DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[EERE–2021–BT–TP–0021]

RIN 1904–AF17

Energy Conservation Program: Test Procedure for Fans and Blowers

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

ACTION: Final rule.

SUMMARY: The U.S. Department of Energy (''DOE'') establishes a test procedure for fans and blowers, including air circulating fans, and incorporates by reference the relevant industry test standards for: measuring the fan electrical input power and determining the fan energy index of fans and blowers other than air-circulating fans; and measuring the fan airflow in cubic feet per minute per watt of electric power input of air-circulating fans. In this final rule, DOE also establishes supporting definitions, requirements for alternative efficiency determination methods, and sampling requirements.

DATES: The effective date of this rule is May 31, 2023. All representations of energy efficiency and energy use, including those made on marketing materials and product labels, must be made in accordance with this test procedure beginning October 30, 2023. To the extent the test procedure established in this document is required only for the evaluation and issuance of newly established efficiency standards, use of the test procedure is not required until the implementation date of such new standards. The incorporation by reference of certain materials listed in the rule is approved by the Director of the Federal Register on May 31, 2023.

ADDRESSES: The docket, which includes **Federal Register** notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at *www.regulations.gov.* 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 those containing information that is exempt from public disclosure.

A link to the docket web page can be found at *www.regulations.gov/docket/EERE-2021-BT-TP-0021.* The docket web page contains instructions on how to access all documents, including public comments, in the docket.

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

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SUPPLEMENTARY INFORMATION:

DOE incorporates by reference the following industry standards into 10 CFR part 431:

ANSI/AMCA Standard 210–16 (AMCA 210–16), ''Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating,'' August 26, 2016. (Co-published as ASHRAE 51–16).

ANSI/AMCA Standard 214–21 (AMCA 214–21), ''Test Procedure for Calculating Fan Energy Index for Commercial and Industrial Fans and Blowers,'' March 1, 2021.

ANSI/AMCA Standard 230–23 (AMCA 230–23), ''Laboratory Methods of Testing Air Circulating Fans for Rating and Certification,'' February 10, 2023.

ANSI/AMCA Standard 240–15 (AMCA 240–15), ''Laboratory Methods of Testing Positive Pressure Ventilators for Aerodynamic Performance Rating,'' May 9, 2015.

Copies of AMCA 210–16, AMCA 214–21, AMCA 230–23, and AMCA 240–15 can be obtained from the Air Movement and Control Association International (AMCA), 30 West University Drive, Arlington Heights, IL 60004–1893, (847) 394–0150, or by going to *www.amca.org.*

ISO 5801:2017(E), ''Fans—Performance testing using standardized airways,'' Third Edition, September 2017.

ISO 80079–36:2016, ''Explosive atmospheres—Part 36: Non-electrical equipment for explosive atmospheres—Basic method and requirements,'' Edition 1.0, February 2016.

Copies of ISO 5801:2017(E) and ISO 80079–36:2016 can be obtained from the International Organization for Standardization (ISO), Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, or by going to *www.iso.org.*

UL 705 (UL 705–2022), ''Standard for Safety for Power Ventilators,'' Edition 7, July 19, 2017 (including revisions through August 19, 2022).

Copies of UL 705–2022 can be obtained from Underwriters Laboratories (UL), 333 Pfingsten Road, Northbrook, IL 60062 or *www.shopulstandards.com.*

For a further discussion of these standards, see section IV.N of this document.

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I. Authority and Background

On August 19, 2021, DOE published a coverage determination classifying fans and blowers as covered equipment under 42 U.S.C. 6311(2)(A) and 6312(b). 86 FR 46579 (''August 2021 Final Coverage Determination''). DOE does not currently have a test procedure or energy conservation standard for fans and blowers. The following sections discuss DOE's authority to establish a test procedure for fans and blowers and relevant background information regarding DOE's consideration of test procedures for this equipment.

A. Authority

The Energy Policy and Conservation Act, as amended (''EPCA''),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part C[2] of EPCA, added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency. EPCA provides that DOE may include a type of industrial equipment, including fans and blowers, as covered equipment if it determines that to do so is necessary to carry out the purposes of Part A–1. (42 U.S.C. 6311(2)(B)(ii) and (iii); 42 U.S.C. 6312(b)) EPCA specifies the types of equipment that can be classified as industrial equipment. (42 U.S.C. 6311(2)(B)) The purpose of Part A–1 is to improve the efficiency of electric motors and pumps and certain other industrial equipment in order to conserve the energy resources of the Nation. (42 U.S.C. 6312(a)) As stated, on August 19, 2021, DOE published a final determination in which DOE determined that fans and blowers meet the three statutory criteria for classifying industrial equipment as covered (42 U.S.C. 6311(2)(A)), because fans and blowers are a type of industrial equipment which: (1) in operation consume, or are designed to consume, energy; (2) are to a significant extent distributed in commerce for industrial or commercial use;[3] and (3) are not covered under 42 U.S.C. 6291(a)(2). 86 FR 46579, 46585–46588. DOE also determined that coverage of fans and blowers is necessary to carry out the purposes of Part A–1. 86 FR 46579, 46588.

The energy conservation program under EPCA consists essentially of four parts: (1) testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. Relevant provisions of EPCA include definitions (42 U.S.C. 6311), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), energy conservation standards (42 U.S.C. 6313), and the authority to require information and reports from manufacturers (42 U.S.C. 6316; 42 U.S.C. 6296).

The Federal testing requirements consist of test procedures that manufacturers of covered equipment must use as the basis for: (1) certifying to DOE that their equipment complies with the applicable energy conservation standards adopted pursuant to EPCA (42 U.S.C. 6316(a); 42 U.S.C. 6295(s)), and (2) making other representations about the efficiency of that equipment (42 U.S.C. 6314(d)). Similarly, DOE must use these test procedures to determine whether the equipment complies with relevant standards promulgated under EPCA. (42 U.S.C. 6316(a); 42 U.S.C. 6295(s))

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

Under 42 U.S.C. 6314, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered equipment. EPCA requires that any test procedures prescribed or amended under this section must be reasonably designed to produce test results which reflect energy efficiency, energy use or estimated annual operating cost of a given type of covered equipment during a representative average use cycle (as determined by the Secretary) and requires that test procedures not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2))

B. Background

As discussed, on August 19, 2021, DOE published in the **Federal Register** a final coverage determination classifying fans and blowers as covered equipment. 86 FR 46579. DOE determined that the term ''blower'' is interchangeable with the term ''fan.'' 86 FR 46579, 46583. DOE defines a fan (or blower) as a rotary bladed machine used to convert electrical or mechanical power to air power, with an energy output limited to 25 kilojoule (''kJ'') per kilogram (''kg'') of air. It consists of an impeller, a shaft and bearings and/or driver to support the impeller, as well as a structure or housing. A fan (or blower) may include a transmission, driver, and/or motor controller. 10 CFR 431.172.

