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[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[Docket No. EERE-2010-BT-TP-0010]

RIN: 1904-AC21

Energy Conservation Program for Consumer Products: Test Procedures for Residential Furnace Fans

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

ACTION: Notice of proposed rulemaking and announcement of public meeting.

SUMMARY: The U.S. Department of Energy (DOE) proposes to establish test procedures for residential products that use electricity for purposes of circulating air through duct work, hereafter referred to as "furnace fans." Specifically, this notice proposes to establish a test method for measuring the airflow performance and electrical consumption of these products. Concurrently, DOE is undertaking an energy conservation standards rulemaking to address the electrical energy used by these products for circulating air. Once these energy conservation standards are promulgated, the adopted test procedures will be used to determine compliance with the standards. DOE is also announcing a public meeting to discuss and receive comments on issues presented in this test procedure rulemaking.

DATES: Meeting: DOE will hold a public meeting on Friday, June 15, 2012, from 9:00 a.m. to 4:00 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section V, "Public Participation," for webinar information, participant instructions, and information about the capabilities available to webinar participants.

Comments: DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than [**INSERT DATE 75 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER**]. For details, see section V, "Public Participation," of this NOPR.

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 at the phone number above to initiate the necessary procedures. Please also note that any person wishing to bring a laptop computer into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes. Persons may also attend the public meeting via webinar. For more information, refer to section V, "Public Participation," of this NOPR.

Any comments submitted must identify the NOPR on Test Procedures for Residential Furnace Fans, and provide docket number EERE-2010–BT–TP–0010 and/or regulatory information number (RIN) number 1904-AC21. Comments may be submitted using any of the following methods:

1. Federal eRulemaking Portal: www.regulations.gov. Follow the instructions for submitting comments.
2. E-mail: FurnFans-2010-TP-0010@ee.doe.gov Include docket number EERE-2010–BT–TP–0010 and RIN 1904-AC21 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 compact disc (CD), in which case 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, in which case it is not necessary to include printed copies.

No telefacsimilies (faxes) will be accepted. For detailed instructions on submitting comments and additional information on the rulemaking process, see section V of this document (Public Participation).

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

However, not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure.

A link to the docket web page can be found at: http://www1.eere.energy.gov/buildings/appliance_standards/residential/furnace_fans.html. This web page contains a link to the docket for this notice on the www.regulations.gov site. The www.regulations.gov web page contains simple instructions on how to access all documents, including public comments, in the docket. See section V, "Public Participation," for information on how to submit comments through www.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. Mohammed Khan, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE-2J, 1000 Independence Avenue, SW., Washington, DC 20585-0121. Telephone: (202) 586-7892. E-mail: Mohammed.Khan@ee.doe.gov.

Mr. Eric Stas, U.S. Department of Energy, Office of the General Counsel, GC-71, 1000 Independence Avenue, SW., Washington, DC 20585-0121. Telephone: (202) 586-9507. E-mail: Eric.Stas@hq.doe.gov.

For information on how to submit or review public comments, contact Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, EE-2J, 1000 Independence Avenue, SW, Washington, DC 20585-0121. Telephone: (202) 586-2945. E-mail: Brenda.Edwards@ee.doe.gov.

SUPPLEMENTARY INFORMATION:

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I. Authority and Background

Title III, Part B[1] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Pub. L. 94-163 (42 U.S.C. 6291-6309, as codified) sets forth a variety of provisions designed to improve energy efficiency and established the Energy Conservation Program for Consumer

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

Products Other Than Automobiles, a program covering most major household appliances.[2] These include products that use electricity for the purposes of circulating air through duct work, hereinafter referred to as "residential furnace fans" or simply "furnace fans," the subject of today's notice. (42 U.S.C. 6295(f)(4)(D))

Under the Act, this 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 certifying to DOE that their products comply with the applicable energy conservation standards adopted pursuant to EPCA and for making representations about the efficiency of those products. (42 U.S.C. 6293(c); 42 U.S.C. 6295(s)) Similarly, DOE must use these test procedures in any enforcement action to determine whether covered products comply with these energy conservation standards. (42 U.S.C. 6295(s))

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 which measure energy efficiency, energy use, or estimated annual operating cost of a covered product during a representative average use cycle or period of use and shall not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) In addition, if DOE determines that a test procedure amendment is warranted, it must publish proposed test

[2] All references to EPCA in this rulemaking refer to the statute as amended through the Energy Independence and Security Act of 2007, Pub. L. 110-140.

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 a covered product as determined under the existing test procedure. (42 U.S.C. 6293(e)(1)) If DOE determines that the amended test procedure would alter the measured efficiency of a covered product, DOE must amend the applicable energy conservation standard accordingly. (42 U.S.C. 6293(e)(2))

On December 19, 2007, the Energy Independence and Security Act of 2007 (EISA 2007), Pub. L. 110-140, was enacted. The EISA 2007 amendments to EPCA, in relevant part, require DOE to amend the test procedures for all covered products to include measures of standby mode and off mode energy consumption.[3] Specifically, section 310 of EISA 2007 provides definitions of "standby mode" and "off mode" (42 U.S.C. 6295(gg)(1)(B)) The statute requires integration of such energy consumption into the overall energy efficiency, energy consumption, or other energy descriptor for each covered product, unless the Secretary determines that: (1) the current test procedures for a covered product already fully account for and incorporate the standby mode and off mode energy consumption of the covered product; or (2) such an integrated test procedure is technically infeasible for a particular covered product, in which case the Secretary shall prescribe a separate standby mode and off mode energy use test procedure for the covered product, if technically feasible. (42 U.S.C. 6295(gg)(2)(A)) Under the statutory provisions adopted by EISA 2007, any such amendment must consider the most current versions of the International Electrotechnical Commission (IEC) Standard 62301, Household electrical

[3] Given EISA 2007's focus on comprehensively addressing standby mode and off mode energy consumption and in order to conserve limited resources, DOE believes it is appropriate to address these issues in this new test procedure, rather than needing to wait for a subsequent rulemaking to "amend" the test procedure.

appliances – Measurement of standby power, and IEC Standard 62087, Methods of measurement for the power consumption of audio, video, and related equipment.[4]

Pursuant to EPCA under 42 U.S.C. 6295(f)(4)(D), DOE is currently conducting a rulemaking to consider new energy conservation standards for furnace fans. EPCA directs DOE to establish test procedures in conjunction with new or amended energy conservation standards, including furnace fans. (42 U.S.C. 6295(o)(3)(A) To fulfill these requirements, DOE is simultaneously initiating a test procedure rulemaking for furnace fans. DOE intends for the test procedure to include: (1) an annual electrical energy consumption metric normalized by total annual operating hours and airflow capacity in the maximum airflow-control setting; and (2) the methods necessary to measure the performance of the covered products. The metric will also account for the electrical energy consumption in standby mode and off mode for furnace fans used in heating ventilation and air-conditioning (HVAC) products for which consumption in those modes is not already fully accounted for in other DOE rulemakings. Manufacturers will be required to use these methods and this metric for the purposes of verifying compliance with the new energy conservation standards when they take effect.

DOE does not currently have a test procedure for furnace fans. On June 3, 2010, DOE published a Notice of Public Meeting and Availability of the Framework Document to initiate the energy conservation standard rulemaking for furnace fans. 75 FR 31323. DOE posted the furnace fans framework document, hereinafter referred to as the June 2010 framework document,

[4] EISA 2007 directs DOE to also consider IEC Standard 62087 when amended its test procedures to include standby mode and off mode energy consumption. See 42 U.S.C. 6295(gg)(2)(A). However, IEC Standard 62087 addresses the methods of measuring the power consumption of audio, video, and related equipment. Accordingly, the narrow scope of this particular IEC standard reduces its relevance to today's proposal.

to its website. In the June 2010 framework document, DOE requested feedback from interested parties on many issues related to test methods for evaluating the electrical energy consumption of furnace fans. DOE held the framework public meeting on June 18, 2010. DOE originally scheduled the framework comment period to close on July 6, 2010. However, due to the large number and broad scope of questions and issues raised in the June 2010 framework document (and during the public meeting), DOE subsequently published a notice in the Federal Register reopening the comment period from July 15, 2010 until July 27, 2010, to allow additional time for interested parties to submit comments. 75 FR 41102 (July 15, 2010).

II. Summary of the Notice of Proposed Rulemaking

In this notice of proposed rulemaking, DOE proposes to establish a test method for measuring the electrical energy consumption of furnace fans, as well as airflow performance (which has a direct effect on efficiency), and the standby mode and off mode energy consumption of such fans. DOE intends for the proposed test procedure to be broadly applicable to electrically-powered devices used in residential central HVAC systems for the purposes of circulating air through duct work (i.e., furnace fans). Furnace fans include, but are not limited to, the air distribution fans used in weatherized and non-weatherized gas furnaces, oil furnaces, electric furnaces, modular blowers, and hydronic air handlers. The proposed test procedure is not intended to be applicable to any non-ducted products, such as whole-house ventilation systems without duct work, central air-conditioning (CAC) condensing unit fans, room fans, and furnace draft inducer fans.

Pursuant to EPCA, DOE must establish these test procedures in order to allow for the development of energy conservation standards that will address the electrical consumption of these products. (42 U.S.C. 6295(o)(3)(A)) As further required by EPCA, the NOPR also includes proposed methods for measuring the standby mode and off mode electrical energy consumption for furnace fans used in HVAC products, to the extent that electrical energy consumption in these modes is not already covered (i.e., the NOPR proposes standby mode and off mode test methods for hydronic air handlers). (42 U.S.C. 6295(gg)(2)(A)) DOE proposes to integrate measurements for standby mode and off mode electrical energy consumption with the active mode energy consumption in the proposed metric for hydronic air handlers. DOE's proposed approach to these test procedure issues is summarized below and addressed in further detail later in this notice.

To rate the electrical efficiency of furnace fans (active mode energy consumption), DOE proposes to incorporate by reference into the test procedure specific provisions from American National Standards Institute (ANSI)/Air Movement and Control Association International, Inc. (AMCA) 210-07 | ANSI/American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 51-07, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating, hereinafter referred to as "ANSI/AMCA 210-07." The specific provisions DOE proposes to include from ANSI/AMCA 210-07 are definitions, test setup and equipment, test conditions, and procedures for measuring airflow and external static pressure. In addition to these provisions, DOE proposes provisions for measuring electrical energy consumption using an electrical power meter. DOE also proposes to specify the methods for measuring standby mode and off mode energy consumption from the DOE residential furnaces test procedure to measure energy consumption in these modes for hydronic air handlers. (10 CFR part 430, subpart B, appendix N, section 8.0) In addition, DOE proposes calculations to derive the rating metric (i.e., fan efficiency rating) based on the measured values.

DOE proposes to use as the furnace fan efficiency rating metric the "estimated annual electrical energy consumption" normalized by: (a) the total number of annual operating hours, and (b) the airflow in the maximum airflow-control setting in standard cubic feet per minute. Standard cubic feet per minute (scfm) is a measure of airflow corrected for predetermined standard air conditions. The estimated annual electrical energy consumption, as proposed, is a weighted average of the input power (in Watts) measured separately for multiple airflow-control settings at different external static pressures (ESPs). These ESPs are determined by a reference system that represents national average duct work system characteristics. The airflow-control settings proposed to be rated correspond to operation in cooling mode, heating mode, and constant-circulation mode. Table II.1 illustrates the airflow-control settings that will be rated for various product types.

Table II.1: Proposed Rated Airflow-control Settings by Product Type

Product Type	Rated Airflow-control Setting 1	Rated Airflow-control Setting 2	Rated Airflow-control Setting 3
Single-stage Heating	Default constant-circulation	Default heat	Maximum
Multi-stage or Modulating Heating	Default constant-circulation	Default low heat	Maximum
Heating-only	Default constant-circulation	None	Maximum

For products with single-stage heating, the three proposed rating airflow-control settings are the maximum setting, the default heating setting, and the default constant-circulation setting. For products with multi-stage heating or modulating heating, the proposed rating airflow-control settings are the maximum setting, the default low heating setting, and the default constant-circulation setting. For products that are not designed to be paired with an evaporator coil, hereinafter referred to as "heating-only products," the proposed rating airflow-control settings are the maximum airflow-control setting (expected to be the default heat airflow-control setting) and the default constant-circulation setting. The lowest default airflow-control setting is used to represent constant circulation if a constant-circulation setting is not specified. DOE proposes to weight the Watt measurements using designated annual operating hours for each function (i.e., cooling, heating, and constant circulation) that are intended to represent national average operation. The specified operating hours for the heating mode for multi-stage heating or modulating heating products are modified to account for variation in time spent in this mode associated with turndown of heating output.

DOE also proposes to establish methods for measuring the standby mode and off mode electrical energy consumption of furnace fans for which consumption in these modes is not already covered by existing standards or currently proposed amendments to those standards (i.e., the NOPR proposes standby mode and off mode test methods for hydronic air handlers). EPCA requires that DOE integrate into the energy conservation standard the energy use associated with standby mode and off mode, unless the current standard already accounts for standby mode and off mode energy consumption or integration is not technically feasible. In the latter case, EPCA requires that DOE prescribe a separate efficiency standard to address standby mode and off mode energy use, unless that is not feasible. (42 U.S.C. 6295(gg)(3)) DOE efficiency metrics for furnaces already fully account for the energy use associated with the standby mode and off mode of their furnace fans. (10 CFR part 430, subpart B, appendix N, section 8.0) On September 13, 2011, DOE published a NOPR in the Federal Register proposing to update the DOE test procedure for furnaces through incorporation by reference of the latest edition of the relevant industry standard, specifically IEC Standard 62301 (Second Edition). 76 FR 56339. For central air conditioners (CAC), DOE has proposed such metrics in a notice of proposed rulemaking. 75 FR 31224, 31270 (June 2, 2010). Subsequently, DOE published two supplemental notices of proposed rulemaking (SNOPR). DOE published the first SNOPR on April 1, 2011 (76 FR 18105) and the second SNOPR on October 24, 2011 (76 FR 65616). Hence, including standby mode and off mode energy use in the furnace fan efficiency metric for these HVAC products would not be appropriate, because it is already fully addressed. Products for which standby mode and off mode energy use is already accounted elsewhere include weatherized and non-weatherized gas furnaces, oil furnaces, electric furnaces, and modular blowers. However, test procedures that include measurement of furnace fan standby mode and off mode energy consumption have been neither established nor proposed for hydronic air handlers, so DOE proposes to do so in this rulemaking.

III. Discussion

A. Scope

Under 42 U.S.C. 6295(f)(4)(D), EPCA directs DOE to consider and prescribe standards for electricity used for purposes of circulating air through duct work. Although the title of this statutory section refers to "furnaces and boilers," this particular provision was written using notably broader language than the other provisions within the same section. Consequently, in the June 2010 framework document for the energy conservation standards rulemaking, DOE tentatively interpreted this relevant statutory language to allow DOE to cover the electricity used by any electrically-powered device used in residential, central HVAC systems for the purpose of circulating air through duct work. 75 FR 31323 (June 3, 2010).

Ultimately, the scope of applicability of the proposed test procedure will be determined by the scope of coverage of the energy conservation standards rulemaking for furnace fans. Therefore, DOE proposes a scope of applicability for this notice that is broad enough to cover the products currently under consideration for the energy conservation standards rulemaking, including single-phase, electrically-powered devices that circulate air through duct work in HVAC systems with heating input capacities less than 225,000 Btu per hour, cooling capacities less than 65,000 Btu per hour, and airflow capacities less than 3,000 cfm. These specifications are consistent with the DOE definitions for residential "furnace" and "central air conditioner" (10 CFR 430.2), and the airflow typically required to provide these levels of heating and cooling. DOE proposes to exclude from the scope of applicability of the test procedure any non-ducted products, such as whole-house ventilation systems without duct work, CAC condensing unit fans, room fans, and furnace draft inducer fans because these products do not circulate air through duct work. DOE believes this proposed scope of applicability is broad enough to anticipate the scope of coverage of the energy conservation standard.

B. Definitions

DOE proposes to incorporate by reference in section 2 of Appendix AA to Subpart B of Part 430, all definitions in section 3.1 of ANSI/AMCA 210-07. DOE also proposes to include in section 2 of Appendix AA to Subpart B of Part 430 the additional and modified definitions listed below:

- Active mode means any mode in which the HVAC product is connected to the power source and circulating air through duct work.

- Airflow-control settings are differing ranges of airflow that a fan motor is programmed or wired to achieve in a single control system configuration (i.e., without manual adjustments) often designated for performing a specific HVAC function (e.g., cooling, heating, or constant circulation).
- ANSI/AMCA 210-07 means the test standard published by ANSI/AMCA 210-07 | ANSI/ASHRAE 51-07 titled "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."
- Default airflow-control settings are the airflow-control settings that can be achieved in the factory-set control system configuration (i.e., without manual adjustment other than interaction with a user-operable control such as a thermostat).
- External static pressure means the difference between the fan total pressure at the air outlet and the total pressure at the air inlet less velocity pressure at the air outlet of an HVAC product containing a furnace fan when operating and installed in accordance with the manufacturer's instructions. External static pressure does not include the pressure drop across appurtenances internal to the HVAC product.
- Hydronic air handler means a furnace designed to supply heat through a system of ducts with air as the heating medium, in which heat is generated by hot water flowing through a hydronic heating coil and the heated air is circulated by means of a fan or blower.
- Off mode means the mode during which the HVAC product is not powered.
- Residential furnace fan means an electrically-powered device used in residential

central heating, ventilation, and air-conditioning (HVAC) systems for the purpose of circulating air through duct work.

