the average inactive mode power of the dehumidifier, P_{IA}, in watts. Otherwise, if the dehumidifier has an off mode, as defined in section 2.13 of this appendix, measure and record the average off mode power of the dehumidifier, P_{OM}, in watts.

4.2.2 If the dehumidifier has an off-cycle mode, as defined in section 2.14 of this appendix, measure and record the average off-cycle mode power of the dehumidifier, P_{OC}, in watts.

5. Calculation of Derived Results From Test Measurements

5.1 *Annual combined low-power mode energy consumption.* Calculate the annual combined low-power mode energy consumption for dehumidifiers, E_{TLP}, expressed in kilowatt-hours per year. If the dehumidifier is capable of operating in off-cycle mode and not fan-only mode, E_{TLP} shall be calculated as:

$$E_{TLP} = [(P_{IO} \times S_{IO}) + (P_{OC} \times S_{OC})] \times K$$

If the dehumidifier is capable of operating in fan-only mode and not off-cycle mode, E_{TLP} shall be calculated as:

$$E_{TLP} = (P_{IO} \times S_{IO}) \times K$$

Where:

$P_{IO} = P_{IA}$, dehumidifier inactive mode power, or P_{OM}, dehumidifier off mode power, in watts, as measured in section 4.2.1 of this appendix.

P_{OC} = dehumidifier off-cycle mode power, in watts, as measured in section 4.2.2 of this appendix.

S_{IO} = 1,840.5 dehumidifier inactive mode or off mode annual hours.

S_{OC} = 1,840.5 dehumidifier off-cycle mode annual hours.

K = 0.001 kWh/Wh conversion factor for watt-hours to kilowatt-hours.

5.2 *Fan-only mode annual energy consumption.* If the dehumidifier is capable of operating in fan-only mode and not off-cycle mode, E_{FM} shall be calculated as:

$$E_{FM} = (P_{FM} \times S_{FM}) \times K$$

Where:

P_{FM} = dehumidifier fan-only mode power, in watts, as measured in section 4.1.2 of this appendix.

S_{FM} = 1,840.5 dehumidifier fan-only mode annual hours.

K = 0.001 kWh/Wh conversion factor for watt-hours to kilowatt-hours.

5.3 *Integrated energy factor.* Calculate the integrated energy factor, IEF, expressed in liters per kilowatt-hour, rounded to two decimal places, according to the following:

$$IEF = L_W/[E_{DM} + ((E_{TLP} + E_{FM}) \times 6/S_{DM})]$$

Where:

L_W = water removed from the air during the 6-hour dehumidification mode test, in liters, as measured in section 4.1.1 of this appendix.

E_{DM} = dehumidification mode test energy consumption during the 6-hour dehumidification mode test, in kilowatt-hours, as measured in section 4.1.1 of this appendix.

E_{TLP} = standby mode and off mode annual energy consumption, in kilowatt-hours per year, as calculated in section 5.1 of this appendix.

E_{FM} = fan-only mode annual energy consumption, in kilowatt-hours per year, as calculated in section 5.2 of this appendix for dehumidifiers that operate in fan-only mode and not off-cycle mode; otherwise, E_{FM} = 0.

6 = hours per dehumidification mode test, used to convert annual standby and off mode energy consumption for integration with dehumidification mode energy consumption.

S_{DM} = 1,095 dehumidification mode annual hours.

5.4 *Capacity for Refrigerant-Desiccant Dehumidifiers.* The weight of water removed during the test period, expressed in pounds, and capacity, expressed in pints/day, shall be calculated as:

$$W=\sum_{i=1}^{n}\left(\left(AH_{I,i} \times X_{I,i}\right) - \left(AH_{O,i} \times X_{O,i}\right)\right) \times \frac{t}{60}$$

Where:

W = weight of water removed during the test period, in pounds;

n = number of samples during the test period in section 4.1.1.2.2 of this appendix;

$AH_{I,i}$ = absolute humidity of the process air on the inlet side of the unit, in pounds of water per cubic foot of dry air, measured for sample *i* in section 4.1.1.2.2 of this appendix;

$X_{I,i}$ = volumetric flow rate of the process air on the inlet side of the unit, in cubic feet per minute, measured for sample *i* in section 4.1.1.2.2 of this appendix. The volumetric flow rate shall be calculated in accordance with Section 7.3, ''Fan airflow rate at test conditions,'' of ANSI/AMCA 210 (incorporated by reference, see § 430.3);

$AH_{O,i}$ = absolute humidity of the process air on the outlet side of the unit, in pounds of water per cubic foot of dry air, measured for sample *i* in section 4.1.1.2.2 of this appendix;

$X_{O,i}$ = volumetric flow rate of the process air on the outlet side of the unit, in cubic feet per minute, measured for sample *i* in section 4.1.1.2.2 of this appendix. The volumetric flow rate shall be calculated in accordance with Section 7.3, ''Fan airflow rate at test conditions,'' of ANSI/AMCA 210 (incorporated by reference, see § 430.3);

t = time interval in seconds between samples, with a maximum of 60; and

60 = conversion from minutes to seconds.

$$C=\frac{W \times 24}{1.04 \times T}$$

Where:

C = capacity in pints per day;

24 = number of hours per day;

1.04 = conversion from pounds of water to pints of water; and

T = total test period time in hours.

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