Prior to the August 2021 Final Coverage Determination, DOE published a notice of intent to establish an Appliance Standards and Rulemaking Federal Advisory Committee (''ASRAC'') Working Group (''Working

[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Public Law 116–260 (Dec. 27, 2020), which reflect the last statutory amendments that impact Parts A and A–1 of EPCA.

[2] For editorial reasons, upon codification in the U.S. Code, Part C was redesignated Part A–1 and hereafter referred to as ''Part A–1.''

[3] DOE notes that distribution for residential use does not preclude coverage as covered equipment so long as to a significant extent the equipment is of a type that is also distributed in commerce for industrial and commercial use.

Group'') for fans and blowers. 80 FR 17359 (April 1, 2015). The Working Group [4] commenced negotiations at an open meeting on May 18, 2015, and held 16 meetings and three webinars to discuss scope, metrics, test procedures, and standard levels for fans.[5] The Working Group concluded its negotiations on September 3, 2015, and, by consensus vote,[6] approved a term sheet containing recommendations for DOE on the scope of a test procedure, and energy conservation standards for fans. The term sheet containing the Working Group recommendations (''term sheet'') is available in the fans energy conservation standard rulemaking docket. (Docket No. EERE–2013–BT–STD–0006, No. 179) [7] ASRAC approved the term sheet on September 24, 2015. (Docket No. EERE–2013–BT–NOC–0005, Public Meeting Transcript, No. 58 at p. 29)

On January 10, 2020, DOE received a notice of petition from the Air Movement and Control Association (''AMCA''), Air Conditioning Contractors of America, and Sheet Metal & Air Conditioning Contractors of America (''the Petitioners'') requesting that DOE establish test procedures for certain categories of commercial and industrial fans based on an industry test method in development, AMCA 214. DOE published a notice of this petition with a request for public comment on April 23, 2020; [8] 85 FR 22677 (''April 2020 Notice of Petition''). As part of the April 2020 Notice of Petition, DOE sought data and information pertinent to whether amended test procedures would (1) accurately measure energy efficiency, energy use, or estimated annual operating cost of fans during a representative average use cycle; and (2) not be unduly burdensome to conduct. 85 FR 22677, 22679.

On October 1, 2021, DOE published a request for information pertaining to potential test procedures for fans and blowers. 86 FR 54412 (''October 2021 RFI''). In the October 2021 RFI, DOE identified a variety of issues on which it sought input to determine whether, and if so how, potential test procedures for fans and blowers, including air circulating fans, would: (1) comply with the requirements in EPCA that test procedures be reasonably designed to produce test results that reflect energy use during a representative average use cycle, and (2) not be unduly burdensome to conduct. *Id.* In response to requests from stakeholders,[9] DOE extended the comment period 14 days to November 15, 2021. 86 FR 59308 (Oct. 27, 2021).

DOE published a notice of proposed rulemaking (''NOPR'') for the test procedure on July 25, 2022. 87 FR 44194 (hereafter, the ''July 2022 NOPR''). DOE held a public meeting related to this NOPR on August 2, 2022 (hereafter, the ''NOPR public meeting''). DOE received several comments [10] requesting a comment extension ranging from 15 to 60 days, some commenters also requested a second public meeting/workshop. In particular, the Air-Conditioning, Heating, and Refrigeration Institute (''AHRI'') commented that the complexity of the commercial fans rulemaking warrants additional time for stakeholder feedback and recommended that DOE reconsider the request for an open meeting and reopen the comment period so that all stakeholders have ample opportunity for discourse on the implementation of an incredibly complex rule, adding that the 60-day comment period was not sufficient. (AHRI, No. 40 at pp. 3–4, 5) DOE determined that the length of the comment period provided a meaningful opportunity to comment on the NOPR and did not provide an extension.[11]

DOE received comments in response to the July 2022 NOPR from the interested parties listed in Table I–1.

TABLE I–1—LIST OF COMMENTERS WITH WRITTEN SUBMISSIONS IN RESPONSE TO THE JULY 2022 NOPR

Commenter(s)	Reference in this final rule	Comment No. in the docket	Commenter type
Association of Home Appliance Manufacturers	AHAM	35	Trade Association.
Air-Conditioning, Heating, and Refrigeration Institute	AHRI	40	Trade Association.
Air Movement and Control Association International	AMCA	13, 41	Trade Association.
Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, Natural Resources Defense Council.	Efficiency Advocates	32	Efficiency Organizations.
California Investor-Owned Utilities: Pacific Gas and Electric Company, San Diego Gas and Electric, and Southern California Edison.	CA IOUs	37	Utilities.
California Energy Commission	CEC	30	Manufacturer.
ebm-papst Inc	ebm-papst	31	Manufacturer.
Greenheck Group	Greenheck	39	Manufacturer.

[4] The Working Group was comprised of representatives from AAON, Inc.; AcoustiFLO LLC; AGS Consulting LLC; AMCA; AHRI, Appliance Standards Awareness Project; Berner International Corp; Buffalo Air Handling Company; Carnes Company; Daikin/Goodman; ebm-papst; Greenheck; Morrison Products Inc.; Natural Resources Defense Council; Newcomb & Boyd; Northwest Energy Efficiency Alliance; CA IOUs; Regal Beloit Corporation; Rheem Manufacturing Company; Smiley Engineering LLC representing Ingersoll Rand/Trane; SPX Cooling Technologies/CTI; The New York Blower Company; Twin City Companies, Ltd; U.S. Department of Energy; and United Technologies/Carrier.