- Seasonal off switch means the switch on the HVAC product that, when activated, results in a measurable change in energy consumption between the standby and off modes.
- Standby mode means the mode during which the HVAC product is connected to the power source and the furnace fan is not activated.

C. Reference Standard

In the June 2010 framework document for the furnace fans energy conservation standards rulemaking, DOE requested interested-party comments on the methods specified in the December 2009 draft version of Canadian Standard CSA C823, Performance Standard for Air Handlers in Residential Space Conditioning Systems, which references ANSI/AMCA 210-07 and ANSI/ASHRAE Std 37-2005, Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment. The December 2009 draft CSA C823 test procedure specifies use of the methods described in the aforementioned industry standards to measure the electrical power consumption of a furnace fan at specific operating points in each of a furnace fan's available airflow-control settings. The December 2009 draft of CSA C823 includes a rating metric with units of kWh that is called the annual electricity consumption rating (AECR). This rating is a time-weighted sum of the energy use measurements.

Rheem and the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) stated that ANSI/AMCA 210-07 is a well-known and widely-used reference test procedure (Rheem, No. 29

at pp. 4-5; AHRI, No. 20 at pp. 3-4). Rheem recommended that DOE use ANSI/AMCA 210-07 as its reference test procedure (Rheem, No. 29 at pp. 4-5). AHRI proposed basing the standard on ANSI/AHRI Standard 210-240-2008, but conceded that this test method might increase burden because it is different from the way furnaces are currently tested (AHRI, No. 20 at p. 5). Ingersoll Rand suggested that DOE use the methods specified in DOE's existing residential furnace test procedure codified in 10 CFR 430, subpart B, appendix N, because the test procedures referenced in CSA C823 (i.e., ANSI/AMCA 210-07) would add test burden by requiring additional test measurements and an alternate test set-up. (Ingersoll Rand, No. 12 at p. 1)

After carefully considering these comments, DOE is proposing to incorporate by reference ANSI/AMCA 210-07. DOE believes that ANSI/AMCA 210-07 is an appropriate reference standard because it is a well-known and widely-used industry standard for measuring fan performance. DOE is aware that manufacturers use ANSI/AMCA 210-07 to generate the airflow performance data tables that they publish in product specification sheets. These tables include measurements of airflow (and sometimes electrical consumption) at various ESPs across a wide range. These tables and comments from interested parties indicate that manufacturers already possess or have access to test facilities suitable for ANSI/AMCA 210-07 testing. DOE also expects that manufacturers are practiced in or at least familiar with the methods necessary to take these measurements. AHRI stated that manufacturers currently perform furnace fan tests according to ANSI/AMCA 210-07 to generate airflow data for intended application of products (AHRI, No. 21 at pp. 3, 4). For these reasons, DOE does not expect that these methods would be overly burdensome to manufacturers. In addition, ANSI/AMCA 210-07 is more suitable for measuring airflow and electrical consumption across a range of ESPs and in multiple airflow-control settings; in contrast, the DOE residential furnace test procedure and ANSI/AHRI 210-240-2008 specify methods for measuring these parameters in a single airflow-control setting per heating stage as long as a minimum ESP has been achieved. The benefits of measuring performance in multiple airflow-control settings is discussed in detail in section III.F.1 While the ESP values specified in the DOE residential furnace test procedure and ANSI/AHRI 210-240-2008 are appropriate for rating furnaces, they are inconsistent with the values determined to be appropriate for rating furnace fan electrical performance, as proposed in this notice. A detailed discussion of the ESP values proposed in this notice compared to the suggested methods is provided in section III.E.

DOE proposes to incorporate by reference most aspects of ANSI/AMCA 210-07, except for specifications related to measuring rotational speed, beam load, torque, and mechanical measurement of input power. Specifically, DOE proposes to incorporate by reference the following provisions from ANSI/AMCA 210-07:

- Definitions, units of measure, and symbols (section 3);
- Instruments and methods of measurement (sections 4.1 through 4.3 and 4.6), excluding those for mechanical measurement of fan input power and motor calibration (section 4.4) and rotational speed (section 4.5);
- Test setup and equipment provisions (section 5) and observation and conduct of test guidelines (section 6), excluding test data to be recorded for rotational speed (N), beam load (F), or torque (T);

- Calculations (sections 7.1 through 7.7 and section 7.9), excluding calculations for fan power input or fan efficiency (sections 7.7 and 7.8); and
- Report and results of test requirements (section 8).

In addition to the methods incorporated by reference from ANSI/AMCA 210-07, DOE proposes to include specification of the range and increments of ESPs at which determinations are to be made. ANSI/AMCA 210-07 defines a "determination" as a complete set of measurements for a particular point of operation for a fan. For this notice, a complete set of measurements at a particular point of operation includes airflow, electrical consumption, and ESP.

DOE also proposes to include provisions for using an electrical meter to measure electrical energy consumption at each determination to replace the mechanical methods specified in section 4.4 of ANSI/AMCA 210-07. The proposed provisions are necessary because measuring electrical energy consumption using electrical power meters is a more widely used method by manufacturers of HVAC products. In addition, the voltage requirements in ANSI/AMCA 210-07 are specified in relation to the results of its specified motor calibration procedure (section 4.4.1.1), which DOE is not proposing to adopt in this notice. The proposed voltage requirements are consistent with those included in the DOE test procedures for residential furnaces and central air conditioners and heat pumps and are, therefore, also widely used by HVAC product manufacturers. DOE proposes to specify the use of an electrical meter with a certified accuracy of ±1 percent of observed readings to measure the electrical input power consumption of the HVAC product in which the furnace fan is incorporated at each determination. In addition, DOE proposes to specify that the electrical power supplied to the HVAC product be maintained within 1 percent of the nameplate voltage of the HVAC product. If a dual voltage is used for nameplate voltage, DOE proposes that the electrical supply be maintained within 1 percent of the higher voltage.

D. Rating Metric

In the June 2010 framework document, DOE requested comment to aid in determining an appropriate metric for rating furnace fan performance. Specifically, DOE identified two possible metrics: (1) the annual electrical energy consumption rating (AECR), as specified in the December 2009 draft version of Canadian Standard Association (CSA) C823, Performance Standard for Air Handlers in Residential Space Conditioning Systems, and (2) the blower power measurement (BE), as specified in the current DOE test procedure for residential furnaces codified in 10 CFR part 430, subpart B, appendix N. AECR uses operating hour multipliers based on climate, consumer behavior assumptions, and product characteristics (e.g., multi-stage or modulating heating and cooling capability) to weight electrical consumption measurements in all possible airflow-control settings in order to estimate the annual electrical energy consumption of furnace fans, reported in kilowatt hours (kWh). BE is a measurement of the steady-state power consumption of furnace fans in watts (W) at a minimum ESP determined by fuel type and input capacity.

Several interested parties stated that using an annualized energy consumption rating metric, such as AECR, is inappropriate for rating furnace fan performance. The American Council for an Energy-Efficient Economy (ACEEE) commented that it is not sure that fans can be rated both simply and meaningfully using a single certifiable number, like AECR, because of the diversity of expected furnace fan electricity consumption levels, depending on house size, duct restrictions, local climate, whether the unit is run in full-time "circulate" mode, and myriad other factors. (ACEEE, No. 19 at p. 2) Ingersoll Rand stated that adopting a rule that estimates the annualized energy usage would be confusing and misleading to consumers, as operating hours vary greatly across the country and from house to house. (Ingersoll Rand, No. 25 at p. 1) AHRI commented that an annual electrical energy consumption metric is not appropriate because of variations in climate, usage patterns, and installation. (AHRI, No. 21 at p. 3) Rheem expressed a similar view, that a less complicated, less specific, and less technically detailed energy descriptor would be a more powerful tool to guide HVAC professionals and consumers in the selection of energy-efficient equipment for specific climates, installations, and use patterns (Rheem, No. 29 at p. 1).

Many interested parties stated that cubic feet per minute per watt (cfm/W), or a similar efficiency metric should be used to rate furnace fan performance. The Northeast Energy Efficiency Partnership (NEEP) recommended that the efficiency metric be based on cfm/W or watts per cubic feet per minute (W/cfm). According to NEEP, this approach would avoid making the calculation overly complicated and potentially watered down with conditional assumptions, which contribute to a very difficult and, potentially, misleading metric to use for comparison. (NEEP, No. 16 at p. 3) Ingersoll Rand stated that the use of the single descriptor, cfm/W, provides the most direct way to compare furnace fan performance regardless of geography and how closely the furnace is sized to the house load. (Ingersoll Rand, No. 25 at p. 1) The Northwest Energy Efficiency Alliance (NEEA) recommended use of an air-delivery efficiency metric, such as cfm/W, to avoid the expectedly large standard deviation of actual energy use values around the rating value, which would be misleading for most installations. (NEEA, No. 9 at p. 2) Regal Beloit and the American Gas Association (AGA) also expressed support for the use of a rating metric expressed in cfm/W or W/cfm. (Regal Beloit, No. 32 at p. 3 and AGA, No. 7 at p. 101)

Interested parties also suggested a number of alternative metrics. AHRI and certain manufacturers, including Rheem, Nordyne, and Lennox, suggested that DOE use "e," a dimensionless descriptor that expresses the electrical consumption of a furnace, including electrical components other than the furnace fan, as a percentage of its total (electrical and fuel) energy consumption. The "e" metric is a function of the average annual auxiliary electrical energy consumption, E_{ae}. E_{ae} is a well-known industry metric that is specified in the current DOE test procedure for residential furnaces. The "e" metric is currently used to determine furnace eligibility for Federal tax credits. (AHRI, No. 21 at p. 4, Rheem, No. 29 at p. 3; Nordyne, No. 31 at p. 2; and Lennox, No. 23 at p. 2) AHRI also recommended that DOE use "e_b." The "e_b" metric is a ratio of the electrical energy consumed by the furnace fan to the total fuel and electrical energy consumed by the furnace. The ratio is similar to the "e" metric but differs in that the numerator only accounts for the electrical energy consumed by the furnace fan and not the total electrical consumption of the furnace. (AHRI No. 34 at pp. 1-3) Regal Beloit, a fan motor manufacturer, suggested that DOE use air horsepower (Air HP) to rate furnace fans. Air HP is the theoretical power required to deliver a specified quantity of air under a specified pressure condition and can be characterized as a function of the airflow, static pressure, and a constant. Regal Beloit did not provide details about the value or nature of the constant. (Regal

Beloit, No. 32 at p. 3) Nordyne, suggested that DOE use the air mover efficiency ratio (AMER) if "e" is not used. AMER is the ratio of the heating output capacity and the power consumed by the furnace fan. For AMER, Nordyne recommended that power be measured at a rating point defined by an airflow that is 0.175 times the output capacity on the lowest speed tap that would yield that airflow at 0.5 in.w.c. (Nordyne, No. 31 at p. 2) ACEEE recommended that DOE require furnace fan efficiency to be reported using three different energy consumption values that correspond to three different application classes: (1) continuous circulation; (2) hot climate; and (3) average-to-cold climate (heating-dominated air handler energy use). (ACEEE, No. 19 at p. 3)

In order to determine an appropriate metric for furnace fan efficiency to propose in this notice, DOE carefully considered the suggestions and other points raised in public comments, and conducted additional research, as explained below. One tentative conclusion that DOE reached is that a furnace fan efficiency metric must capture operation at multiple key operating points. DOE's investigation of furnace fan performance data indicates that input power can drop dramatically as airflow is reduced. In addition, different furnace fans exhibit very different behavior with respect to their range of achievable airflows and the corresponding reduction in power input as airflow is reduced. DOE expects that examination of a furnace fan at a single operating point would not likely provide a full representation of energy use of a furnace fan in a typical installation. Therefore, DOE is proposing a metric that evaluates the furnace fan operation at multiple key operating points, as suggested by ACEEE. DOE proposes that the energy use in these modes is combined into a single metric, however, because DOE cannot set energy conservation standards based on multiple metrics.[5] The incorporation of multiple

[5] EPCA defines "energy conservation standard" as a performance standard which prescribes a minimum level of

operating points in evaluation of furnace fan efficiency would ensure that the operating characteristics throughout the expected operating range are accounted for in the efficiency metric, and would, thus, rate at higher efficiency a furnace fan with the potential for airflow-control setting reduction and with greater reduction in input power as airflow is reduced.

Another tentative conclusion which DOE reached was that, consistent with comments received from interested parties, a metric in units of watts per cfm at specified ESPs would provide a useful metric for interested parties to compare and evaluate furnace fan performance. DOE finds that interested parties are familiar with discussing fan efficiency in terms of watts per 1000 cfm, as this is how fan performance is estimated in the alternative rating method for coil-only CAC products. Accordingly, in DOE's proposed metric (discussed below), the average power input is normalized by maximum airflow (in cfm), to allow for comparison across HVAC products of different capacities.

Finally, DOE tentatively concluded that it would not be possible for a furnace fan efficiency metric to capture all aspects of field operation. Several interested parties pointed out the dependence of furnace fan operating hours in the field on a wide range of factors such as climate, house size, duct characteristics, etc., as discussed above. However, the field performance of many products is dependent on the range of field installation and operating conditions. For example, the integrated combined energy efficiency ratio (CEER) for room air conditioners is based on active mode operation for 750 hours in outdoor temperature conditions

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energy efficiency or a maximum quantity of energy use for a covered product. (42 U.S.C. 6291(6)(A)) This definition does not allow prescription of multiple minimum levels of energy efficiency or maximum quantities of energy use, as would be required if multiple efficiency metrics were prescribed by the test procedure for energy conservation standards compliance purposes.

of 95 ˚F dry bulb temperature and 75 ˚F wet bulb temperature.[6] A product's rating provides an indication of energy use in a typical installation, but actual field energy use may vary. The annual operating hours for the proposed fan efficiency metric, which allow calculation of typical annual energy use, are intended to be representative of typical national average hours, and they allow determination of annualized performance over a typical annual cycle.

In light of the parameters discussed above, DOE proposes to use a new rating metric called the "fan efficiency rating" (FER). FER is not included in the aforementioned industry standards, but is derived from data collected using the methods specified in ANSI/AMCA 210-07. The proposed FER is the estimated annual electrical consumption normalized by total operating hours and the airflow measured in the maximum airflow-control setting at a specified ESP. The proposed estimate of annual electrical consumption is a weighted average of Watts measured separately for multiple airflow-control settings at different ESPs. These ESPs are determined by a reference system curve, which is developed using a specified airflow-control setting and ESP. This reference system curve is intended to represent typical duct work systems used for circulation of air. DOE determined the reference system criteria specified in this notice through analysis of measured ESP field data. Section III.E discusses in greater detail the reference system concept proposed in this notice.

The airflow-control settings in which determinations are specified to be made depend on the number of heating stages that the HVAC product has and whether the HVAC product is designed to be used for cooling. Two-stage and modulating controls allow HVAC products to

[6] "Wet bulb temperature" is the temperature measured by a thermometer having its bulb cooled by a wet "sock." The measurement gives an indication of the relative humidity of the surrounding air. For 95 ˚F dry bulb and 75 ˚F wet bulb temperatures at sea level under standard barometric pressure, the relative humidity is 40 percent.

meet heating load requirements more precisely. When low heating load conditions exist, a two-stage or modulating HVAC product can operate at a reduced input rate for an extended period of burner on-time to meet the reduced heating load. For products with single-stage heating, the three proposed rating airflow-control settings are the maximum setting, the default heating setting, and the default constant-circulation setting. For products with multi-stage or modulating heating, the proposed rating airflow-control settings are the maximum setting, the default low-heating setting, and the default constant-circulation setting. For heating-only products (i.e., HVAC products not designed to be paired with an external cooling coil), the proposed rating airflow-control settings are the maximum airflow-control setting (expected to be the default heating airflow-control setting) and the default constant-circulation setting. The lowest default airflow-control setting is used to represent constant-circulation if a constant circulation setting is not specified.

DOE understands that furnace fans typically have three or more airflow-control settings which are designated for specific functions. DOE is also aware that some furnace fans have more than one airflow-control setting designated for heating and/or cooling in multi-stage or modulating products. DOE requests comments on whether rating furnace fans using multiple but fewer than the total number of available airflow-control settings is appropriate, including multi-stage products. DOE expects that furnace fan factory settings typically designate the highest default airflow settings for cooling, median default airflow settings for heating, and the lowest default airflow settings for constant circulation. DOE also requests comments on the proposed assumptions for factory set airflow-control setting designations for specific functions. (See Issue 1 under "Issues on Which DOE Seeks Comment" in section V.E of this NOPR.)