[5] Details of the negotiation sessions can be found in the public meeting transcripts that are posted to the docket for the energy conservation standard rulemaking at: *www.regulations.gov/docket?D=EERE-2013-BT-STD-0006.*

[6] At the beginning of the negotiated rulemaking process, the Working Group defined that before any vote could occur, the Working Group must establish a quorum of at least 20 of the 25 members and defined consensus as an agreement with less than 4 negative votes. Twenty voting members of the Working Group were present for this vote. Two members (Air-Conditioning, Heating, and Refrigeration Institute and Ingersoll Rand/Trane) voted no on the term sheet.

[7] The references are arranged as follows: (commenter name, comment docket ID number, page of that document). If one comment was submitted with multiple attachments, the references are arranged as follows: (commenter name, comment docket ID number. Attachment number, page of that document). The attachment number corresponds to the order in which the attachment appears in the docket. The parenthetical reference provides a reference for information located in DOE Docket No. EERE–2021–BT–TP–0021. If the information was submitted to a different DOE docket, the DOE docket number is additionally specified in the reference.

[8] At the time of the petition, AMCA 214–21 was available as a draft version (AMCA 214).

[9] AMCA requested a 21-day extension (AMCA, No. 2 at p. 1).

[10] AMCA and AHRI, No. 19 at p. 1; AHAM, No. 20 at p. 1; CA IOUs, No. 21 at pp. 1–2; NEEA, No. 22 at p. 1, JCI, No. 23 at p. 1; AHAM, No. 24 at p. 1.

[11] DOE posted a copy of the pre-**Federal Register** publication of the fans and blowers test procedure NOPR on the DOE website and notified stakeholder organizations via email on June 24, 2022, which provided stakeholders approximately 30 days for review of that copy in addition to the 60-day comment period that was announced in the notice published in the **Federal Register** on July 25, 2022. A public meeting was held on August 2, 2022, and the written comment period closed on September 23, 2022.

TABLE I–1—LIST OF COMMENTERS WITH WRITTEN SUBMISSIONS IN RESPONSE TO THE JULY 2022 NOPR—Continued

Commenter(s)	Reference in this final rule	Comment No. in the docket	Commenter type
Johnson Controls	JCI	34	Manufacturer.
Morrison Products Inc	Morrison	42	Manufacturer.
New York Blower	New York Blower	33	Manufacturer.
Northwest Energy Efficiency Alliance	NEEA	36	Efficiency Organization.
Robinson Fans Holdings	Robinson	43	Manufacturer.
Trane Technologies	Trane	38	Manufacturer.

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[12] To the extent that interested parties have provided written comments that are substantively consistent with any oral comments provided during the NOPR public meeting, DOE cites the written comments throughout this final rule. DOE identified one oral comment from Nidec Motor Corporation (''Nidec'') regarding stability determination that is summarized and addressed in section III.E.16.a.; one comment from ASAP generally supporting the test procedure rulemaking summarized and addressed in section III.A; one comment from Daikin related to embedded fans exclusions summarized and addressed in section III.B.3.b; and one comment from Loren Cook Company (''Loren Cook'') related to test burden summarized and addressed in section III.E.12 of this document. All other comments provided during the webinar are substantively addressed by written comments.

In addition, DOE notes that it received several comments[13] that were not related to the test procedure and instead relate to potential energy conservation standards. DOE will address these comments in a separate rulemaking pertaining to energy conservation standards.

On November 21, 2022, AMCA, as well as AMCA members (ebm-papst, Big Ass Fans, Greenheck, New York Blower, and Twin City Fan), ASAP, and NEEA met with DOE to discuss several items related to the fan and blower test procedure during an ex-parte meeting. (AMCA No. 45, at pp. 1–12)

II. Synopsis of the Final Rule

In this final rule, DOE adopts a test procedure for fans and blowers in subpart J of 10 CFR part 431 and modifies 10 CFR part 429, as follows:

- Establishes the scope of the test procedure for fans and blowers as to include standalone and embedded fans and blowers (*i.e.,* fans and blowers incorporated into other equipment) that are either: axial inline fans; axial panel fans; centrifugal housed fans; centrifugal unhoused fans; centrifugal inline fans; radial-housed fans; power roof/wall ventilators (''PRVs''); or air circulating fans with input power greater than or equal to 125 W; and excluding some fans that are embedded in other products or equipment; and excluding radial housed unshrouded fans with a diameter less than 30 inches or a blade width of less than 3 inches; safety fans; induced flow fans; jet fans; cross-flow fans; fans manufactured exclusively to be powered by internal combustion engines; fans that create a vacuum of 30 inches water gauge (''in. wg'') or greater; and fans designed and marketed to operate at or above 482 degrees Fahrenheit (250 degrees Celsius). In addition, for fans and blowers other than air circulating fans, the test procedure only applies to duty points with fan shaft input power equal to or greater than 1 horsepower and fan air power equal to or less than 150 horsepower.
- Defines ''axial inline fan,'' ''axial panel fan,'' ''centrifugal housed fan,'' ''centrifugal unhoused fan,'' ''centrifugal inline fan,'' ''radial-housed fan,'' ''power roof ventilator,'' ''cross-flow fan,'' ''induced flow fan,'' ''jet fan,'' ''basic model,'' ''safety fan,'' ''air circulating fan,'' and related terms.
- Adopts through reference in newly adopted appendix A to subpart J of 10 CFR part 431 (''appendix A'') certain provisions of ANSI/AMCA 214–21, ''Test Procedure for Calculating Fan Energy Index for Commercial and Industrial Fans and Blowers'' (''AMCA 214–21''), with modifications, as the test procedure for determining FEP and FEI of fans and blowers other than circulating fans;
- Adopts through reference in newly adopted appendix B to subpart J of 10 CFR part 431 (''appendix B'') certain provisions of ANSI/AMCA 230–23, ''Laboratory Methods of Testing Air Circulating Fans for Rating and Certification,'' with modifications, as the test procedure for determining efficacy in cubic feet per minute (''CFM'') per watt (''W'') (''CFM/W'');
- Adopts through reference certain provisions of the following industry standards referenced by AMCA 214–21: ANSI/AMCA 210–16, (''AMCA 210–16'') ''Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating'' and ISO 5801:2017(E), ''Fans Performance testing using standardized airways'' (ISO 5801:2017).
- Establishes fan and blower sampling requirements and provisions related to determining represented values in 10 CFR 429.69;
- Establishes an alternative efficiency determination method (''AEDM'') for fans and blowers in 10 CFR 429.70; and

The adopted requirements are summarized in Table II–1.