DOE proposes to weight the input power at the operating points of the proposed rating airflow-control settings using estimates of the annual operating hours that the furnace fan spends performing each of the functions typically designated for each airflow-control setting. The proposed average annual operating hours for furnace fans take into account differences in climate and constant-circulation operation. DOE recognizes that furnace fan annual operating hours vary significantly by region, but DOE believes the proposed values provide a reasonable estimate of average national annual operating hours by function. The following paragraphs include a detailed description of the approach and sources used to derive the proposed operating hour values, which are included in Table III.2.

DOE proposes to specify one set of annual operating hours for products with single-stage heating and another for products with multi-stage or modulating heating. This proposed rule specifies use of the default low-heating setting to rate multi-stage or modulating furnaces because DOE expects that these furnaces spend most of their heating operating time in the low-heating mode. In addition, as compared to single-stage furnaces, multi-stage and modulating furnaces also spend more total time operating in heating mode, due to the reduced heat output for the low-heating mode. Consequently, the proposed heating mode hours used to calculate annual energy use in the metric are calculated based on the reduced heat output, as described below. DOE does not propose to account for multi-stage cooling because the presence and capacity of low-stage cooling is dependent on the cooling system with which the furnace fan HVAC products are paired. DOE found in its review of publicly-available product literature that detailed characteristics of the cooling system are not provided in the product literature for furnace fan HVAC products. In addition, multi-stage heating is not necessarily associated with multi-stage cooling capability (e.g., multi-stage cooling equipment is much less common than multi-stage heating equipment).

For products with single-stage heating, national average annual heating operating hours are calculated using the following formula :

$$HH_{ss} = y \times \frac{(WF_{heat} \times HE)_{Annual}}{Q_{in}}$$

Where:

HH_{ss} = estimated annual furnace heating hours for products with single-stage heating, in hours;

y = ratio of blower on-time to average burner on-time;

WF_{heat}= heating weather adjustment factor; and

HE_{Annual} = average annual heating energy use, in MMBtu/year; and

Q_{in} = average input heating capacity, in MMBtu/hour.

The inputs to this equation are determined as follows. The ratio of blower on-time to average burner on-time is derived from manufacturer default blower delay settings for non-weatherized gas furnace models found in the 2007 Furnace Database[7] from DOE's 2007 Furnace and Boiler Final Rule. 72 FR 65136 (Nov. 19, 2007). Using these data, the median values are 2

[7] The 2007 Furnace Database (Available at: http://www1.eere.energy.gov/buildings/appliance_standards/residential/fb_fr_analysis.html)

minutes for blower off-delay and 0.5 minutes for blower on-delay. The average burner on-time per cycle is 3.87 minutes for single-stage furnaces with fan delay based on DOE's furnace test procedure.[8] Therefore, ratio of blower on-time to average burner on-time ,*y*, is estimated to be 1.39.

The average annual heating energy use is derived using the average Energy Information Administration's (EIA) RECS 2005[9] heating energy use data for households with a gas or oil-fired furnace.[10] The average heating energy use, HE_{Annual}, in 2005 from these data is 49.8 MMBtu/year. Because heating energy use varies every year due to climate variations and because 2005 was a warmer than average year, an average weather factor, WF_{heat}, was applied to this value. To calculate the average weather factor, DOE used annual National Oceanic and Atmospheric Administration (NOAA) heating degree day (HDD) per Census Division.[11] To represent average conditions, DOE used the 30-year annual average HDD from 1981-2010 and compared it to 2005 HDD (weighting both sets of data by the number of households with a gas and oil-fired furnace in RECS 2005 found in each Census Division). The resulting average weather factor is 1.04. This factor (1.04) is then multiplied times average 2005 heating energy use (49.8 MMBtu/year) to yield 51.6 MMBtu/year average heating energy use. The average input capacity is calculated to be 86.3 kBtu/hour based on gas furnace 2001 gas furnace shipment

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[8] 10 CFR part 430, subpart B, Appendix N.

[9] U.S. Department of Energy: Energy Information Administration, Residential Energy Consumption Survey (RECS), Public use data files (2005) (Last accessed Sept. 2011.) (Available at: http://www.eia.doe.gov/emeu/recs/recspubuse05/pubuse05.html).

[10] Electric furnaces are excluded because they are mostly associated with heat pumps, and average input capacity data for electric furnaces is scarce. Also, RECS does not provide information to distinguish which households have hydronic air-handlers. Potentially adding electric furnaces and hydronic equipment might slightly lower BOH, since this equipment tends to be located in warmer climates.

[11] National Oceanic and Atmospheric Administration (NOAA) National Data Center Climate Data Online: HDD Data by Census Division (Last accessed Sept. 5, 2011) (Available at: http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp).

data by input capacity bins[12] and number of models in the 2010 AHRI directory[13] for non-weatherized gas furnaces.[14] Using these values, DOE calculates the average annual heating operating hours to be 830 hours per year.

DOE proposes to account for the differences in operation between single-stage and multi-stage or modulating units in its estimated annual heating operating hours. When heating a residential building, a certain amount of heat is required to reach a desired indoor temperature in that given building. The heat output of the HVAC product installed in that building is the rate at which the product provides that heat. The lower the heating output capacity of the installed HVAC product in that building, the longer that HVAC product must operate to provide the necessary heat to reach a desired temperature rise. For products with multi-stage or modulating heating, DOE is aware that heating operation hours are distributed between two or more heating operating modes that have different output capacities, referred to as "stages." DOE finds that product literature refers to multi-stage/modulating heating as a comfort feature characterized by long run-times in the low-heat setting, which can account for 90 percent or more of heating operation time. As a result, DOE recognizes that total heating operating hours for multi-stage and modulating furnace fans will likely be higher than for single-stage furnace fans in a given installation, because the HVAC product will be operating at its lower output capacity for a majority of these hours. Therefore, for the purposes of this test procedure, DOE proposes to rate multi-stage and modulating furnace fans using input power in the default low-heating stage only.

[12] GAMA, GAMA Shipment Data by Input Capacity Bins (2002) (Provided to DOE for the 2007 Furnace and Boiler Standards rulemaking) (EERE-2006-STD-0102-0056).

[13] Air Conditioning Heating and Refrigeration Institute (AHRI), Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment (AHRI Directory February 2010) (Last accessed September 2011).

[14] It is assumed that the input capacity proxy value is very close to the average value for all gas and oil-fired furnaces (especially since non-weatherized gas furnaces represent more than 80 percent of all gas and oil furnaces).

The increase in heating operating hours, and ultimately the energy consumed for heating, in multi-stage and modulating furnace fans is determined by the ratio of high-output heating capacity to low-output heating capacity. DOE proposes to use the following equation to determine average annual heating operating hours for multi-stage and modulating furnace fans:

$$HH_m = \frac{830}{HCR}$$

Where:

HH_m = estimated annual furnace fan heating hours for products with multi-stage or modulating heating, in hours; and

830= estimated annual heating hours for products with single-stage heating;

HCR = heating capacity ratio (output capacity in lowest heat mode divided by output capacity in highest heat mode).

Because fans can also be used to circulate cool air through duct work, DOE is also proposing calculations intended to capture energy use for that purpose. DOE estimates national average cooling operating hours using the following formula:

$$CH = y_C \times \frac{(WF_{cool} \times CB_{Annual} \times SEER)}{Q_{in}}$$

Where:

CH= estimated annual furnace fan cooling operating hours;

y_C = ratio of blower on-time to average compressor on-time;

WF_{cool}= cooling weather adjustment factor; and

CE_{Annual} = average annual cooling energy use, in kWh/year;

$SEER$= seasonal energy efficiency ratio; and

Q_{in} = average cooling capacity, in Btu/hour.

Most furnace fans come with a cooling blower-on and blower-off delay feature. To account for this feature, DOE estimated the ratio of blower on-time to average compressor on-time based on manufacturer default blower delay settings listed in publically-available product literature for non-weatherized gas furnace models. DOE found that the median values are 45 seconds for blower off-delay and 2 seconds for blower on-delay. The average compressor on-time per cycle is 6 minutes for single-stage central air conditioners based on DOE's central air conditioner test procedure (10 CFR part 430, subpart B, Appendix M). Therefore, DOE estimates the ratio of blower on-time to average compressor on-time, y_C, to be 1.12.

The average cooling energy use is derived using the average EIA's RECS 2005[15] cooling energy use data for households with both a central air conditioner and either a gas or oil-fired furnace.[16] The average annual cooling energy use, CE_{Annual}, in 2005 from these data is 2025 kWh/year. Because cooling energy use varies every year due to climate and because 2005 was a warmer-than-average year, an average weather factor was applied to this value. To calculate the average weather factor, DOE used annual NOAA cooling degree day (CDD) per Census Division.[17] To represent average conditions, DOE used the 30-year annual average CDD from

[15] U.S. Department of Energy: Energy Information Administration, Residential Energy Consumption Survey (RECS), Public use data files (2005) (Last accessed Sept. 2011). (Available at: http://www.eia.doe.gov/emeu/recs/recspubuse05/pubuse05.html).

[16] Similar to the heating operating hours calculation, electric furnaces and hydronic air-handlers are not included. The data include both heat pump and non-heat pump central air-conditioners.

[17] National Oceanic and Atmospheric Administration (NOAA). NNDC Climate Data Online: CDD Data by Census

1981-2010 and compared it to 2005 CDD (weighting both sets of data by the number of households with both a central air conditioner and either a gas or oil-fired furnace in RECS 2005 found in each Census Division). The resulting average cooling weather factor, WF_{cool}, is 0.89. This factor (0.89) is then multiplied times average 2005 cooling energy use (2025 kWh/year) to come up with 1794 kWh/year average cooling energy use adjusted for weather. The average seasonal energy efficiency ratio (SEER) in the U.S. stock in 2005 is estimated to be 11.06 based on Annual Energy Outlook (AEO) 2008 data for central air-conditioner efficiency.[18] The average cooling capacity in the U.S. stock in 2005 is estimated to be 34,884 Btu/h based on 2007-2010 AHRI shipments data.[19] Using these values, the average annual furnace fan cooling operating hours is estimated to be 637 hours. For the purposes of the test procedure, this number is rounded to 640 hours.

The average annual constant-circulation hours are based on data from surveys. The first survey was conducted by researchers in Wisconsin in 2003.[20] The second survey was conducted by the Center for Energy and the Environment (CEE) in Minnesota, the results of which were provided by CEE in a written comment that is included in the docket for the furnace fan energy conservation standard (Docket Number EERE-2010-BT-STD-0011), which can be viewed as described in the Docket section at the beginning of this notice. (CEE, No. 22 at pp. 1-3) DOE combined both studies and derived average annual furnace fan constant-circulation operating hours for each survey, as shown in

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Division (Last accessed Sept. 5, 2011) (Available at: www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp).

[18] Energy Information Administration, Annual Energy Outlook 2008 with Projections to 2030, Report No. DOE/EIA-0383 (2008) (Available at: http://www.eia.doe.gov/oiaf/aeo/).

[19] Air Conditioning Heating and Refrigeration Institute (AHRI), Monthly Shipment Statistics: 2007-2010 (Available at: http://www.ahrinet.org/monthly+shipments.aspx).

[20] Piggs, S. 2003. Central Electricity Use by New Furnaces: A Wisconsin Field Study. (URL: http://www.doa.state.wi.us/docview.asp?docid=1812).

Table III.1. DOE did not use these data directly, however, because it believes they are not representative of consumer practices for the U.S. as a whole. In Wisconsin and Minnesota, many homes have low air infiltration, and there is a high awareness of indoor air quality issues, which leads to significant use of continuous ventilation. To develop U.S. average values, DOE modified the data from the surveys using information from manufacturer product literature and consideration of climate conditions in other regions.

Table III.1: Results from Constant-Circulation Use Studies and Estimated Constant-Circulation Hours

How Often is Continuous Fan Used?	Combined Data from Studies		National Weighted Average Percentage of Consumers (%)	Assumed Average Number of Hours	National Weighted Average Number of Hours
	Number of Households	Percentage (%)			
No continuous fan	69	68%	89%	0	0
Year-round	14	14%	5%	7290	365
During heating season	4	4%	1%	1097	16
During cooling season	4	4%	1%	541	8
Other (some continuous fan)	10	10%	4%	365	13
Total	101	100%	100%	-	401

DOE assumed a value for average number of constant-circulation hours for each survey response. For "no constant circulation" responses, DOE assumed zero annual furnace fan constant-circulation hours. For "year-round" responses, DOE assumed 7,290 average annual furnace fan constant-circulation hours, which DOE calculated by subtracting furnace fan heating and cooling operating hours for single-stage furnace fans (830 and 640, as estimated above) from the total annual hours (8,760). For "during heating season" responses, DOE assumed 1,097 hours, which is half of the quantity of heating season operating hours less furnace fan heating operating hours. More specifically, DOE calculated this value by subtracting furnace fan heating operating hours (830, as estimated above) from the total heating season operating hours (5,216)[21] and multiplying by 25 percent to account for the consumers that use fan constant-circulation only during part of the heating season. For "during cooling season" responses, DOE assumed 541 hours. DOE calculated this value by subtracting furnace fan cooling operating hours (640, as estimated above) from the total cooling season hours (2,805)[22] and multiplying by 25 percent to account for the consumers that use fan constant-circulation only during part of the cooling season. For other or "some constant circulation" responses, DOE assumed 365 hours, which is 5 percent of year-round operation.

Table III.1 also shows the estimated weighted average national fraction of consumers and derived annual constant-circulation hours. To derive the annual constant-circulation hours, DOE assumed that on average, the combined data from the Wisconsin/Minnesota studies overestimate the fraction of consumers that use constant-circulation by 50 percent in the North and South Hot Dry region and by 90 percent in the South Hot Humid region.[23] Using EIA's RECS 2005 data, DOE estimated that 65 percent of furnace fans are located in the North and South Hot Dry region, while the remaining 35 percent are located in the South Hot Humid region.

As shown in

Table III.1, the weighted average annual constant-circulation hours is 401 hours, rounded

[21] Based on June 2, 2010 Test Procedure NOPR for Residential Central Air Conditioners and Heat Pumps. 75 FR 31224, 31270.
[22] Id.
[23] The regions are described in June 27, 2011 Direct Final Rule for Residential Furnaces, Central Air Conditioners and Heat Pumps. 76 FR 37408.

to 400 hours for the purposes of this test procedure.

For hydronic air handlers, DOE proposes to use a variation of FER that integrates standby mode and off mode electrical energy consumption with active mode electrical energy consumption. This variation of FER will be referred to as the integrated fan efficiency rating (IFER). The proposed standby mode hours are the remainder of annual hours not designated for cooling, heating, constant circulation, or off mode. Therefore:

$$SBH = 8760 - HH - CCH - CH - OH$$

Where:

SBH= annual furnace fan standby mode operating hours;

8760= number of hours in a year;

HH= annual furnace fan heating operating hours;

CCH= annual furnace fan constant-circulation hours;

CH= annual furnace fan cooling operating hours; and

OH= annual furnace fan off mode operating hours.

DOE proposes a value of zero for hydronic air handler off mode operating hours because DOE expects that hydronic air handlers are not typically equipped with a seasonal off switch or that consumers will not turn off power to the hydronic air handler. Consideration of standby mode and off mode is discussed in more detail in section III.G. Table III.2 shows the proposed furnace fan annual operating hours by mode, as estimated according to the methods detailed above.

Table III.2: Proposed Furnace Fan Annual Operating Hours by Mode

Operating Mode	Variable	Single-Stage (hours)	Multi-Stage (hours)
Heating mode	HH	830	830 / HCR
Circulation mode	CCH	400	400
Cooling mode	CH	640	640
Off mode (if applicable)	OH	0	0
Standby mode (if applicable)	SBH	8760-HH-CCH-CH-OH	8760-HH-CCH-CH-OH

DOE is aware that climate conditions vary across the United States. DOE seeks comment on the appropriate values and methods for estimating these values for weighting fan efficiency in each rated airflow-control setting. DOE also seeks comment on how these operating hours may vary for multi-stage products. (See Issue 2 under "Issues on Which DOE Seeks Comment" in section V.E of this NOPR.)

DOE believes the AECR metric specified by CSA C823 is less appropriate than FER, because AECR is more burdensome without providing any additional useful information. AECR is more burdensome because it requires as many as 26 more determinations for the proposed range of ESP (0.1 in.w.c. to 0.75 in.w.c.). The number of determinations proposed to be specified for FER is discussed in detail in section III.F.2. In contrast to the proposed metric, DOE believes the approach suggested by ACEEE is also less appropriate, because DOE cannot set standards based on multiple metrics, as explained above. Furthermore, DOE believes the metric variations based on the current DOE furnace test procedure (i.e., BE, e, and e_b) are less appropriate than FER, because they are based on measurements at one operating point for units with single-stage heating or measurements at two operating points for units with multi-stage or modulating heating. These metrics do not account for operation in cooling or constant-circulation modes. As stated previously, DOE anticipates that a rating metric based on a single operating point would not provide a good indication of the variation of typical annual energy use exhibited by the range of available furnace fan products. The issue of the appropriate number of airflow-control settings for rating furnace fans is discussed further in section III.F.1. In addition, DOE believes the BE, "e," and "e_b" metrics are inappropriate because they are measured at ESPs that are not representative of field conditions. DOE believes Air HP, as it is described by Regal Beloit, is an important concept when considering the efficiency of fans and blowers. However, Air HP does not include a measurement of electrical consumption, which is a necessary part of a test procedure supporting an energy conservation standard. DOE believes AMER would be less appropriate than FER, because it is based on furnace output capacity instead of air delivery. DOE expects that AMER would reward furnaces that have higher output capacities, regardless of whether any improvement in fan efficiency would result. For these reasons, DOE is proposing FER as the most appropriate metric for rating furnace fan performance.