[12] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop test procedures for fans and blowers. (Docket No. EERE–2021–BT–TP–0021, maintained at *www.regulations.gov.*) The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

[13] *See* AHRI, No. 40 at pp. 7, 8, 9–10, 12–14; CA IOUs, No. 37 at pp. 1–3.

TABLE II–1—SUMMARY OF ADOPTED REQUIREMENTS

Topic	Location in CFR	Adopted requirements	Applicable preamble discussion
Scope	10 CFR 431.174	Establish the scope of the test procedure for fans and blowers as to include standalone and embedded fans and blowers (*i.e.,* fans and blowers incorporated into other equipment) that are either: axial inline fans; axial panel fans; centrifugal housed fans; centrifugal unhoused fans; centrifugal inline fans; radial-housed fans; power roof/wall ventilators; or air circulating fans with input power greater than or equal to 125 W; and excluding some fans that are embedded in other products or equipment; and excluding radial housed unshrouded fans with diameter less than 30 inches or a blade width of less than 3 inches; safety fans; induced flow fans; jet fans; cross-flow fans; fans manufactured exclusively to be powered by internal combustion engines; fans that create a vacuum of 30 in. wg or greater; and fans designed and marketed to operate at or above 482 degrees Fahrenheit (250 degrees Celsius). In addition, for fans and blowers other than air circulating fans, the test procedure is applicable to duty points with fan shaft input power equal to or greater than 1 horsepower and fan air power equal to or less than 150 horsepower.	Section III.B.
Definitions	10 CFR 431.172	Define ''axial inline fan,'' ''axial panel fan,'' ''centrifugal housed fan,'' ''centrifugal unhoused fan,'' ''centrifugal inline fan,'' ''radial-housed fan,'' ''power roof ventilator,'' ''cross-flow fan,'' ''induced flow fan,'' ''jet fan,'' ''basic model,'' ''safety fan,'' ''air circulating fan,'' and related terms.	Section III.C.
Test Procedure	10 CFR 431.174	Establish FEI as the metric for fans and blowers other than air circulating fans; incorporate by reference AMCA 214–21, AMCA 210–16, and provide additional instructions for determining the FEI (and other applicable performance characteristics) for fans and blowers other than air circulating fans. Establish the efficacy (CFM/W) as the metric for air circulating fans; incorporate by reference AMCA 230–23 and provide additional instructions for determining the efficacy (and other applicable performance characteristics) for air circulating fans.	Sections III.D, III.E, III.F and III.G.
Sampling Plan	10 CFR 429.69	Specify the minimum number of fans or blowers to be tested to rate a basic model and determine representative values.	Section III.J.
AEDM	10 CFR 429.70	Establish requirements for applying an alternative energy use determination method.	Section III.I.

DOE's test method for fans and blowers includes measurements of pressure, flow rate, and fan shaft or electrical input power, all of which are required to calculate FEP, FEI, and efficacy (CFM/W) as applicable, as well as other quantities to characterize rated fan and blower performance (*e.g.,* speed). DOE has determined that the relevant sections of AMCA 214–21, AMCA 210–16, and AMCA 230–23, in conjunction with the additional provisions adopted in this test procedure, would produce test results that reflect the energy efficiency and energy use of a fan or blower during a representative average use cycle. (42 U.S.C. 6314(a)(2)) Additionally, DOE has determined that the test procedure, which is based on the relevant industry testing standard, would not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2)) DOE's analysis of the burdens associated with the proposed test procedure is presented in section III.M of this document.

The effective date for the test procedure adopted in this final rule is 30 days after publication of this document in the **Federal Register**. Representations of energy use or energy efficiency must be based on testing in accordance with the test procedure beginning 180 days after the publication of this final rule.

III. Discussion

In the following sections, DOE establishes test procedures and related definitions for fans and blowers in subpart J of part 431, sampling plans for this equipment, an alternative efficiency determination method (''AEDM'') for this equipment, and enforcement provisions for this equipment. In the following sections, DOE provides relevant background information, discusses and responds to relevant public comments, and presents the adopted requirements.

A. General

ASAP commented in general support of the July 2022 NOPR. (Public Meeting transcript, No. 18 at p. 5)

AHRI commented that in the Table of Contents of the NOPR, DOE lists a section ''C. Deviation from the Process Rule;'' however, no such section can be found in the NOPR. AHRI noted that according to Section 3(a) of 10 CFR part 430, subpart C, appendix A, DOE may, as necessary, deviate from [the Process Rule] to account for specific circumstances of a particular rulemaking, and interested parties will receive notice of the deviation and explanation. AHRI recommended that DOE reopen the comment period to include the missing ''Section C. Deviation from the Process Rule'' that includes an explanation for the deviation so that the public can respond and provide meaningful comments. AHRI stated that DOE has failed to be transparent in the NOPR in providing no notice or explanation of any deviation from the applicable guidance of appendix A. (AHRI, No. 40 at pp. 2–3)

AHAM commented that DOE did not provide notice and explanation for deviations from the Process Rule, although the table of contents included such section. Nevertheless, AHAM noted that it is clear that DOE deviated from the Process Rule at least with regard to the comment period, although DOE did not explain why. AHAM commented that instead of the process rule's required 75-day comment period for test procedures, DOE provided only 60 (which has become DOE's common practice regardless of the particular rulemaking). AHAM stated that DOE declined several parties' requests to extend that comment period despite substantive reasons necessitating more time and reasonable extension requests that would not meaningfully extend DOE's rulemaking process requested. In addition, AHAM commented that a longer comment period was required for manufacturers to test products using DOE's proposed tests. In addition, AHAM noted that AHAM members struggled to understand whether the proposed test procedure would implicate consumer fans and/or fans used in home appliances in the allotted time. AHAM stated that denying reasonable requests for modest comment period extensions will not ultimately streamline DOE's efforts and will result in increased resource needs for the Department to respond to stakeholder meeting requests and supplemental documents, which would lengthen the rulemaking process. AHAM commented that in the future, DOE should allow for reasonable extensions to comment periods in order to increase the quality of responses to its requests for comment and the overall accuracy of its final rules. (AHAM, No. 35 at pp. 7–8)

AMCA noted that incorporating air circulating fans in the test procedure NOPR at a time when AMCA 230 was undergoing revisions added considerable time and efforts in addition to having to review the expected material and AMCA commented that DOE denied multiple stakeholder requests for a 30-day extension. AMCA further commented that an ex-parte meeting after the pre-publication of the NOPR and before the publication of the NOPR would have benefited stakeholders and potentially improved the NOPR. (AMCA No. 41 at p. 2)

DOE did not deviate from 10 CFR part 430, subpart C, appendix A (''appendix A''), applicable to fans and blowers under 10 CFR 431.4, and did not include such discussion in the July 2022 NOPR. DOE notes however that a section title for this section was not deleted from the table of contents and should have been deleted.