E. Reference System

In the June 2010 framework document, DOE sought comment on the appropriate reference system for the purposes of rating furnace fan performance. 75 FR 31323 (June 3, 2010). DOE proposes to specify a reference system, which provides a standardized set of airflow characteristics to model duct work. The energy use of a furnace fan depends heavily on the duct work system through which it circulates air, but duct work characteristics vary between installations and are outside the control of manufacturers of residential HVAC products. Use of a reference system for rating furnace fans allows for consistent comparison across HVAC products. Furthermore, the reference system provides a basis for estimating the airflow, ESP, and electrical consumption of the fan in the rating airflow-control settings and, therefore, for different furnace fan functions (i.e., cooling, heating, constant-circulation).

To circulate air through duct work, a furnace fan motor rotates an impeller, which increases the velocity of an airstream. As a result, the airstream gains kinetic energy. This kinetic energy is converted to a static pressure increase when the air slows downstream of the impeller blades. This static pressure created by the fan must be enough to overcome the pressure losses the airstream will experience throughout the duct work, and to a smaller degree, within the HVAC product itself, to provide sufficient delivery of conditioned air to the residence. Pressure losses are the result of directional changes in the duct work, friction between the moving air and surfaces of the duct work, and possible appurtenances in the airflow path. (In layman's terms, the conditioned air slows and eventually would stop the further it travels from the fan. However, in effective systems, continued action of the furnace fan overcomes such resistance and provides conditioned air to the intended space.) Therefore, the geometry of any HVAC component that obstructs the airflow path, the length of the duct work path, and number and nature of direction changes in the ductwork of a given system contribute to the pressure losses of the system. In most duct systems, the static pressure required to move the air is approximately equal to the square of the airflow rate. The duct static pressure is the ESP, which can be represented as follows:

$$ESP = K_{ref} \times Q^2$$

Where:

ESP = external static pressure in inches water column (in.w.c.);

K_{ref} = a constant that characterizes the reference system; and

Q = airflow in cfm.

A reference system is defined by specifying an airflow-control setting and a standardized ESP to determine values for Q and ESP. Once these values are known, K, which characterizes the reference system, can be calculated. The quadratic relationship described above is assumed for the duct work system to relate ESP to airflow in different airflow-control settings.

In the June 2010 framework document, DOE requested comment on a definition of the reference system based on a standardized ESP of 0.5 in.w.c. for the default heating airflow-control setting. For the framework document, DOE identified this reference system definition so as to be consistent with the reference system specified in the December 2009 draft of CSA C823.

Rheem recommended testing at an external static pressure of 0.2 in. w. c. in the default heating speed, and Morrison made the same point. (Rheem, No. 7 at p. 76; Morrison, No. 7 at p. 77) Mortex stated that 0.3 in. w.c. in cooling mode is used to test coil-only units and that similar criteria would be appropriate for furnace fans. (Mortex, No. 7 at p. 86) Ingersoll Rand stated that the default heating mode speed does not match up with any other conditions under which furnaces are already tested. Ingersoll Rand added that default heating speeds are typically lower than cooling speeds, which would result in better ratings when compared to air conditioners. (Ingersoll Rand, No. 7 at p. 79) Rheem commented that it expects ducting is designed for the highest airflow, which is typically the cooling mode, so specifying a heating speed for the reference system can be problematic, because it could result in extrapolating operating points for higher airflow-control settings that are beyond the manufacturer-recommended operating points. (Rheem, No. 7 at pp. 74-75)

Many interested parties stated that the ESP at which furnace fans are rated should reflect the ESP that furnace fans will face in the field. The National Resources Defense Council (NRDC), ACEEE, Center for Energy and Environment (CEE), NEEP, and Adjuvant Consulting all stated that an ESP of at least 0.5 in.w.c. should be used because it would best reflect actual field conditions. (ACEEE, No. 19 at p. 2; NRDC, No. 28 at p. 4; NEEP, No. 16 at pp. 3-4; Adjuvant Consulting, No. 7 at p. 80; CEE, No. 22 at p. 1) Pacific Gas and Electric Company asserted that the ESPs at which furnace fans are tested should be higher than those at which furnaces are currently rated in order to mirror the ESPs of systems in the field. (Pacific Gas and Electric Company, No. 7 at p. 81) CEE measured the ESP in 81 homes and found that the average was 0.55 in.w.c. in heating mode. (CEE, No. 22 at p. 1)

Not all interested parties agreed with setting the reference ESP at 0.5 in.w.c. AHRI and Morrison stated that DOE should utilize the methods outlined in ANSI/ASHRAE Standard 103, Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers (i.e., the reference standard for DOE's residential furnaces test procedure), for determining ESP rating points as a function of capacity, and the commenters further stated that 0.5 in.w.c. in the default heating airflow setting is too high to conduct testing. (AHRI, No. 20 at p. 5; Morrison, No. 26 at p. 4) Rheem recommended that the ESP used for rating furnace fans reflect the ESP that is recommended by manufacturers for appropriate operation of their products. Rheem added that specifying the rating criteria to mimic field conditions is not appropriate, because poor installation practices and misinformed consumer demands are pushing products outside the range of recommended operation. Rheem further stated that setting a standard based on these practices would perpetuate and escalate the misuse of the products, thereby increasing energy consumption. (Rheem, No. 7 at p. 91) Morrison, NEEA, Rheem, and AHRI remarked that the ESP in the furnace fan test procedure should reflect the methods in the existing DOE test procedures for residential furnaces and central air conditioners to reduce manufacturer testing burden and to maintain consistency. (NEEA, No. 11 at p. 3; Morrison, No. 26 at p. 3; Rheem, No. 29 at pp. 4-5; Rheem, No. 7 at p. 54; AHRI, No. 20 at pp. 3-4)

DOE proposes to use an ESP value that is consistent, to the extent possible, with known field conditions. DOE expects this approach would result in ratings that are most representative of field energy use. DOE also expects that the use of manufacturer-recommended ESPs might overestimate furnace fan efficiency, because the ESP of field-installed HVAC systems typically exceeds the ESP recommended by manufacturers. Like manufacturers, DOE is also concerned about the energy use impact of installations with high static pressures. However, DOE does not expect that a reduction in average field ESPs that approaches the manufacturer-recommended levels is likely to occur, because installing new, larger, and more-efficient ducts in existing homes is generally cost-prohibitive. DOE is concerned that a metric based on a low, albeit desirable, static pressure level would not best represent furnace fan efficiency. Also, DOE is concerned that a metric based on a low static pressure may lead to excessive energy use by furnace fan designs which do not achieve high efficiency levels when operating at the higher, real-world static pressures. Adapting the efficiency metric to the real-world conditions better facilitates meaningful comparisons of furnace fans operating under these conditions.

In addition, DOE does not agree with contentions from Morrison, NEEA, Rheem, and AHRI that defining the reference system using an ESP value other than those already specified in associated DOE test procedures would be overly burdensome. Based on DOE's review of publicly-available product literature, airflow performance data is already measured and listed by manufacturers at ESPs that exceed those specified in the DOE test procedures for residential furnaces and central air conditioners. The ESPs specified in the residential central air conditioner test procedure at 10 CFR part 430, subpart B, Appendix M range from 0.1 to 0.2 in.w.c. for conventional split systems. The ESPs specified in the furnace test procedure at 10 CFR part 430, subpart B, Appendix N range from 0.12 to 0.58 in.w.c., depending on the fuel source and rated input capacity of the furnace. In contrast, most of the publicly-available product specification sheets that DOE reviewed include airflow performance data up to 1 in.w.c.

DOE gathered field data from available studies and research reports to determine an appropriate ESP value to propose for the reference system. DOE compiled over 1300 field ESP measurements from several studies that included furnace fans in single-family and manufactured homes in different regions of the country. DOE has included a list of citations for these studies in the docket for this rulemaking. A link to the docket web page can be found at: http://www1.eere.energy.gov/buildings/appliance_standards/residential/furnace_fans.html. This webpage contains a link to the docket for this notice on the www.regulations.gov site. The www.regulations.gov webpage contains simple instructions on how to access all documents, including public comments, in the docket. The docket number for this rulemaking is EERE-

2010-BT-TP-0010.

Data across studies were not consistent because some included external evaporator coil and/or filter pressure drops in their ESP measurements, whereas others did not. So that DOE could compare the data, DOE calculated adjusted ESP values for each study to derive one value that included the measured/estimated evaporator coil pressure drop and one that did not for each residence. All values included a measured or estimated filter pressure drop. Three of the aforementioned studies included filter and coil pressure drop data that DOE used to estimate average filter and coil pressure drops for these adjustments.[24] DOE found that on average, the pressure drop measured for the evaporator coil was 0.20 in.w.c., and the pressure drop for the filter was 0.21 in.w.c.

Table III.3 includes the weighted average "with-coil" and "without-coil" ESP results for single-family homes and manufactured homes.

Table III.3: Summary of Adjusted Field ESP Data

Household Type	With Coil ESP (in.w.c.)	Without Coil ESP (in.w.c.)
Single-family Home	0.73	0.52
Manufactured Home	0.37	0.17

DOE identified four installation types with unique reference system ESP considerations:

- Heating-only units;

[24]Piggs, S. 2008. Central Air Conditioning in Wisconsin: A Compilation of Recent Field Research. Energy Center of Wisconsin. (Two studies reported 2005 and 2007) (URL: http://www.ecw.org/resource_detail.php?resultid=289); and Wilcox, B. J. Proctor, R. Chitwood, and K. Nittler. 2006. Furnace Fan Watt Draw and Air Flow in Cooling and Air Distribution Modes. 2008 California Building Energy Efficiency Standards. (URL: http://www.energy.ca.gov/title24/2008standards/prerulemaking/documents/2006-07-12_workshop/reviewdocs/FAN_WATT_DRAW_AND_AIR_FLOW.pdf)

- Units with an internal evaporator coil;
- Units designed to be paired with an evaporator coil; and
- Manufactured home units.

DOE proposes to treat these types of units as follows. DOE is aware that some hydronic air handlers are not designed to provide cooling. DOE has identified these as heating-only products. DOE proposes to specify a lower reference system ESP for these products, because they do not experience the additional pressure drop of circulating air past an evaporator coil.

DOE has identified weatherized gas furnaces as units with an internal evaporator coil. DOE proposes to specify a reference system ESP for these products that does not include the pressure drop of circulating air past an evaporator coil because FER already accounts for internal losses.

DOE is aware that non-weatherized gas furnaces, oil-fired furnaces, electric furnaces, modular blowers, and some hydronic air handlers are designed to accommodate an evaporator coil for cooling. DOE has identified these products as products not originally supplied with an evaporator coil but designed to be paired with an evaporator coil in the field. DOE proposes a higher reference system ESP for these products to ensure their FER accounts for the pressure drop of circulating air past an evaporator coil.

DOE proposes to use a different reference system ESP for manufactured home products to account for the space constraints and installation requirements that are unique to the manufactured home market.

DOE recognizes that units designed to be paired with an evaporator coil and manufactured home products are not always paired with evaporator coils, even though they are designed for this option. Using EIA's RECS 2005 data, DOE estimated the fraction of furnace installations paired with an evaporator coil in the field. DOE determined that 72.9 percent of single-family households with a non-weatherized gas or oil-fired furnace had central air-conditioners (i.e., are paired with an evaporator coil).[25] DOE determined that 50.2 percent of manufactured home households with a non-weatherized gas or oil-fired furnace had central air-conditioners. For manufactured homes and units designed to be paired with an evaporator coil in single-family homes, DOE used these percentages to weight the with-coil and without-coil ESP values (see

Table III.3) to derive the proposed reference system ESP value. DOE proposes to specify the reference system values, as reflected in

Table III.4 for each installation type. The proposed values are rounded to the nearest 0.05 in.w.c. DOE seeks comment on its proposed reference system ESP values. DOE also welcomes additional field data. In addition, DOE seeks comment on whether the specified reference system ESP should be dependent on capacity. (See Issue 3 under "Issues on Which DOE Seeks Comment" in section V.E of this NOPR.)

[25] For simplicity, electric furnaces are excluded since they are mostly associated with heat pumps. Also, RECS does not provide information to distinguish which households have hydronic air-handlers. Adding electric furnaces and hydronic equipment will increase the fraction of households with central air-conditioners, since this equipment tends to be located in warmer climates.

Table III.4: Proposed Reference System ESP Values for All Furnace Fan Installation Types

Installation Type	Weighted Average ESP (in. w.c.)
Heating-only units	0.50
Units with an internal evaporator coil	0.50
Units designed to be paired with an evaporator coil	0.65
Manufactured home[26]	0.30

DOE proposes to use the maximum airflow-control setting to define the reference system for each installation type. DOE is aware that furnace fan control schemes typically include airflow-control settings, each often designated for specific functions (e.g., cooling, heating, and constant circulation). DOE found that the maximum airflow-control setting is often factory set for cooling operation or for high or default heating for heating-only units that do not have a cooling setting. DOE has tentatively concluded that specifying the maximum airflow-control setting for the reference system would preclude the need to extrapolate performance data outside the desired range of operation, which might be necessary if DOE selected an airflow-control setting other than the maximum. Extrapolating performance outside the recommended and tested range is less desirable than interpolation because extrapolation will not account for dramatic changes in furnace fan performance that may occur beyond a certain ESP threshold. In addition, comments from interested parties indicate that, unlike in Canada, U.S. HVAC systems and components (including furnace fans) are often designed for cooling operation (i.e., maximum required airflow).

DOE found that field ESP values vary compared to manufacturer-recommended ESP

[26] Manufactured home external static pressure is much smaller due to the fact there is no return air duct work in manufactured homes. Also, the United States Department of Housing and Urban Development (HUD) requirements stipulate that the duct work for cooling should be set at 0.3 in. w.c.

values and considered the use of multiple reference systems. This notice refers to the December 2009 draft version of CSA C823, because that was the version that was referenced in the June 2010 furnace fan framework document. For the reasons discussed in section III.C, DOE is not proposing to use CSA C823 as a reference standard for this notice. However, DOE is aware that for the final version of CSA C823, CSA considered specifying multiple reference systems to account for differences in ESP and ultimately, fan performance at manufacturer-recommended operating conditions and typical, poor field operating conditions. Rheem supported the use of two reference system curves if the rating must include the effects of incorrect and potentially unsafe installation practices that occur in the field in spite of the manufacturers' installation instructions. Rheem suggested that these two curves should be based on a static pressure of 0.3 in.w.c. and 0.6 in.w.c. in the default heating airflow-control setting. (Rheem, No. 29 at p. 6)

DOE proposes to use only one reference system curve for each installation type, as described above because for the reasons discussed previously, DOE cannot set standards based on multiple metrics. In addition, DOE investigated the use of a combined metric based on multiple reference system curves. For a subset of fans, DOE averaged an FER based on a high reference system ESP value and an FER based on a low reference system ESP value by increasing and decreasing the proposed ESP values by 0.15 in.w.c. For example, the resulting high and low reference system ESP values for this investigation for furnace fan products that are designed to be paired with evaporator coils (i.e., non-weatherized gas furnaces, oil-fired furnaces, electric furnaces, some hydronic air-handlers, and modular blowers) were 0.8 in.w.c. and 0.5 in.w.c., respectively. These values are higher than those suggested by Rheem because they are specified for the maximum airflow-control setting, which is expected to be higher than the default heating airflow-control setting. Using the reference system equation described above and assuming that default heating airflow is in the range of 80 percent to 90 percent of the maximum airflow, the high and low reference system ESP values for the default heating airflow-control setting used for this comparison are roughly equivalent to those suggested by Rheem. DOE found that the combined, multiple reference system FER values varied on average by less than 2 percent with a standard deviation of 2 percent compared to the proposed, single reference system FER and did not alter the ranking of furnace fans by efficiency. Therefore, DOE believes the use of multiple reference system curves is unnecessary. DOE requests comment on whether a multiple reference system rating approach would provide a better indication of the overall performance. (See Issue 4 under "Issues on Which DOE Seeks Comment" in section V.E of this NOPR.)