In addition, appendix A does not prescribe any mandatory comment period for test procedure NOPRs. A 60-day period is the typical period that DOE provides for all NOPRs, which exceeds the 45-day minimum required by EPCA. (*See* 42 U.S.C. 6314(b)(2)) As previously noted, the pre-publication version of the NOPR was publicly available for 30 days for stakeholders to review prior to publication of the NOPR. As such, the timing and sequence of this rulemaking has been conducted consistent with the provisions in appendix A. Additionally, the intent of the pre-publication version of a document is to provide stakeholders with additional time to review and prepare comments. Further, DOE provided opportunity for written comments and subsequent ex-parte meeting, as previously discussed, and comments from all stakeholders were considered in finalizing this test procedure pertaining to fans and blowers as discussed in section III of this document.

AHRI commented that the proposed test procedure will exacerbate supply chain issues, contradicting Executive Order 14017.[14] AHRI commented that supply chain disruptions have been lowering the competitiveness of the HVAC industry and hindering AHRI manufacturing capabilities. AHRI commented that trade distortions and the COVID–19 pandemic have resulted in shortages of essential components and led to delays and costly inflation at every stage of the manufacturing supply chain. AHRI commented that the immediacy of the implementation of a test procedure change serves to exacerbate near-term supply chain disruptions, and that these issues are made worse with ongoing labor shortages, and added together, disrupt domestic production, and result in temporary shutdowns, reduced sales, increased consumer costs, and delayed delivery of critical products.[15] AHRI further provided a description of current supply issues experienced by its members and commented that such regulatory burdens by DOE and others have left manufacturers in an almost constant state of redesign and testing. AHRI added that innovation is no longer as important as just modifying products to meet what AHRI described as new and ever-changing regulatory burdens. (AHRI, No. 40 at pp. 15–17)

DOE has determined that establishing a test procedure will not impact the availability of current models. The test procedure does not establish any energy conservation standards and does not result in any non-compliant fans. Section III.M of this document discusses DOE's analysis of testing costs and burden as a result of establishing this test procedure.

Morrison commented that the proposed new metric and testing plans was inconsistent with 2015 ASRAC WG term sheet agreement and disregarded the 11 years of work that went into this challenging and groundbreaking rulemaking effort. (Morrison No. 42 at p.1) As discussed in section III.G.1 of this document, DOE did not propose a new metric in the July 2022 NOPR. Further in this final rule, DOE is adopting a minimum sample size of one unit in line with the term sheet as discussed in section III.J of this document.

B. Scope of Applicability

This rulemaking applies to fans and blowers. A fan or blower is defined as a rotary bladed machine that is used to convert electrical or mechanical power to air power with an energy output limited to 25 kilojoule (''kJ'')/kilogram (''kg'') of air. 10 CFR 431.172. It consists of an impeller, a shaft and bearings and/or a driver to support the impeller, as well as a structure or housing. *Id.* A fan or blower may include a transmission, driver, and/or motor controller. *Id.* As discussed, DOE has classified fans and blowers as covered equipment. 86 FR 46579. ''Covered equipment'' consists of certain industrial equipment, which is classified by the Secretary according to section 6312(b) and excludes covered

[14] Executive Order on America's Supply Chains, February 24, 2021. Available at: *www.whitehouse.gov/briefing-room/presidential-actions/2021/02/24/executive-order-on-americas-supply-chains.*

[15] AHRI referenced appendix A of the Supply Chain Disruptions Affect Viability of U.S. Manufacturing Sector white paper, published by AHRI, AHAM, NAFEM, and NEMA. Available at *www.nema.org/docs/default-source/advocacy-document-library/joint-association-supply-chain-white-paper.pdf?sfvrsn=1763ed3b_2.*

products, other than industrial equipment that is a component of a covered product. (42 U.S.C. 6311(1) and (2)(A)(iii)) DOE explained in the coverage determination that fans and blowers, the subjects of this rulemaking, do not include ceiling fans and furnace fans, as defined at 10 CFR 430.2. *See* 86 FR 46579, 46586. DOE also noted that distribution for residential use does not preclude coverage as covered equipment so long as to a significant extent the equipment is of a type that is also distributed in commerce for industrial and commercial use. *Id.* at fn. 26.

In the August 2021 Final Coverage Determination, DOE did not establish definitions for specific categories of fans and blowers. DOE stated that it would consider specific categories of fans and blowers and the scope of applicability of test procedures and energy conservation standards in its respective rulemakings. 86 FR 46579, 46585.

This section discusses the fans and blowers that DOE includes in the scope of applicability of the test procedure, as well as exemptions.

1. Fans and Blowers Inclusions

This section discusses fans and blowers, other than air circulating fans, proposed for inclusion in the scope of applicability of the test procedure. Air circulating fans are discussed in section III.B.4 of this document.

The Working Group recommended that the test procedure be applicable to certain classifications of fans and blowers, listed in Table III–8 of this document. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #1 at p. 1) The Working Group did not provide definitions for the specified classifications of the fans and blowers identified for inclusion in the scope of a test procedure. AMCA 214–21 provides terms and associated definitions for certain classifications of fans and blowers that correspond to the Working Group recommendation. The Working Group further recommended that the test procedure apply only to the fan operating points (*i.e.,* duty points) with a fan shaft power equal to or greater than 1 horsepower (''hp'') and fan air power [16] equal to or less than 150 hp. The Working Group recommended that air power be calculated using static pressure for unducted fans (''static air power'') and total pressure for ducted fans (''total air power'').[17] (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #5 at p. 4)

In the July 2022 NOPR, DOE noted that on February 24, 2022, the California Energy Commission (''CEC'') published a proposed rulemaking for fans and blowers that includes terms and definitions that correspond to the Working Group recommendations.[18] The CEC proposed to cover the following fan categories: axial inline, axial panel, centrifugal housed, centrifugal unhoused, centrifugal inline, radial housed, and power roof/wall ventilators, and to define these terms largely based on the definitions in AMCA 214–21, with revisions to indicate a fan's intended application and if a fan's inlet or outlet can be (optionally, as applicable) ducted. In addition, the CEC proposal considers fans and blowers that have a rated fan shaft power greater than or equal to 1 horsepower, or, for fans without a rated shaft input power, an electrical input power greater than or equal to 1 kW, and a fan output power less than or equal to 150 horsepower.[19] 87 FR 44194, 44199.