F. Performance Curves

1. Number of Airflow-Control Settings

In the June 2010 framework document, DOE requested feedback on the appropriate number of measurements (i.e., determinations) needed to characterize the performance of a furnace fan, which is dependent in part on the number of airflow-control settings used to rate the furnace fan.[27] Installed furnace fans can have as many as five or more airflow-control settings. In a given HVAC system, energy consumption of the furnace fan increases as airflow increases. Therefore, airflow-control settings have varying energy use profiles. As mentioned, DOE finds that airflow-control settings are each often designated for a specific function, such as cooling, heating, or constant circulation. In addition, the relative efficiency of certain furnace fan

[27] See Issue 10 on page 11 of the June 2010 framework document. DOE posted the framework document to the DOE website, which can be accessed at this link: http://www1.eere.energy.gov/buildings/appliance_standards/residential/furnace_fans_framework.html

technologies varies with airflow-control setting. The extent to which energy consumption across a furnace fan's operating range is accounted is determined by the number of airflow-control settings used to rate the furnace fan.

Comments from interested parties indicate that some are in favor of a metric that accounts for fan electrical consumption while operating in a single airflow-control setting, while others are in favor of a metric that accounts for operation in multiple airflow-control settings. AHRI and certain manufacturers, including Rheem, Nordyne, and Lennox, suggested that DOE should use "e," which is based on the measured electrical energy consumption of the fan at a single operating point. (AHRI, No. 21 at p. 4; Rheem, No. 29 at p. 3; Nordyne, No. 31 at p. 2; and Lennox, No. 23 at p. 2) Ingersoll Rand added that it questions whether more than one test point per airflow-control setting and whether more airflow-control settings than there are heat stages (with possible consideration of an additional point for cooling) is necessary to rate furnace fans, given that they perform quite predictably in accordance with well-established "fan laws." (Ingersoll Rand, No. 25 at p. 1) Johnson Controls stated that electrically-commutated motors (ECM) have an efficiency advantage over permanent split capacitor (PSC) motors at low or partial-load conditions but not necessarily at higher/maximum-load conditions. (Johnson Controls, No. 7 at p. 145) In contrast, ACEEE remarked that DOE should not use a single annual energy consumption metric, but instead, the minimum efficiency standard should be based on the power for circulation, heating, and cooling modes weighted by average annual operating hours in each mode. (ACEEE, No. 30 at p. 3) NEEP recommended that DOE use a rating system based on two or three fan speeds to capture the efficiency of fans that use ECM motors. (NEEP, No. 16 at p. 3)

After considering available information and public comments on this issue, DOE has tentatively concluded that a metric based on measurements in multiple airflow-control settings would be appropriate to account for furnace fan energy consumption across its entire operating range. DOE recognizes that furnace fans are used not just for circulating air through duct work during heating operation, but also for circulating air during cooling and constant-circulation operation. As mentioned previously, DOE understands that higher airflow-control settings are factory set for cooling operation. Therefore, DOE expects that the electrical energy consumption of a furnace fan is generally higher while performing the cooling function. Consequently, DOE expects that using a metric based on a single measurement in an airflow-control setting designated for heating could result in an incomplete assessment of overall performance. DOE further recognizes that the potential for significant power reduction occurs when the fan is operating in its lowest airflow-control setting, which DOE finds is typically factory set for constant-circulation. This significant power reduction is consistent with the theory that fan input power is proportional to the cube of the airflow. Consequently, a "snapshot approach" which specifies only a single airflow-control setting may not be representative of the product's average use. However, some fan technologies may not reduce power input in this fashion. DOE is concerned that rating furnace fan performance at a single airflow-control setting would incentivize manufacturers to design fans optimized to perform efficiently at the selected rating airflow-control setting but that are not efficient over the broad range of field operating conditions. DOE expects that a rating metric that includes measurements at multiple airflow-control settings would help ensure that the rating metric captures the efficiency advantages of using motor technologies that maintain higher efficiencies over a broad range of operating conditions. DOE is aware that other technologies, such as improved impeller designs, may also improve efficiency in some, but not all, of the expected range of operation.

For the reasons above, DOE proposes that FER be based on measurements taken in multiple airflow-control settings, which have been selected to represent the main product functions that have varied energy usage profiles. For products with single-stage heating, the three proposed rating airflow-control settings would be the maximum setting, the default heating setting, and the default constant-circulation setting. For products with multi-stage heating or modulating heating, the proposed rating airflow-control settings would be the maximum setting, the default low-heating setting, and the default constant-circulation setting. For heating-only products, the proposed rating airflow-control settings would be the default heating setting and the default constant-circulation setting. The lowest default airflow-control setting would be used to represent constant circulation, for units in which a constant-circulation setting is not specified. The default low-heat setting would be the airflow-control setting used to circulate air when the HVAC product is operating at its lowest nominal heating input capacity. DOE believes that using the FER metric would ensure that the operating characteristics of all of the relevant airflow-control settings are accounted for in the efficiency metric, and it would, thus, rate at higher efficiency a furnace fan that does reduce power more consistently with the theoretical cubic relationship. In selecting the multiple airflow-control settings discussed above, it is noted that DOE is aware that some furnace fans are designed to have more than three airflow-control settings. DOE compared ratings that use measurements in two, three, and five airflow-control settings and found that a metric that uses measurements in three (or two for heating-only products) of the available airflow-control settings appropriately captures the efficiency advantages of using more-efficient technologies while minimizing burden on manufacturers.

2. Number of Determinations

In the June 2010 framework document, DOE sought comment on the appropriate total number of determinations that DOE should specify that manufacturers make in each airflow-control setting to develop performance curves without being overly burdensome.[28] As defined in ANSI/AMCA 210-07 and incorporated by reference in this notice, a determination is a complete set of measurements for a particular point of operation of a fan. For the purposes of this test procedure, a complete set of measurements includes measurements of airflow, electrical consumption, and external static pressure. The total number of determinations per performance curve depends on the ESP range and measurement increments specified in the test procedure.

As described above in section III.D, the proposed active mode metric incorporates furnace fan input power at multiple operating points, which are determined by the intersections of the performance curves (i.e., airflow-ESP relationship) of the rating airflow-control settings and a specified reference system curve. Determinations are not necessarily measured at the operating points, because reproducing the exact ESP and airflow of the operating points during testing is extremely burdensome. Instead, a series of determinations are made for each rating airflow-control setting that bracket the operating point for that setting. Separate best-fit curves for the determination test results are developed in which airflow and input power are equal to second order polynomial of ESP.[29] These curves estimate the relationship between airflow and

[28] See Issue 10 on page 11 of the June 2010 framework document. DOE posted the framework document to the DOE website, which can be accessed at this link: http://www1.eere.energy.gov/buildings/appliance_standards/residential/furnace_fans_framework.html

[29] In other words, $Q = A \times ESP^2 + B \times ESP + C$ and input power $E = X \times ESP^2 + Y \times ESP + Z$. The coefficients A, B,

electrical consumption to ESP within the range of ESP specified for each product in this notice. When evaluating FER, the performance curve for the airflow-control setting and the reference curve constant, K_{ref}, are used to determine the operating point ESP. Subsequently, the power input curve for the airflow-control setting is used to calculate the input power for each operating point. The input power values are used in the FER calculations. The methodology for calculating FER is described in more detail in section III.H. The issues addressed in this section are: (a) the number of determinations required to develop the airflow and power input curves for each airflow-control setting, and (b) the range of ESPs over which these determinations must be made.

Rheem commented that the maximum ESP for PSC motors is typically 0.7 in.w.c. and that the maximum ESP for ECM motors is documented up to 1 in.w.c. (Rheem, No. 29 at p. 4) Ingersoll Rand expressed a similar view, stating that the maximum reported testing data are taken at about 1 in.w.c. ESP for ECM motors and 0.8 in.w.c. for PSC motors. (Ingersoll Rand, No. 7 at p. 67)

Many interested parties commented that fewer determinations are necessary than are specified in the December 2009 draft version of CSA C823. The December 2009 draft of CSA C823 required measurements at increments of at least 0.1 in.w.c. for the desired range of operation, so under that approach, a furnace fan with 5 airflow-control settings and a range of operation from 0 to 1 in.w.c. would require 50 determinations. ACEEE recommended that manufacturers be required to certify the smallest set of data required to build performance maps

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and C which provide the best fit to the data for flow are determined, as are the coefficients X, Y, and Z with provide the best fit to the data for input power.

for intended applications. ACEEE added that few measurements would need to be certified. (ACEEE, No. 19 at p. 4) Rheem stated that, theoretically, only three points are required to develop a performance curve. Rheem also stated that it is important to get the high and low points correct to avoid extrapolation. (Rheem, No. 7 at p. 67) Ingersoll Rand, NRDC, Johnson Controls, and AHRI recommended that determinations be made in 0.2 in.w.c. increments. (Ingersoll Rand, No. 7 at pp. 65-66; NRDC, No. 28 at p. 4; Johnson, No. 7 at pp. 67-69; and AHRI, No. 20 at p. 5) Regal Beloit recommended that DOE rate furnace fans at ESPs from 0.5 in.w.c. to 1.4 in.w.c. at 0.1 in.w.c. increments. Regal Beloit added that there must be multiple static points to help define the operating range of the blower with 0.5 in.w.c. maximum difference between points. (Regal Beloit, No. 32 at p. 2)

DOE agrees that the total number of determinations resulting from measuring at 0.1 in.w.c. increments would be unnecessary to derive reasonably accurate ratings for furnace fans. In seeking to determine the appropriate number of measurements, DOE explored three determination methods by generating FER values using airflow and electrical consumption measurement data from testing and publically-available product literature at: (1) 0.1 in.w.c. increments; (2) 0.2 in.w.c. increments; and (3) the minimum, mid-point, and maximum ESP. The test data and product-literature data were measured according to ANSI/AMCA 210-07, and the methodology used to derive the FER values is described in detail in section III.H. DOE analyzed measurements for 15 furnace fans used in various product types, including non-weatherized condensing and non-condensing gas furnaces, weatherized gas furnaces, oil-fired furnaces, electric furnaces, hydronic air handlers, and modular blowers. DOE found that the FER changes by an average of less than 1 percent (with a standard deviation of 3 percent) when using the 3-point determination method, as compared to the 0.1 in.w.c. increment method. Similar differences resulted for the 0.2 in.w.c. increment determination method, as compared to the 0.1 in.w.c. increment method. DOE expects that the FER differences between the 0.1 in.w.c. and 3-point determination methods are small enough that using the 3-point determination method would still result in reasonably accurate ratings and rankings of furnace fan efficiency. Therefore, DOE proposes to specify that 3 determinations be made for each rating airflow-control setting. DOE proposes to specify determinations at: (1) 0.1 in.w.c.; (2) an ESP equal to the applicable reference system ESP divided by 2; and (3) an ESP between the applicable reference system ESP and 0.1 in.w.c. above that reference system ESP.

G. Standby Mode and Off Mode Energy Consumption

EPCA, as amended by EISA 2007, requires that any final rule for a new or amended energy conservation standard adopted after July 1, 2010, must address standby mode and off mode energy use pursuant to 42 U.S.C. 6295(o). (42 U.S.C. 6295(gg)(3)) Thus, the statute implicitly directs DOE, when developing new test procedures to support new energy conservation standards, to account for standby mode and off mode energy consumption. EISA 2007 also requires that such energy consumption be integrated into the overall energy efficiency, energy consumption, or other energy descriptor, unless the current test procedure already accounts for standby mode and off mode energy use. If an integrated test procedure is technically infeasible, DOE must prescribe a separate standby mode and off mode test procedure for the covered product, if technically feasible. (42 U.S.C. 6295(gg)(2)(A)) Accordingly, DOE must address the standby mode and off mode energy use of residential furnace fans in this test procedure. However, DOE has already incorporated standby mode and off mode energy use in the test procedures (or proposed test procedures) for several of the products to which this test procedure rulemaking is applicable.

Table III.5 summarizes the test procedure rulemaking vehicles through which DOE is addressing standby mode and off mode energy consumption for the various types of products which circulate air through duct work.

Table III.5: Rulemaking Activities Addressing Furnace Fan Standby Mode and Off Mode Energy Consumption

HVAC Products	Status	DOE Rulemaking Activity
• Gas Furnaces • Oil-fired Furnaces • Electric Furnaces	Addressed in separate rulemaking	• Codified Furnaces Test Procedure October 20, 2010 final rule (75 FR 64621) (10 CFR part 430, subpart B, appendix N, section 8.0) • September 13, 2011 NOPR (76 FR 56339).
• Modular Blowers • Weatherized Gas Furnace	Addressed in separate rulemaking	• Codified CAC Test Procedure October 22, 2007 final rule (72 FR 59906). (10 CFR part 430, subpart B, appendix M) • June 2, 2010 NOPR (75 FR 31224). • April 1, 2011 SNOPR (76 FR 18105). • October 24, 2011 SNOPR (76 FR 65616).
• Hydronic Air Handlers	Addressed in current rulemaking	• N/A

1. Residential Furnaces and Central Air Conditioner Products

Measurement of standby mode and off mode energy use for non-weatherized gas furnaces, oil-fired furnaces, and electric furnaces is already prescribed in the furnace test procedure (10 CFR part 430, subpart B, appendix N, section 8.0). In a September 13, 2011 NOPR, DOE proposed amendments to the furnaces test procedure related to standby mode and off mode. 76 FR 56339. DOE proposed coverage of standby mode and off mode energy use for modular blowers and weatherized gas furnaces in a June 2, 2010 NOPR. 75 FR 31224. DOE subsequently published one SNOPR on April 1, 2011 and another on October 24, 2011 regarding standby mode and off mode test procedures for these products. 76 FR 18105; 76 FR 65616. Furnace fans are integrated in the electrical systems of the HVAC products in which they are used and controlled by the main control board. Therefore, there is no standby mode and off mode energy use associated with furnace fans used in the aforementioned products that would not already be measured by the established or proposed test procedures associated with these products. Hence, given that the standby mode and off mode energy consumption of these types of furnace fans either has been or is in the process of being fully addressed, there is no need for DOE to adopt additional test procedure provisions for these modes in this rulemaking.

2. Hydronic Air Handlers

There are no current DOE test procedures for measurement of electrical energy use in hydronic air handlers nor is there an ongoing rulemaking for which such test procedures have been proposed. Hence, the standby mode and off mode energy use for furnace fans that are incorporated into these products must be considered in this rulemaking. DOE proposes to incorporate in this notice test methods to measure the standby mode and off mode energy of hydronic air handlers that are identical to those specified in the DOE test procedure for residential furnaces and boilers (10 CFR part 430, subpart B, appendix N, section 8.0). On September 13, 2011, DOE published a NOPR to update the DOE test procedure for furnaces through incorporation by reference of the latest edition of the relevant industry standard, specifically IEC Standard 62301 (Second Edition). 75 FR 56339. DOE proposes to also adopt the updates proposed in the September 2011 furnaces test procedure NOPR for measurement of standby mode and off mode energy of furnace fans incorporated in hydronic air handlers. DOE believes these methods are appropriate, because both furnaces and hydronic air handlers are used primarily in central heating applications, and DOE expects that the electrical systems (i.e., electrical components and controls) of hydronic air handlers are similar to the electrical systems of furnaces. DOE proposes to integrate the steady-state standby mode and off mode electrical energy consumption measurements for hydronic air handlers, E_{SB} and E_{OFF}, into the active mode metric for these furnace fans, as required by EPCA. DOE proposes to weight the standby mode and off mode measurements by the representative hours proposed for these modes. The hours associated with these modes are discussed in section III.D. Similar to furnaces, DOE expects that hydronic air handlers are not typically equipped with a seasonal off switch or that consumers would not turn off power to the hydronic air handler. Therefore, DOE expects that E_{OFF} and the estimated annual off mode operating hours, HO, would effectively be equal to zero. The integrated metric for hydronic air handlers is described in more detail in section III.H. DOE seeks comment on whether the methods for measuring standby mode and off mode energy consumption specified in the DOE test procedure for residential furnaces and boilers are appropriate for hydronic air handlers. DOE notes that this integration of standby mode and off mode hours is proposed only for hydronic air handlers, since, as discussed above, the energy use of these modes is already addressed in other established or proposed metrics for the other furnace fan products covered by this rulemaking. DOE further seeks comment on whether hydronic air handlers are typically equipped with a seasonal off switch or if consumers would turn off power to the hydronic air handler. If so, DOE also requests comment on the expected off mode electrical energy consumption, the number of hours that should be allocated to standby mode and the number that should be allocated to off mode, as well as data to support these allocations.

H. Methodology for Deriving the Fan Efficiency Rating

First, three determinations (i.e., measurements of airflow and electrical consumption at a measured ESP) will be made for each rating airflow-control setting according to the methods proposed in this notice and incorporated by reference and modified from ANSI/AMCA 210-07. DOE proposes to specify determinations at: (1) 0.1 in.w.c.; (2) an ESP equal to the applicable reference system ESP divided by 2; and (3) an ESP between the applicable reference system ESP and 0.1 in.w.c. above that reference system ESP. DOE proposes the following calculations to derive FER using these measured values. First, fit separate quadratic curves to the airflow and ESP measurements of the determinations for each rating airflow-control setting to derive a performance curve (relates airflow to ESP). The best-fit relationship would minimize the sum of the squares of the differences between the measured and calculated airflow rates of the three determinations. The derived quadratic performance curves should express airflow as a function of ESP in the following form:

$$Q_i = a_i ESP^2 + b_i ESP + c_i$$

Where:

Q_i = airflow in cfm for rating airflow-control setting i;

ESP = external static pressure in in.w.c.; and

a_i, b_i, c_i = quadratic coefficients for rating airflow-control setting i.