In the July 2022 NOPR, DOE proposed to include all fans and blowers that are included within the scope of AMCA 210–16 (referenced by AMCA 214–21) and proposed that the test procedure would be applicable to the following fans and blowers, with exclusions discussed in sections III.B.2 and III.B.3 of this document: (1) axial inline fan; (2) axial panel fan; (3) centrifugal housed fan; (4) centrifugal unhoused fan; (5) centrifugal inline fan; (6) radial-housed fan; and (7) power roof/wall ventilator (''PRV'').[20] 87 FR 44194, 44200. (See section III.C.1 of this document for definitions of these terms)

AMCA supported the proposed standalone fan inclusions and did not provide comments regarding embedded fans. (AMCA, No. 41 at p. 5) New York Blower commented that the fans and blowers proposed for inclusion in the DOE test procedure are appropriate. (New York Blower, No. 33 at p. 6)

DOE did not receive any other comments on this issue and includes all fans and blowers within the scope of AMCA 210–16 (referenced by AMCA 214–21) in the scope of the DOE test procedure. As such, DOE specifies that the test procedure is applicable to the following fans and blowers, with exclusions discussed in sections III.B.2 and III.B.3 of this document: (1) axial inline fan; (2) axial panel fan; (3) centrifugal housed fan; (4) centrifugal unhoused fan; (5) centrifugal inline fan; (6) radial-housed fan; and (7) PRV.

In the July 2022 NOPR, DOE proposed that the scope of the test procedure cover fans and blowers with a fan shaft input power equal to or greater than 1 horsepower and a fan static or total air power equal to or less than 150 horsepower. DOE proposed the lower 1 hp limit to match the technical applicability of the AMCA 214–21 and AMCA 210–16 test procedures. DOE proposed the upper air power limit at this time because fans that operate above the proposed upper limit are typically custom orders and are too large to be tested in a laboratory setting. In addition, DOE noted that these limits are in line with the Working Group recommendations and the CEC scope. 87 FR 44194, 44200–44201.

In the July 2022 NOPR, DOE tentatively determined that the 1 hp fan shaft power lower limit may not be a practical unit of measurement for all fans because some fans are designed such that the measurement of the shaft input power is not feasible, and the only feasible measurement is the FEP, which is measured in units of kW. For example, some fans incorporate the bare shaft and the motor in the same enclosed housing and do not provide access to the fan shaft (*i.e.,* between the motor and the fan), where the measurement of the fan shaft power would be conducted. DOE relied on the motor efficiency equations provided in section 6.4.2.3 of AMCA 214–21 to convert the fan shaft power into electrical input power [21] and has tentatively determined that 0.89 kW is appropriate to establish a standardized equivalent to the 1 hp fan shaft input power limit. Additionally, section 6.5.3.1.3 ''Fan Efficiency Requirements'' of ANSI/ASHRAE/IES 90.1, ''Energy Standard for Buildings except Low-Rise Residential Buildings (2019)'' (''ASHRAE 90.1–2019'') relies on the value of 0.89 kW as the corresponding

[16] The air power of a fan is the fan's output power. It is proportional to the product of the fan airflow rate and the fan pressure.

[17] The terms ''ducted'' and ''unducted'' refer to the recommended test configuration used when conducting a fan test. Appendix C of the term sheet specifies which fan categories are typically ducted (*i.e.,* tested using a ducted outlet and for which the FEI is calculated on a total pressure basis): axial cylindrical housed, centrifugal housed (excluding inline and radial), inline and mixed flow, radial housed; and which fan types are considered unducted (*i.e.,* tested with a free outlet and for which the FEI is calculated on a static pressure basis): panel, centrifugal unhoused (excluding inline and radial), and power roof ventilators.

[18] All documents related to this rulemaking can be found in the rulemaking Docket 22–AAER–01 accessible at: *www.energy.ca.gov/rules-and-regulations/appliance-efficiency-regulations-title-20/appliance-efficiency-proceedings-11.*

[19] *See* Proposed regulatory language for Commercial and Industrial Fans and Blowers available in the following Docket: 22–AAER–01 at: *efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=22-AAER-01.*

[20] PRVs include: Centrifugal PRV exhaust fans; Centrifugal PRV supply fans; and Axial PRVs, as defined in AMCA 214–21.

[21] The electrical input power is equal to the fan shaft input power divided by the motor efficiency.

threshold to a value of 1 hp of shaft input power. Accordingly, DOE proposed that the test procedure would be applicable to a fan or blower with duty points [22] with the following characteristics: (1) a fan shaft input power equal to or greater than 1 horsepower and a fan static or total air power equal to or less than 150 horsepower, or (2) a FEP equal to or greater than 0.89 kW and a fan static or total air power equal to or less than 150 horsepower. 87 FR 44194, 44200.

In addition, AMCA 214–21 distinguishes between fans that use a total pressure basis [23] and fans that use a static pressure basis.[24] In the July 2022 NOPR, DOE proposed to establish the 150 hp upper limit in terms of total air power for fans and blowers that use a total pressure basis FEI and would be required to be tested with a ducted outlet according to the proposed provisions adopted through reference to AMCA 214–21. For fans and blowers that use a static pressure basis FEI and would be required to be tested using a free outlet under the provisions of AMCA 214–21, DOE proposed to establish the air power limit in terms of static air power. 87 FR 44194, 44200–44201.

Finally, to define total air power, DOE proposed to rely on the definition of ''fan output power'' in AMCA 210–16. DOE proposed to define ''total air power'' as the total power delivered to air by the fan; it is proportional to the product of the fan airflow rate, the fan total pressure, and the compressibility coefficient and is calculated in accordance with section 7.8.1 of AMCA 210–16. *See* the definition of ''fan output power'' in Section 3.1.31 of AMCA 210–16 and calculation formulas in section 7.8.1 of AMCA 210–16. DOE also proposed to define ''static air power'' as the static power delivered to air by the fan; it is proportional to the product of the fan airflow rate, the fan static pressure, and the compressibility coefficient and is calculated in accordance with section 7.8.1 of AMCA 210–16, using static pressure instead of total pressure. 87 FR 44194, 44201.

In response to the July 2022 NOPR, AMCA commented in support of the basis of the proposed power limits based on fan air power, fan shaft input power and fan electrical input power. In terms of scope, AMCA added that fans deliver air power, defined generally as pressure multiplied by volume flow rate. AMCA stated that by limiting the top end of the scope to air power, as opposed to electrical input power, a less efficient fan is not allowed to escape regulation by consuming a larger amount of electrical input power to deliver a similar amount of air power. Regarding the low side of the scope related to power, for bare fans, AMCA commented that shaft input power is the appropriate measure because there is no driver. For fans tested wire-to-air, AMCA commented that the appropriate measure is electrical input power. (AMCA, No. 41 at p. 5)

Morrison commented in support of the proposed power limits (Morrison, No. 42 at p. 2)

New York Blower commented that the proposed power limits were appropriate. New York Blower commented that the limits are configured in a manner that captures products at the low end of fan powers and does not allow less efficient products at the high end to escape regulation by being less efficient. However, New York Blower noted that the July 2022 NOPR implies that if a fan is capable of operating within the scope of regulation, it should be regulated under all possible operating conditions. New York Blower commented that such approach would remove the upper limit of scope considering that practically any fan could be slowed down enough to operate within the proposed scope. Instead, New York Blower commented that for applications that operate at the high end of the proposed scope, fan performance is typically attached to the fan and that these types of fans are not sold as a distributed product—like a fan in a box—but configured and applied to the application. Thus, for these fans, New York Blower recommended that the industry be regulated for fans configured and identified as operating within scope and for identical products operating outside the scope, the product not be regulated. (New York Blower, No. 33 at p. 7)

ebm-papst commented that testing of larger fans becomes exponentially more burdensome and recommended that DOE exempt all fans that have at least one duty point at an air power above 150 horsepower. Otherwise, according to ebm-papst, many speed adjustable industrial fans become subject to this regulation even if just a small portion of the operating map is below 150 hp or air power. (ebm-papst, No. 31 at p. 1)

Robinson commented that they are not in favor of the inclusion of duty points within the power range. Robinson commented that custom fan equipment is often selected at a duty point well beyond the horsepower limitation, but included within the operational requirements are operating duty points that fall within the horsepower range. Robinson asked if the manufacturer is only required to make a representation regarding that single duty point. Robinson added that in some instances, customers cannot obtain a desired duty point through speed control, and therefore duty points must be attained through damper control. Inclusion of these appurtenances in testing will significantly multiply testing requirements to make an assertation regarding FEP, FEI, etc. and result in over-designed fans. (Robinson, No. 43 at p. 4)

The CA IOUs commented that DOE should rely on the best efficiency point (''BEP'') [25] as the criteria for whether a fan falls within the power input range and air horsepower to determine if a fan is within the scope of the test procedure. The CA IOUs commented that DOE proposed that the test procedure applies to a fan or blower with duty points greater than one horsepower and equal to or less than 150 horsepower. Therefore, fans with a single duty point of less than 150 air horsepower would be within the scope of this rulemaking. The CA IOUs asserted that fans with variable speed drives, regardless of size, are bound to have duty points less than 150 horsepower. The CA IOUs also stated that there are also many small fans, particularly forward-curved fans, with a few points and shaft input power greater than one horsepower at the extreme right end of the fan curve. The CA IOUs recommended that DOE change this exclusion to fans where the BEP is less than or equal to one horsepower or greater than 150 hp. (CA IOUs, No. 37 at p. 10)

As noted, the Working Group recommended that the test procedure be only applicable to the fan operating points with a fan shaft power equal to or greater than 1 horsepower (''hp'') and fan air power equal to or less than 150 hp. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #5 at p. 4) In line with this approach, DOE adopts the power limits as proposed in the July 2022 NOPR and corresponding definitions of static air power (''fan static air power'') and total airpower

[22] A duty point is characterized by a given airflow and pressure and has a corresponding operating speed.

[23] This includes: centrifugal housed fans, radial housed fans, centrifugal inline fans, centrifugal PRVs Supply, and Axial Inline fans. (*See* Table 7.1 of AMCA 214–21.)

[24] This includes: Centrifugal unhoused fans, Centrifugal PRVs Exhaust, Axial Panel fans, Axial PRVs. (*See* Table 7.1 of AMCA 214–21.)

[25] The BEP represents the flow and pressure values at which the fan total efficiency (ratio of total air power to fan shaft input power) is maximized when operating a given speed.

(fan total air power''). DOE further clarifies that the test procedure is only applicable to the fan or blower duty points with the following characteristics: (1) a fan shaft input power equal to or greater than 1 horsepower and a fan static or total air power equal to or less than 150 horsepower, or (2) a FEP equal to or greater than 0.89 kW and a fan static or total air power equal to or less than 150 horsepower. When determining the duty points of a basic model, to establish whether a fan includes duty points that meet the scope requirements in terms of power limit, DOE will refer to published data, marketing literature, and other publicly available information about the range of operation (*i.e.,* flow, speed, and pressure) of each basic model. If the manufacturer only includes 1 single duty point in the fan operating range, then the manufacturer is only required to make a representation at that one point. In addition, DOE follows the Working Group recommendation for establishing the scope power limit as proposed in the July 2022 NOPR. Finally, the limit recommended by the Working Group recommendation was set to capture the design points that represent the majority of the market and therefore corresponds to a limit in terms design point not BEP. (EERE–2013–BT–STD–0006, Public Meeting Transcript, No. 161 at pp. 96, 100–101) In line with this Working Group recommendation, DOE is not relying on BEP to establish the scope of the test procedure.