Next, calculate the reference system airflow using the quadratic performance curve derived for the maximum airflow-control setting and the appropriate reference system ESP, ESP_{ref}, for the product (see

Table III.4). Using this maximum airflow, Q_{max}, determine the reference system curve coefficient, K_{ref}, as follows:

$$K_{ref} = \frac{ESP_{ref}}{Q_{max}^2}$$

Where:

K_{ref}= a constant that characterizes the reference system;

ESP_{ref}= specified reference system external static pressure in in.w.c.; and

Q_{max}= airflow in maximum airflow control setting at ESP_{ref}, in cfm.

The intersections of the reference system curve and the performance curves of each rating airflow-control setting are the expected operating points for the furnace fan in ducting with the characteristics of the reference system. Determine the airflows of the operating points in the other (non-maximum) rating airflow-control settings by identifying at which airflows the reference system curve intersects each performance curve. Do this by solving separately for each control setting the set of two equations representing the reference system curve and performance curve. To calculate the ESPs of the operating points, use the previously calculated airflows and the reference system equation.

Electrical consumption at the operating points is determined using curve fits for power input derived from the power measurements made for the rating airflow-control settings. Fit a separate quadratic curve to the electrical consumption and ESP measurements made for each airflow-control setting to derive an equation providing electrical consumption as a function of ESP for each rating airflow-control setting in the following form:

$$E_i = x_i ESP^2 + y_i ESP + z_i$$

Where:

E_i = electrical consumption in watts for rating airflow-control setting i;

ESP = external static pressure in in.w.c.; and

x_i, y_i, z_i = quadratic coefficients for rating airflow-control setting i.

Input the previously calculated ESPs of the operating points into the electrical consumption curve to derive the expected electrical consumption at the operating point for each rating airflow-control setting. Use these electrical consumption measurements to calculate FER.

A general form of the FER equation is as follows:

$$FER = \frac{(CH \times E_{max}) + (HH \times E_{heat}) + (CCH \times E_{circ}) + (SBH \times E_{SB}) + (OH \times E_{OFF})}{(CH + HH + CCH + SBH + OH) \times Q_{max}} \times 1000$$

Where:

FER= fan efficiency rating in watts/1000 cfm;

CH= annual furnace fan cooling operating hours;

E_{max}= electrical consumption at maximum airflow-control setting operating point;

HH= annual furnace fan heating operating hours;

E_{heat}= electrical consumption at the default heating airflow-control setting operating point for units with single-stage heating or the default low-heating airflow control setting operating point for units with multi-stage heating;

CCH= annual furnace fan constant circulation hours;

E_{circ}= electrical consumption at the default constant-circulation airflow-control setting operating point (or lowest default airflow-control setting operating point if a default constant-circulation airflow-control setting is not specified);

SBH= annual furnace fan standby mode operating hours;

E_{SB}= electrical consumption in standby mode;

OH= annual furnace fan off mode operating hours;

E_{OFF}= electrical consumption in off mode;

Q_{max}= airflow at maximum airflow-control setting operating point; and

1000= constant to put metric in terms of watts/1000 cfm, which is consistent with industry practice.

There are a number of variations of the FER equation depending on the product type. For furnace fans used in HVAC products other than hydronic air handlers, standby mode and off mode electrical energy consumption is not integrated in the FER calculation, because such energy consumption is captured in other test procedure provisions. The standby mode and off mode variables (i.e., SBH, E_{SB}, OH, and E_{OFF}) are eliminated from the above equation as a result. For furnace fans used in hydronic air handlers, electrical energy consumption in standby mode and off mode is integrated in the FER metric. DOE proposes to designate the hydronic air handler variation of the FER metric as integrated fan efficiency rating (IFER). Section III.G includes a detailed discussion addressing standby mode and off mode electrical energy consumption. For hydronic air handlers that are used in both heating and cooling applications, all terms shown in the above equation are used in the calculation. For hydronic air handlers that are not used in cooling applications, the cooling mode energy consumption is excluded from the equation. For single-stage, heating-only products, E_{heat} equals E_{max}. For multi-stage, heating-only products, the reference system is still defined by the maximum airflow-control setting (expected to be the default high-heat setting), but E_{heat} is the electrical consumption in the default low-heat airflow control setting. For non-hydronic air handler products (i.e., weatherized and non-weatherized gas furnaces, oil-fired furnaces, electric furnaces, and modular blowers), the standby mode energy consumption is excluded from the calculation, because electrical energy consumption in this mode is already fully accounted for in other established or proposed DOE test procedures, as described in Table III.5.

Table III.6 presents the proposed values for the operating hour variables in the above FER equations.

Table III.6: Proposed Operating Hour Values for Calculating FER

Operating Mode	**Variable**	**Single-Stage** (hours)	**Multi-Stage** (hours)

Heating mode	HH	830	830 / HCR
Circulation mode	CCH	400	400
Cooling mode	CH	640	640
Off mode (if applicable)	OH	0	0
Standby (if applicable)	SBH	8760-HH-CCH-CH-OH	8760-HH-CCH-CH-OH

I. Sampling Plans and Certification Report Requirements for Residential Furnace Fans

DOE provides sampling plans for all covered products. The purpose of these sampling plans is to provide uniform statistical quality for the various test procedure representations of energy consumption and energy efficiency for each covered product. These sampling plans apply to all aspects of the EPCA program for consumer products, including public representations, labeling, and energy conservation standards. 10 CFR 429.11 DOE proposes that the existing sampling plans used for furnaces be adopted and applied to measures of energy consumption for furnace fans, with some exceptions as noted in the discussion below.

For purposes of certification testing, the determination that a basic model complies with the applicable energy conservation standard must be based on testing conducted using DOE's test procedures and the sampling procedures, which are found at 10 CFR 429.18 for residential furnaces. The sampling procedures provide that "a sample of sufficient size shall be randomly selected and tested to ensure [compliance]." A minimum of two units must be tested to certify a basic model as compliant. This minimum is implicit in the requirement to calculate a mean – an average – which requires at least two values. Under no circumstances is a sample size of one (1) authorized. Manufacturers may need to test more than two samples depending on the variability of their sample. Therefore, the sample size can be an important element when evaluating the compliance of a basic model.

DOE uses statistically meaningful sampling procedures for selecting test specimens of residential products, which would require the manufacturer to select a sample at random from a production line and, after each unit or group of units is tested, either accept the sample or continue sampling and testing additional units until a rating determination can be made. DOE did not propose a specific sample size for each product because the sample size is determined by the validity of the sample and how the mean compares to the standard, factors which cannot be determined in advance.

In this notice, DOE proposes to create a provision at 10 CFR 429.55 for furnace fan certification. This section would include sampling procedures and certification report requirements for furnace fans. DOE proposes that 10 CFR 429.55 adopt, for furnace fans, the same statistical sampling procedures that are applicable to residential furnaces, which are contained in 10 CFR 429.18. DOE proposes that these statistical sampling procedures be applied to covered products addressed by the test procedures in this NOPR. DOE believes product variability and measurement repeatability associated with the electrical energy consumption measurements proposed for rating residential furnace fans are similar to the variability and measurement repeatability associated with electrical energy consumption measurement required for residential furnaces. Hence, DOE believes that the existing statistical sampling procedures for furnace measures of energy consumption and efficiency are appropriate for the corresponding measures for furnace fans.

Although the statistical sampling procedures would be the same for furnaces and furnace fans, DOE proposes to create the new section 429.55 within 10 CFR part 429, because certification reporting requirements for furnace fans will be different than those specified for furnaces. DOE proposes that this section specify reporting of the general certification report requirements within 10 CFR 429.12, as well as the following additional information in certification reports for furnace fans:

- Residential furnace fans used in HVAC products other than hydronic air-handlers: The fan efficiency rating (FER) in watts per thousand cubic feet per minute (W/cfm); the maximum airflow capacity at the reference system external static pressure (ESP) in cubic feet per minute (cfm); whether the HVAC product has multi-stage or modulating heating, and if so, the maximum and minimum output heat capacities in British thermal units per hour (Btu/h); and whether the HVAC product is designated for use in manufactured homes.
- Residential furnace fans used in hydronic air-handlers: The integrated fan efficiency rating (IFER) in watts per thousand cubic feet per minute (W/cfm); the maximum airflow capacity at the reference system ESP in cubic feet per minute (cfm); whether the HVAC product has multi-stage or modulating heating, and if so, the maximum and minimum output heat capacities in British thermal units per hour (Btu/h); and whether the HVAC product is designated for use in manufactured homes.

DOE requests comment on whether the sampling plan specified in 10 CFR 429.18 for residential furnaces is appropriate for residential furnace fans. DOE also requests comment on whether the proposed certification report requirements are appropriate. (See Issue 10 under "Issues on Which DOE Seeks Comment" in section V.E of this NOPR.)

IV.Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

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

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.) requires preparation of an initial regulatory flexibility analysis (IFRA) for any rule that by law must be proposed for public comment and a final regulatory flexibility analysis (FRFA) for any such rule that an agency adopts as a final rule, 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's procedures and policies may be viewed on the Office of the General Counsel's Web site (www.gc.doe.gov).

DOE reviewed today's proposed rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. 68 FR 7990. DOE has tentatively concluded that the proposed rule would not have a significant economic impact on a substantial number of small entities under the provisions of the Regulatory Flexibility Act. The factual basis for this certification is as follows:

The Small Business Administration (SBA) considers an entity to be a small business if, together with its affiliates, it employs fewer than a threshold number of workers specified in 13 CFR part 121. The threshold values set forth in these regulations use size standards and codes established by the North American Industry Classification System (NAICS) that are available at: http://www.sba.gov/sites/default/files/Size_Standards_Table.pdf. The threshold number for NAICS classification for 333415, which applies to Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing (including furnace fan manufacturers) is 750 employees.[30] DOE reviewed the Air-Conditioning, Heating, and Refrigeration Institute's Directory of Certified Product Performance for Residential Furnaces and Boilers (2009),[31] the ENERGY STAR Product Databases for Gas and Oil Furnaces (May 15, 2009),[32] the California Energy Commission's Appliance Database for Residential Furnaces and Boilers,[33] and the Consortium for Energy Efficiency's Qualifying Furnace and

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[30] U.S. Small Business Administration, Table of Small Business Size Standards (August 22, 2008) (Available at: http://www.sba.gov/sites/default/files/Size_Standards_Table.pdf).

[31] The Air-Conditioning, Heating, and Refrigeration Institute, Directory of Certified Product Performance (June 2009) (Available at: *http:// www.ahridirectory.org/ahridirectory/pages/home.aspx).*

[32] The U.S. Environmental Protection Agency and the U.S. Department of Energy, ENERGY STAR Furnaces—Product Databases for Gas and Oil Furnaces (May 15, 2009) (Available at: *http://www.energystar.gov/ index.cfm?c=furnaces.pr_furnaces).*

[33] The California Energy Commission, Appliance Database for Residential Furnaces and Boilers (2009) (Available at: *http://www.appliances.energy.ca.gov/ QuickSearch.aspx).*

Boiler List (April 2, 2009).[34] From this review, DOE found 11 small businesses within the furnace fan industry. DOE does not believe the test procedure amendments described in this proposed rule would represent a substantial burden to any manufacturer, including small manufacturers, as explained below. DOE requests comments on its characterization of the furnace fan industry in terms of the number of and impacts on small businesses.

This proposed rule would establish test procedures that would be used for representations of energy use and to test compliance with new energy conservation standards, which are being developed in a concurrent rulemaking, for the products that are the subject of this rulemaking. This notice proposes new test procedures for active mode testing for all covered products, and, for furnace fans used in hydronic air handlers, it proposes test procedures for standby mode and off mode testing as well. For active mode testing, the proposed rule would require the use of the testing methods prescribed in ANSI/AMCA 210-07. As discussed in section III.C above, this would not represent a substantial burden to any furnace fan manufacturer, small or large. According to AHRI, the trade organization that represents manufacturers of furnace fans, manufacturers currently routinely perform furnace fan tests according to ANSI/AMCA 210-07 to generate airflow data for intended application of products (AHRI, No. 21 at pp. 3,4). Therefore, DOE expects little or no additional cost as the result of the new test procedure. If there were to be a new manufacturer which does not own the necessary equipment (i.e., an ANSI/AMCA 210-07-compliant airflow chamber), DOE anticipates an investment of less than $150,000 would be required to both acquire it and to train personnel to use it properly. Alternatively, a manufacturer

[34] Consortium of Energy Efficiency, Qualifying Furnace and Boiler List (April 2, 2009) (Available at: *http:// www.ceedirectory.org/ceedirectory/pages/cee/ ceeDirectoryInfo.aspx).*

could conduct testing through an independent third-party facility. In DOE's experience, third-party active mode furnace fan testing costs less than $2,000 per test. DOE estimates

the time to complete a single active mode furnace fan test according to the proposed test procedure to be 3 to 4 hours, including setup.

For standby mode and off mode testing, the proposed rule would require the use of the testing methods prescribed in IEC Standard 62301 (Second Edition). As discussed in section III.G, the proposed rule would only result in additional testing related to standby mode and off mode electrical energy consumption for manufacturers of furnace fans used in hydronic air handlers. Manufacturers of furnace fans used in HVAC products other than hydronic air handlers are (or will be) required to conduct standby mode and off mode testing pursuant to other rulemakings. DOE expects that furnace fan manufacturers would incur no additional equipment costs as a result of the proposed standby mode and off mode testing because an electrical power meter is already required to conduct the proposed active mode testing. Also, manufacturers of furnace fans used in hydronic air handlers are often manufacturers of furnace fans used in other HVAC products. These manufacturers should already possess or will have to purchase an electrical power meter as a result of other rulemakings that require standby mode and off mode testing of the non-hydronic products covered in this rulemaking. DOE estimates the cost per unit for standby mode and off mode testing to be less than $300 and the time to complete a single standby mode and off mode test according to the proposed test procedure to be less than one hour.

Even in the unlikely scenario that a small manufacturer with low annual shipments has to purchase testing equipment or contract with a third-party test facility as a result of this rule, DOE estimates that the per-unit investment would not be significant. For example, a small manufacturer that ships 1,000 units per year could choose to purchase the necessary equipment for approximately $150,000. DOE estimates that, over the life of the test equipment (20 years), the additional cost of testing for the manufacturer would be $7.50 per unit shipped. A less costly option for the same manufacturer would be to use third-party testing to certify its products. In this scenario, the small manufacturer would likely pay less than $2,300 per test for at least two tests to certify one new product every two years. DOE estimates that this would cost the small manufacturer $2.30 per unit shipped. DOE finds that the selling price for HVAC products that incorporate furnace fans ranges from approximately $400 to $4,000. Therefore, the added cost of testing, at most, would be less than 2 percent of the manufacturer selling price (and lower than 0.1 percent in some cases).

For these reasons, DOE certifies that the proposed rule, if adopted, would not have a significant economic impact on a substantial number of small entities. Accordingly, DOE has not prepared a regulatory flexibility analysis for this rulemaking. DOE will provide its certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the SBA for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

There is currently no information collection requirement related to the test procedure for residential furnace fans. In the event that DOE proposes an energy conservation standard with which manufacturers must demonstrate compliance, or otherwise proposes to require the collection of information derived from the testing of residential furnace fans according to this test procedure, DOE will seek OMB approval of such information collection requirement.

Manufacturers of covered products must certify to DOE that their products comply with any applicable energy conservation standard. In certifying compliance, manufacturers must test their products according to the applicable DOE test procedure, including any amendments adopted for that test procedure.

DOE established regulations for the certification and recordkeeping requirements for certain covered consumer products and commercial equipment. 76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping was subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement was approved by OMB under OMB Control Number 1910-1400. Public reporting burden for the certification was 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.

As stated above, in the event DOE proposes an energy conservation standard for residential furnace fans with which manufacturers must demonstrate compliance, DOE will seek OMB approval of the associated information collection requirement. DOE will seek approval either through a proposed amendment to the information collection requirement approved under

OMB control number 1910-1400 or as a separate proposed information collection requirement.

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

D. Review Under the National Environmental Policy Act of 1969

In this notice of proposed rulemaking, DOE proposes a new test procedure for furnace fans. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this rule proposes a test procedure without affecting the amount, quality or distribution of energy usage, and, therefore, will not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A5 under 10 CFR part 1021, subpart D, which applies to any rulemaking that does not result in any environmental impacts. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (August 10, 1999) imposes certain requirements on Federal 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 tentatively 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 today's 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. With regard to the review required by section 3(a), 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. No. 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 "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. DOE's policy statement is also available at www.gc.doe.gov. DOE examined today's 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 by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100 million or more in any year. Accordingly, no assessment or analysis is required under UMRA.

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 Federal agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed today's 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 OIRA at OMB, a Statement of Energy Effects for any significant energy action. A "significant energy action" is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that: (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must provide 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.

DOE has tentatively concluded that today's regulatory action, which would prescribe the test procedure for measuring the energy efficiency of residential furnace fans, is not a significant energy action because the proposed test procedure is not a significant regulatory action under Executive Order 12866 and is not likely to 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. Accordingly, DOE has not prepared a Statement of Energy Effects on the proposed rule.

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), DOE must comply with all laws applicable to the former Federal Energy Administration, including section 32 of the Federal Energy Administration Act of 1974 (Pub. L. 93-275), as amended by the Federal Energy Administration Authorization Act of 1977. (Pub. L. 95-70) 15 U.S.C. 788. Section 32 provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

The proposed rule incorporates testing methods contained in ANSI/AMCA 210-07 | ANSI/ASHRAE 51-07, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating"; IEC Standard 62301(Second Edition), "Household electrical appliances – Measurement of standby power;" and ANSI/ASHRAE Standard 103, "Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers." While today's proposed test procedure is not exclusively based on these standards, some components of the DOE test procedure would adopt definitions, test setup, measurement techniques, and additional calculations from them without amendment. The Department 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 Chairman 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. Any foreign national wishing to participate in the meeting should advise DOE of this fact as soon as possible by contacting Ms. Brenda Edwards in order to initiate the necessary 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 website at: http://www1.eere.energy.gov/buildings/appliance_standards/residential/furnace_fans.html. Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Requests to Speak and Prepared General Statements For Distribution

Any person who has an interest in the topics addressed in this notice, or who is representative of a group or class of persons that has an interest in these issues, may request an opportunity to make an oral presentation at the public meeting. Such persons may hand-deliver requests to speak to the address show in the **ADDRESSES** section at the beginning of this notice between 9:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays. Requests may also be sent by mail or email to Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC 20585-0121, or Brenda.Edwards@ee.doe.gov. Persons who wish to speak should include in their request a computer diskette or CD-ROM in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format that briefly describes the nature of their interest in this rulemaking and the topics they wish to discuss. Such persons should also provide a daytime telephone number where they can be reached.

DOE requests persons selected to make an oral presentation to submit an advance copy of their statements at least one week before the public meeting. DOE may permit persons who cannot supply an advance copy of their statement to participate, if those persons have made advance alternative arrangements with the Building Technologies Program. As necessary, request to give an oral presentation should ask for such alternative arrangements.

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 notice. 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 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. There shall not be discussion of proprietary information, costs or prices, market share, or other commercial matters regulated by U.S. anti-trust laws. After the public meeting, interested parties may submit further comments on the proceedings, as well as on any aspect of the rulemaking, until the end of the comment period.

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 allow, 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 posted on the DOE website and will be included in the docket, which can be viewed as described in the Docket section at the beginning of this notice. 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 notice.

Submitting comments via www.regulations.gov. The www.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 itself 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. Otherwise, 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 www.regulations.gov information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (CBI)). Comments submitted through www.regulations.gov cannot be claimed as CBI. Comments received through the website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through www.regulations.gov before posting.

Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that www.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 www.regulations.gov. If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information in a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via mail or hand delivery/courier, please provide all items on a compact disk (CD), if feasible, in which case it is not necessary to submit printed copies. No telefacsimiles (faxes) will be accepted.

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

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

Confidential Business Information. Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery/courier 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. Airflow-Control Setting Function Designations

DOE is aware that furnace fan control schemes typically include airflow-control settings (i.e., set ranges of differing operating airflows), each often designated for specific functions (e.g., cooling, heating, and circulation). DOE found that the maximum airflow-control setting is often designated for cooling operation, that median default airflow-control settings are designated for heating operation, and that the lowest default airflow-control setting is designated for constant-circulation operation. DOE is aware, however, that airflow-control settings are not always designated for the same function across all products, models, and manufacturers. DOE is also aware that some furnace fans have more than three airflow-control settings and that multiple airflow-control settings can be designated for heating and/or cooling in multi-stage products. DOE seeks comment on the appropriateness of the proposed assumptions regarding which airflow-control settings are designated for which functions and whether these assumed designations are appropriate for deriving FER. DOE also seeks comment on airflow-control setting designations for multi-stage products.

2. Operating Hour Values for Calculating the Fan Efficiency Rating

DOE is aware that climate conditions and consumer behavior vary in the United States. DOE's proposed furnace fan annual operating hour values are intended to be representative of the national average operating hours that furnace fans are expected to spend performing each primary function: cooling, heating, and constant-circulation. DOE proposes to specify one set of annual operating hours for products with single-stage heating and another for products with multi-stage or modulating heating. DOE does not propose to account for multi-stage cooling, because detailed characteristics of the cooling system with which furnace fan HVAC products are paired, such as the presence and capacity of low-stage cooling, are not known. In addition, multi-stage heating is not necessarily associated with multi-stage cooling capability (e.g., multi-stage cooling is much less common than multi-stage furnace equipment). DOE also requests comments on whether hydronic air handlers are designed to provide multi-stage or modulated heat. DOE requests comments on whether the proposed operating hour values and proposed rating airflow-control settings are appropriate for rating multi-stage and modulating hydronic air handlers.

Table V.1 below summarizes the proposed operating hour values to be specified for calculating FER.

Table V.1: Proposed Average Annual Operating Hours by Mode

Operating Mode	Variable	Single-Stage (hours)	Multi-Stage (hours)
Heating mode	HH	830	830 / HCR
Circulation mode	CCH	400	400

Cooling mode	CH	640	640
Off mode (if applicable)	OH	0	0
Standby mode (if applicable)	SBH	8760-HH-CCH-CH-OH	8760-HH-CCH-CH-OH

DOE requests comment on whether the proposed operating hour values are reasonable estimations of national average operating hours for each furnace fan function. DOE also requests comment on the methodology and assumptions used to estimate these values, which are described in detail in section III.D.

3. Reference System ESP Values

As described in section III.E, DOE compiled field ESP data to determine reference system ESP values that are representative of field conditions. Based on the data collected, DOE proposes the reference system ESP values in

Table V.2 below for the four identified installation types.

Table V.2: Proposed Reference System ESP Values by Installation Type

Installation Type	Weighted Average ESP (in. w.c.)
Heating-only units	0.50
Units with an internal evaporator coil	0.50
Units designed to be paired with an evaporator coil	0.65
Manufactured homes[35]	0.30

[35] Manufactured home external static pressure is much smaller due to the fact there is no return air duct work in manufactured homes. Also, HUD requirements stipulate that the duct work for cooling should be set at 0.3 in. w.c.

DOE seeks comment and data regarding these values and the assumptions used to estimate them, which are detailed in section III.E, are appropriate. DOE also seeks comment on whether the specified reference system ESP should vary with the HVAC product capacity.

4. Multiple Reference System Method

DOE is aware that field ESPs can be higher than recommended by manufacturers. DOE is also aware that CSA considered rating fan performance in multiple reference systems for the finalized version of CSA C823: one at 0.3 in.w.c. in the heating speed to represent a manufacturer-recommended installation, and one at 0.6 in.w.c. in the heating speed to be more representative of a typical (poor) field installation. A multiple-reference system rating metric would specify reference systems to represent the expected range of installations. DOE expects that a furnace fan may provide enough airflow for 4 tons of cooling in a house with generously-sized ducts, but it may only provide enough airflow for 3 tons of cooling in a house with a more restrictive duct system. Therefore, a furnace fan with these performance characteristics might be installed in 2-ton to 4-ton cooling systems in large-duct houses and 1.5-ton to 3-ton cooling systems in tight-duct houses. DOE recognizes that rating the furnace fan using one reference system defined by a high ESP and one reference system defined by a low ESP (determined by statistical methods from field ESP data) could give a good indication of the ability of the furnace fan to provide good performance over a range of ESP. DOE investigated the use of a combined, multi-reference system FER, but found that it provided no additional useful information compared to the proposed, single-reference system FER. This comparison is discussed in detail in section III.E. DOE requests comment on multiple-reference system rating approaches and whether they would give a better indication of the overall performance, as compared to the proposed single reference system approach.

5. Standby Mode and Off Mode Electrical Energy Consumption for Furnace Fans Used in Hydronic Air Handlers

DOE proposes to incorporate in this test procedure the methods specified in the DOE test procedure for residential furnaces and boilers (10 CFR part 430, subpart B, appendix N, section 8.0) to measure the standby mode and off mode energy consumption for furnace fans used in hydronic air handlers. On September 13, 2011, DOE published a NOPR to update the DOE test procedure for furnaces through incorporation by reference of the latest edition of the industry standard, specifically IEC Standard 62301 (Second Edition). 76 FR 56339. DOE proposes to also adopt the updates proposed in the September 2011 furnaces test procedure NOPR for measurement of standby mode and off mode energy of furnace fans incorporated in hydronic air handlers. The standby mode and off mode electrical energy consumption of the other HVAC products discussed in this notice are already fully accounted for in other proposed or established DOE test procedures. DOE believes the methods specified in the DOE test procedure for residential furnaces and boilers to measure the standby mode and off mode energy consumption are appropriate because both furnaces and hydronic air handlers are used primarily in central heating applications, and DOE expects that the electrical systems (i.e., components and controls) of hydronic air handlers are similar to the electrical systems of furnaces. DOE seeks comment on whether the assumed similarities between the electrical systems of furnaces and hydronic air handlers are appropriate.

DOE proposes to integrate the standby mode and off mode electrical energy consumption measurements , E_{SB} and E_{OFF}, with the active mode metric for hydronic air handlers. DOE seeks comment on whether the methods for measuring standby mode and off mode energy consumption specified in the DOE test procedure for residential furnaces and boilers are appropriate for hydronic air handlers. As mentioned previously, similar to furnaces, DOE expects that hydronic air handlers are not typically equipped with a seasonal off switch or that consumers would turn off power to the hydronic air handler. Therefore, DOE expects that E_{OFF} and the estimated annual off mode operating hours, HO, would effectively be equal to zero. DOE seeks comment on whether hydronic air handlers have a seasonal off switch or consumers would turn off power to the hydronic air handler. If so, DOE also requests comment on the expected electrical energy consumption in off mode, the number of hours that should be allocated to standby mode, and the number of hours that should be allocated to off mode, as well as data to support these allocations.

6. Controlling ECM Motors for Testing

DOE is aware that higher-efficiency motors have complicated control schemes that make selecting their available airflow-control settings during performance testing difficult. The ability to select and operate a furnace fan in multiple airflow-control settings is imperative to conducting the proposed test procedure as intended and to derive FER. While this may be simple for manufacturers who are familiar with HVAC controls, independent test labs may need guidance. Therefore, DOE seeks comment on the appropriateness of the proposed test procedures for controlling furnace fans that use higher-efficiency motors, including recommendations for any necessary modifications.

7. Test Setup

DOE recognizes that ANSI/AMCA 210-07 includes 16 setup variations. DOE requests comments on which of these setups are best-suited for the purposes of this test procedure. DOE expects that the blow-through setups, such as test setup 12, may be more appropriate than pull-through setups, such as setup 13, because they are more representative of typical installations of the HVAC products discussed in this notice. DOE also requests comments on whether any of these test setups are inappropriate and should be disallowed for the purposes of this test procedure.

8. External Static Pressure

DOE expects that measurements referred to as "external static pressure" in manufacturer product literature are the same as "fan static pressure" measurements in ANSI/AMCA 210-07 (ANSI/AMCA 210-07 section 3.1.25). The ANSI/AMCA 210-07 "fan static pressure" measurement is defined to be equal to the outlet total pressure minus the inlet total pressure minus the outlet velocity pressure. Therefore, this notice proposes an equivalent definition for "external static pressure." However, DOE notes that this value is not equal to the difference between outlet and inlet static pressure—it is less than such a difference by an amount equal to the inlet velocity pressure. DOE requests comments on the proposed definition of "external static pressure" and whether DOE is correct in assuming that external static pressure ratings reported in product literature are equivalent to ANSI/AMCA 210-07 fan static pressure measurements.

9. Ambient Pressure Conditions

DOE is aware that barometric pressure changes may have an impact on test measurement results and notes that the ANSI/AMCA 210-07 standard does not appear to include correction for this effect. DOE requests comment on whether any limitations on the barometric pressure range or adjustments to address the impact of barometric pressure should be included in the test procedure.

10. Sampling Plan Procedures and Certification Report Requirements

DOE proposes to adopt the existing sampling plan procedures applicable to residential furnaces for certification of residential furnace fans. DOE requests comments on whether the sampling plan procedures for residential furnaces are appropriate for representation and certification of residential furnace fans measures of electrical energy consumption. DOE also proposes to specify the general certification report requirements within 10 CFR 429.12, as well as the following additional information in certification reports for furnace fans:

- Residential furnace fans used in HVAC products other than hydronic air-handlers: The represented value of fan efficiency rating (FER) in watts per thousand cubic feet per minute (W/cfm); the maximum airflow capacity at the reference system ESP in cubic feet per minute (cfm); whether the HVAC product has multi-stage or modulating heating, and if so, the maximum and minimum output heat capacities in British thermal units per hour (Btu/h); and whether the HVAC product is designated for use in manufactured homes.

- Residential furnace fans used in hydronic air-handlers: The represented value of integrated fan efficiency rating (IFER) in watts per thousand cubic feet per minute (W/cfm); the maximum airflow capacity at the reference system ESP in cubic feet per minute (cfm); whether the HVAC product has multi-stage or modulating heating, and if so, the maximum and minimum output heat capacities in British thermal units per hour (Btu/h); and whether the HVAC product is designated for use in manufactured homes.

DOE also requests comment on whether these certification report requirements are appropriate.

VI. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's notice of proposed rulemaking.

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 1, 2012.

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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, subchapter D, of Title 10 of the Code of Federal Regulations to read 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. Add new §429.55 to read as follows:

§ 429.55 Residential furnace fans.

(a) *Sampling plan for selection of units for testing.* (1) The requirements of §429.11 are applicable to residential furnace fans; and

(2) For each basic model of heating, ventilation, and air-conditioning (HVAC) product using a furnace fan, a sample of sufficient size shall be randomly selected and tested to ensure that any represented value of fan efficiency rating (FER) or integrated fan efficiency rating (IFER) for which consumers would favor lower values shall be greater than or equal to the higher of:

(i) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

And, $\bar{x}$ is the sample mean; n is the number of samples; and x_i is the ith sample;

Or,

(ii) The upper 97-1/2 percent confidence limit (UCL) of the true mean divided by 1.05, where:

$$UCL = \bar{x} + t_{0.975}\left(\frac{s}{\sqrt{n}}\right)$$

And $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.975}$ is the t statistic for a 97.5% one-tailed confidence interval with n-1 degrees of freedom (from Appendix A)

(b) *Certification reports*. (1) The requirements of §429.12 are applicable to residential furnace fans; and

(2) Pursuant to §429.12(b)(13), a certification report shall include the following public product-specific information:

(i) Residential furnace fans used in HVAC products other than hydronic air-handlers: The represented value of fan efficiency rating (FER) in watts per thousand cubic feet per minute (W/cfm); the maximum airflow capacity at the reference system ESP in cubic feet per minute (cfm); whether the HVAC product has multi-stage or modulating heating, and if so, the maximum and minimum output heat capacities in British thermal units per hour (Btu/h); and whether the HVAC product is designated for use in manufactured homes.

(ii) Residential furnace fans used in hydronic air-handlers: The represented value of integrated fan efficiency rating (IFER) in watts per thousand cubic feet per minute (W/cfm); the maximum airflow capacity at the reference system ESP in cubic feet per minute (cfm); whether the HVAC product has multi-stage or modulating heating, and if so, the maximum and minimum output heat capacities in British thermal units per hour (Btu/h); and whether the HVAC product is designated for use in manufactured homes.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

4. Section 430.3 is amended by:

a. Adding paragraph (d)(1);

b. Redesignating paragraphs (d)(1) through (d)(18) as (d)(2) through (d)(19);

c. Removing, in paragraph (f)(9) "and appendix N to subpart B" and adding in its place "appendix N and appendix AA to subpart B";

d. Removing, in paragraph (m)(2), "IBR approved for Appendix J2 and AA to subpart B" and adding in its place "IBR approved for appendix G, N, O, P, and AA" .

The addition reads as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(d) ANSI. * * *

(1) ANSI/AMCA 210-07 | ANSI/ASHRAE 51-07 ("ANSI/AMCA 210-07"), Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating, approved 2007,

IBR approved for Appendix AA to Subpart B.

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5. Section 430.23 is amended by adding a new paragraph (cc) to read as follows:

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

*   *   *   *   *

(cc) *Furnace Fans.* The energy efficiency of a residential furnace fan expressed in watts per1000 standard cubic feet per minute (scfm) to the nearest integer shall be calculated in accordance with section 6 of appendix AA of this subpart.

6. Appendix AA to subpart B of part 430 is added to read as follows:

Appendix AA to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Efficiency of Residential Furnace Fans

1. Scope. This appendix covers the test requirements used to measure the energy efficiency of residential furnace fans, including the energy use contributions of standby mode and off mode of residential furnace fans used in hydronic air handlers.

2. Definitions, Units of Measure, and Symbols. Definitions, units of measure, and symbols include the definitions, units of measure, and symbols specified in section 3 of ANSI/AMCA 210-07 (incorporated by reference, see §430.3) and the following additional and modified definitions, units of measure, and symbols:

2.1. Active mode means any the mode of operation in which the HVAC product is connected to a power source and circulating air through duct work.

2.2. Airflow-control setting means any distinct operating mode characterized by nominal fan speed or airflow that a furnace fan is programmed or wired to achieve when installed in accordance with manufacturer instructions and which is often designated for performing a specific HVAC function (e.g., cooling, heating, or constant-circulation).

2.3. ANSI/AMCA 210-07 means the test standard published by ANSI/AMCA 210-07 | ANSI/ASHRAE 51-07 titled "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating" (incorporated by reference, see §430.3).

2.4. Default airflow-control settings are the airflow-control settings that can be achieved in the factory-set control system configuration (i.e., without manual adjustment other than interaction with a user-operable control such as a thermostat).

2.5. External static pressure means the difference between the total pressure at the air outlet and the total pressure at the air inlet less velocity pressure at the air outlet of an HVAC product containing a furnace fan when operating and installed in accordance with the manufacturer's instructions. External static pressure does not include the pressure drop across appurtenances internal to the HVAC product.

2.6. Hydronic air handler means a furnace designed to supply heat through a system of ducts with air as the heating medium, in which heat is generated by hot water flowing through a hydronic heating coil and the heated air is circulated by means of a fan or blower.

2.7. Off mode means the mode of operation during which the HVAC product is not powered.

2.8. Residential furnace fan means an electrically-powered device used in residential central heating, ventilation, and air-conditioning (HVAC) systems for the purpose of circulating air through duct work.

2.9. Seasonal off switch means a switch on the HVAC product that, when activated, results in a measurable change in energy consumption between the standby and off modes.

2.10. Standby mode means the mode during which the HVAC product is connected to the power source and the furnace fan is not activated.

2.11. Symbols and subscripts. The following units of measure and symbols are provided in addition to those specified in section 3.2 of ANSI/AMCA 210-07 (incorporated by reference, see §430.3).

E_{circ}= furnace fan electrical consumption at the default constant-circulation airflow-control setting operating point (or lowest default airflow-control setting operating point if a default constant-circulation airflow-control setting is not specified), in watts

E_{heat}- furnace fan electrical consumption in the default heat airflow-control setting for single-stage heating products or the default low-heat setting for multi-stage heating products, in watts

CH = annual furnace fan cooling hours

CCH = annual furnace fan constant-circulation hours

E_{max} – furnace fan electrical consumption at the maximum airflow-control setting operating point, in watts

E_{OFF} = furnace fan electrical consumption in off mode, in watts

E_{SB} = furnace fan electrical consumption in standby mode, in watts

ESP – external static pressure, in in.w.c.

FER – Fan efficiency rating for furnace fans used in HVAC products other than hydronic air handlers, in watts per 1000 cfm at specified operating points

HH = annual furnace fan heating hours

IFER – Integrated fan efficiency rating for furnace fans used in hydronic air handlers, in watts per 1000 cfm at specified operating points

K_{ref} – physical descriptor characterizing the reference system

OH = annual furnace fan off mode operating hours

Q_{max} = airflow in the maximum airflow-control setting at the specified reference system ESP, in cfm

SBH = annual furnace fan standby mode operating hours

8760 = total annual hours

3. Instruments and Methods of Measure. Instruments and methods of measure are as specified in section 4 of ANSI/AMCA 210-07 (incorporated by reference, see §430.3), excluding those for mechanical measurement of fan input power and motor calibration (sections 4.4) and rotational speed (section 4.5). Instruments and methods of measure for active mode electrical power consumption are as specified in section 3.1 of this appendix.

3.1. Measurement of electrical active mode power consumption.

3.1.1. Electrical meter. An electrical meter shall have a certified accuracy of ±1% of the observed reading.

3.1.2. Voltage. Electrical power shall be supplied to the HVAC product in which the furnace fan is incorporated within 1% of the nameplate voltage for the duration of the test. If a dual voltage is used for nameplate voltage, maintain the electrical supply within 1% of the higher voltage.

4. Test Setups and Equipment. Test setups and equipment are as specified in section 5 of ANSI/AMCA 210-07 (incorporated by reference, see §430.3). Furnace fans shall be tested as factory-installed in the HVAC product in which they are integrated.

5. Observations and Conduct of Test. Observations and procedures for the conduct of test are as specified in section 6 of ANSI/AMCA 210-07 (incorporated by reference, see § 430.3), except for test data to be recorded related to rotational speed, beam load, or torque as specified in Table 3 of ANSI/AMCA 210-07. Additional observations and procedures for the conduct of test are as specified in section 5.1 of this appendix, which modifies section 6.1.1 of ANSI/AMCA 210-07. Observations and procedures for the conduct of test to measure standby mode and off mode energy consumption are as specified in section 5.2 of this appendix which modifies the methods specified in appendix N of subpart B of part 430 to be applicable to hydronic air handlers.

5.1. Determinations. Determinations shall be made at: (1) 0.1 in.w.c.; (2) an ESP equal to the applicable reference system ESP divided by 2; and (3) an ESP between the applicable reference system ESP and 0.1 in.w.c. above that reference system ESP. Determinations shall include measurements of input electrical power, external static pressure, and airflow.

5.2. Measurement of electrical standby mode and off mode power for hydronic air handlers.

5.2.1. Standby mode power measurement. With the hydronic air handler powered but with all electrical auxiliaries not activated, measure the standby mode power (E_{SB}) in accordance with the procedures in IEC Standard 6230, Edition 2.0, 2011–01 (incorporated by reference, see §430.3), except that section 8.5, "Room Ambient Temperature," of ASHRAE 103-1993 (incorporated by reference, see §430.3) and the voltage provision of section 8.2.1.4, "Electrical Supply," of ASHRAE 103—1993 shall apply in lieu of the corresponding provisions of IEC Standard 62301 at section 4.2, "Test room," and the voltage specification of section 4.3, "Power supply." Frequency shall be 60Hz. Clarifying further, IEC Standard 62301 section 4.4, "Power measurement instruments," and section 5, "Measurements," shall apply in lieu of section 6.10, "Energy Flow Rate," of ASHRAE 103—1993. Measure the wattage so that all possible standby mode wattage for the entire appliance is recorded, not just the standby mode wattage of a single auxiliary. The recorded standby power (E_{SB}) shall be rounded to the second decimal place, and for loads greater than or equal to 10W, at least three significant figures shall be reported.

5.2.2. Off mode power measurement. If the unit is equipped with a seasonal off switch or there is an expected difference between off mode power and standby mode power, measure off mode power (E_{OFF}) in accordance with applicable procedures in IEC Standard 62301, Edition 2.0, 2011–01 (incorporated by reference, see §430.3), except that section 8.5, "Room Ambient Temperature," of ASHRAE 103—1993 (incorporated by reference, see §430.3) and the voltage provision of section 8.2.1.4, "Electrical Supply," of ASHRAE 103—1993 shall apply in lieu of the corresponding provisions of IEC Standard 62301 at section 4.2, "Test room," and the voltage specification of section 4.3, "Power supply." Frequency shall be 60Hz. Clarifying further, IEC Standard 62301 section 4.4, "Power measurement instruments," and section 5, "Measurements," shall apply for this measurement in lieu of section 6.10, "Energy Flow Rate," of ASHRAE 103—1993. Measure the wattage so that all possible off mode wattage for the entire appliance is recorded, not just the off mode wattage of a single auxiliary. The recorded off mode power shall be rounded to the second decimal place, and for loads greater than or equal to 10W, at least three significant figures shall be reported.

6. Calculations. Calculations are as specified in section 7 of ANSI/AMCA 210-07 (incorporated by reference, see §430.3), except for sections 7.7 and 7.8, and as specified in section 6.1, 6.2, 6.3, 6.4, 6.5, and 6.6 of this appendix, which are supplemental to ANSI/AMCA 210-07.

6.1. Performance curve. A performance curve shall be determined for each rated airflow-control setting by fitting a quadratic curve to the three airflow and corresponding

ESP measurements taken for the determinations associated with that respective airflow-control setting. The derived quadratic performance curves is to express airflow as a function of ESP in the following form:

$$Q_i = a_i ESP^2 + b_i ESP + c_i$$

where:

Q_i = airflow in cfm for rating airflow-control setting i;

ESP = external static pressure in in.w.c.; and

a_i, b_i, c_i = quadratic coefficients for rating airflow-control setting i.

For products with single-stage heating, the rating airflow-control settings are the maximum setting, the default heating setting, and the default constant-circulation setting. For products with multi-stage heating or modulating heating, the rating airflow-control settings are the maximum setting, the default low-heating setting, and the default constant-circulation setting. For hydronic air handlers that are not designed to be paired with an evaporator coil, the rating airflow-control settings are the default heating setting (expected to be the maximum airflow-control setting) and the default constant-circulation setting. The lowest default airflow-control setting is used to represent constant circulation if a constant-circulation setting is not specified.

6.2. Electrical consumption curve. An electrical consumption curve shall be derived for each rated airflow-control setting by fitting a quadratic curve to the three electrical consumption measurements and corresponding ESP measurements taken for the determinations associated with that rating airflow-control setting. The derived quadratic electrical consumption curve is to express electrical consumption as a function of ESP in the following form:

$$E_i = x_i ESP^2 + y_i ESP + z_i$$

where:

E_i = electrical consumption in watts for rating airflow-control setting i;

ESP = external static pressure in in.w.c.; and

x_i,y_i,z_i = quadratic coefficients for rating airflow-control setting i.

6.3. Reference system curve. The reference system curve constant, K_{ref}, shall be derived as follows:

$$K_{ref} = \frac{ESP_{ref}}{Q_{max}^2}$$

where:

K_{ref} = a constant that characterizes the reference system;

ESP_{ref} = 0.65 in.w.c. for furnace fans used in products designed to be paired with an external cooling coil; 0.5 in.w.c. for heating-only products or furnace fans used in products with an internal cooling coil; and 0.3 for manufactured home products

$$Q_{max} = a_{max}^{2}ESP_{ref} + b_{max}ESP_{ref} + c_{max}$$

a_{max}, b_{max}, c_{max} = quadratic coefficients of the maximum airflow-control setting performance curve, as derived in section 6.1 of this appendix

6.4. Operating points. The operating point in the maximum airflow-control setting is defined by the reference system criteria: ESP_{ref} and Q_{max}. The operating points for the default heat and default constant-circulation settings shall be determined by finding the intersections of the performance curves for these rating airflow-control settings (determined as described in section 6.1 of this appendix) and the reference system curve ($ESP = K_{ref} Q^2$).

6.5. Electrical consumption. Electrical consumption at the operating points shall be derived by inputting the operating point ESPs identified, as specified in section 6.4 of this appendix, into the electrical consumption curve for each respective airflow-control setting, as derived in section 6.2 of this appendix.

6.6. Fan efficiency rating (FER) and integrated fan efficiency rating (IFER). The fan efficiency rating shall be derived by using the following equations and the specified operating hour values in Table 1 below.

6.6.1. Heating-only Hydronic Air Handlers. For heating-only hydronic air handlers, the cooling mode annual hours and energy consumption variable are eliminated, and the standby mode and off mode energy consumption is integrated with the active mode energy consumption. The IFER equation for heating-only hydronic air handlers is:

$$IFER_{heating-only} = \frac{(HH \times E_{heat}) + (CCH \times E_{circ}) + (SBH \times E_{SB}) + (OH \times E_{OFF})}{(\mathrm{HH} + \mathrm{CCH} + \mathrm{SBH} + \mathrm{OH}) \times Q_{max}} \times 1000$$

where:

$IFER_{heating-only}$ = fan efficiency rating in watts/1000 cfm for hydronic air handlers not designed to be paired with an external cooling coil;

HH = annual furnace fan heating operating hours;

E_{heat} = electrical consumption at the default heat airflow-control setting (i.e., maximum setting for single-stage) operating point;

CCH =annual furnace fan constant-circulation hours;

E_{circ} = electrical consumption at the default constant-circulation airflow-control setting operating point (or lowest default airflow-control setting operating point if no default constant-circulation setting is specified);

SBH =annual furnace fan standby mode operating hours;

E_{SB} = electrical consumption in standby mode;

OH = annual furnace fan off mode hours;

E_{OFF} =electrical consumption in off mode;

Q_{max} =airflow in maximum airflow-control setting at reference system ESP; and

1000 =constant to put metric in terms of watts/1000 cfm.

6.6.2. Hydronic Air Handlers Designed to be Paired with an Evaporator Coil. For hydronic air handlers designed to be paired with an evaporator coil, the variables for cooling mode consumption and operating hours are included, and standby mode and off mode energy consumption are integrated with the active mode energy consumption. The IFER equation for hydronic air handlers designed to be paired with an external cooling coil is:

$$IFER_{hydronic} = \frac{(CH \times E_{max}) + (HH \times E_{heat}) + (CCH \times E_{circ}) + (SBH \times E_{SB}) + (OH \times E_{OFF})}{(CH + HH + CCH + SBH + OH) \times Q_{max}} \times 1000$$

where:

$IFER_{hydronic}$ = fan efficiency rating in watts/1000 cfm for hydronic air handlers designed to be paired with an evaporator coil;

CH = annual furnace fan cooling operating hours;

E_{max} = electrical consumption at maximum airflow-control setting operating point;

HH = annual furnace fan heating operating hours;

E_{heat} = electrical consumption at the default heating airflow-control setting operating point for units with single-stage heating or the default low-heating setting operating point for units with multi-stage or modulating heating;

CCH = annual furnace fan constant-circulation hours;

E_{circ} = electrical consumption at the default constant-circulation airflow-control setting operating point (or lowest default airflow-control setting operating point if a default constant-circulation airflow-control setting is not specified);

SBH = annual furnace fan standby mode operating hours;

E_{SB} = electrical consumption in standby mode;

OH = annual furnace fan off mode hours;

E_{OFF} =electrical consumption in off mode;

Q_{max} = airflow in the maximum airflow-control at the reference system ESP; and

1000 = constant to put metric in terms of watts/1000 cfm.

6.6.3. Non-hydronic Air Handler Products. For weatherized and non-weatherized gas furnaces, oil furnaces, electric furnaces, and modular blowers, the standby mode and off mode energy consumption is excluded, and the FER equation is as follows:

$$FER = \frac{(CH \times E_{max}) + (HH \times E_{heat}) + (CCH \times E_{circ})}{(CH + HH + CCH) \times Q_{max}} \times 1000$$

where:

FER = fan efficiency rating in watts/1000 cfm for weatherized and non-weatherized gas furnaces, oil furnaces, electric furnaces, and modular blowers;

CH = annual furnace fan cooling operating hours;

E_{max} = electrical consumption in the maximum airflow-control setting at the reference system ESP;

HH = annual furnace fan heating operating hours;

E_{heat} = electrical consumption at the default heating airflow-control setting operating point for units with single-stage heating or the default low-heating airflow-control setting operating point for units with multi-stage or modulating heating;

CCH = annual furnace fan constant-circulation hours;

E_{circ} = electrical consumption at the default constant-circulation airflow-control setting operating point (or lowest default airflow-control setting operating point if a default constant-circulation airflow-control setting is not specified);

Q_{max} = airflow on the maximum airflow-control setting at the reference system ESP; and

1000 = constant to put metric in terms of watts/1000 cfm.

Table 1 includes the operating hour values to be used to calculate FER.

Table 1: Furnace Fan Annual Operating Hours for Calculating FER

Operating Mode	**Variable**	**Single-Stage** (hours)	**Multi-Stage** (hours)
Heating mode	HH	830	830 / HCR
Circulation mode	CCH	400	400
Cooling mode	CH	640	640
Off mode (if applicable)	OH	0	0
Standby mode (if applicable)	SBH	8760-HH-CCH-CH-OH	8760-HH-CCH-CH-OH

where:

HH = annual furnace fan heating operating hours;

HCR = heating capacity ratio (output capacity in lowest-heat mode divided by output capacity in highest-heat mode);

CCH = annual furnace fan constant-circulation operating hours;

CH = annual furnace fan cooling operating hours;

OH= annual furnace fan off mode operating hours; and

SBH = annual furnace fan standby mode operating hours.

7. <u>Report and results of test</u>. Test results and information shall be reported as

specified in section 8 of ANSI/AMCA 210-07 (incorporated by reference, see §430.3) and as specified in section 7.1 of this appendix.

7.1. Additional report information. The following additional test results and calculated values shall be reported: (1) fan efficiency rating (FER); (2) the airflow, ESP, and electrical consumption at each operating point, K_{ref}; and (3) the quadratic coefficients for the performance curve and electrical consumption curves for each rated airflow-control setting.

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