Regarding fans that are designed to operate outside of the power limits but that may include duty points that fall in the scope, DOE notes that the manufacturer would be required to test such a fan at the duty points that fall in the scope of the test procedure. Regarding testing with accessories, DOE addresses this issue in section III.E.12 of this document.

2. Fans and Blowers Exclusions

The Working Group recommended the exclusion of circulating fans (also known as air circulating fans), induced flow fans, jet fans, and cross-flow fans. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #2 at pp. 2–3) The Working Group also recommended the exclusion of safety fans due to low operating hours and specific design features that impair efficiency (*e.g.,* high tip clearance), and a subset of radial fans that are used for material handling applications [26] (*e.g.,* to move paper dust, sand, etc.).[27] (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #2 at pp. 2–3) Table III–1 of this document presents the exclusions recommended by the Working Group.

TABLE III–1—FAN CATEGORIES RECOMMENDED FOR EXCLUSION BY THE WORKING GROUP

Fan category recommended for exclusion by the working group *	Definition in AMCA 214–21
Radial housed unshrouded fan with diameter less than 30 inches or a blade width of less than 3 inches.	Included in the definition ''radial housed fan'' as noted in Table III-1.
Safety fan	Not defined in AMCA 214–21.
Induced flow fan	''Induced flow fan'' means a type of laboratory exhaust fan with a nozzle and windband; the fan's outlet airflow is greater than the inlet airflow due to induced airflow. All airflow entering the inlet exits through the nozzle. Airflow exiting the windband includes the nozzle airflow plus the induced airflow.
Jet fan	''Jet fan'' means a fan designed and marketed specifically for producing a high velocity air jet in a space to increase its air momentum. Jet fans are rated using thrust. Inlets and outlets are not ducted but may include acoustic silencers.
Cross-flow fan	''Cross-flow fan'' means a fan with a housing that creates an airflow path through the impeller in a direction at right angles to its axis of rotation and with airflow both entering and exiting the impeller at its periphery. Inlets and outlets can optionally be ducted.**

* **Note:** The Working Group also recommended the exclusion of circulating fans (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #2 at pp. 2–3), which are defined in AMCA 214–21 as a fan that is not a ceiling fan that is used to move air within a space that has no provision for connection to ducting or separation of the fan inlet from its outlet. The fan is designed to be used for the general circulation of air. Circulating fans are discussed in Section III.B.4 of this document.

** Excluded from AMCA 214–21 and defined in ANSI/AMCA Standard 208, ''Calculation of the Fan Energy Index for calculating FEI'' (''AMCA 208–18'').

The Petitioners requested that the scope of any future DOE test procedure be consistent with the scope described in the term sheet and requested the exclusion of fans that cannot be tested per AMCA 210–16 (*i.e.,* the physical test method referenced in AMCA 214–21).[28] The Petitioners also requested that the scope of the test procedure be consistent with ASHRAE 90.1–2019. (Docket No. EERE–2020–BT–PET–0003, The Petitioners, No. 1, attachment ''AMCA Petition to DOE Cover Letter and Petition [sic] 2020110'' at pp. 7–8)

Table III–2 of this document compares the scope exclusions requested by the Petitioners in accordance with the commercial and industrial fan and blower requirements in ASHRAE 90.1–2019 and the scope of exclusions as recommended by the Working Group (other than embedded fans and blowers). In the July 2022 NOPR, DOE reviewed the fan and blower exclusions to section 6.5.3.1.3 of ASHRAE 90.1–2019 ''Fan Efficiency Requirements'' as listed in Table III–2 of this document and tentatively determined that these exclusions are covered by the exclusions recommended by the Working Group. 87 FR 44194, 44201–44202.

[26] Specifically, radial housed unshrouded fans, which means a radial housed fan for which the impeller blades are attached to a backplate and hub (*i.e.,* open radial blade), or to a hub only (*i.e.,* open paddle wheel), and with an open front at the impeller's inlet. These are different than radial shrouded fans, for which the impeller blades are attached to a backplate and to a ring or ''shroud'' at the impeller's inlet.

[27] The discussions of the Working Group related to these exclusions can be found in the meeting transcripts, available in the fan's energy conservation standard rulemaking docket. (Docket No. EERE–2013–BT–STD–0006, Public Meeting Transcript, No. 161 at pp. 63–70; Public Meeting Transcript, No. 85 at pp. 60–62).

[28] For example, circulating fans, ceiling fans, desk fans, jet tunnel fans, and induced flow fans (*e.g.,* used in laboratory exhaust systems). This is consistent with the scope of the term sheet.

TABLE III–2—EXCEPTIONS TO SECTION 6.5.3.1.3 OF ASHRAE 90.1–2019 "FAN EFFICIENCY REQUIREMENTS"

[Other than for embedded fans and blowers]

Exceptions to section 6.5.3.1.3 of ASHRAE 90.1–2019 "fan efficiency requirements"	Included in the exclusions recommended by the working group?
Fans that are not embedded fans with a motor nameplate horsepower of less than 1.0 hp or with a fan nameplate electrical input power of less than 0.89 kW.	Yes.
Ceiling fans	Yes (NOTE: ceiling fans are not within the scope of the definition of fans and blowers).
Fans used for moving gases at temperatures above 482 degrees Fahrenheit.	Yes (safety fans).
Fans used for operation in explosive atmospheres	Yes (safety fans).
Reversible fans used for tunnel ventilation	Yes (jet fans, safety fans).
Fans outside the scope of AMCA 208–18	Yes (AMCA 208–18 references the scope of AMCA 210–16).
Fans that are intended to operate only during emergency conditions	Yes (safety fans).

In the July 2022 NOPR, DOE noted that in its proposed rulemaking for commercial and industrial fans and blowers, the CEC proposed to exclude the following categories of fans: (1) safety fans (*see* section III.C.2 of this document for more details on this definition); (2) ceiling fans as defined in 10 CFR 430.2; (3) circulating fans; (4) induced flow fans; (5) jet fans; (6) cross-flow fans; (7) embedded fans as defined in ANSI/AMCA 214–21; [29] (8) fans mounted in or on motor vehicles or other mobile equipment; (9) fans that create a vacuum of 30 in. wg or greater; [30] and (10) air curtain unit.[31] 87 FR 44194, 44202. *See* Table III–3 and section III.B.3 for a discussion of embedded fans and air curtain units and section III.B.5 for a discussion of fans mounted in or on motor vehicles or other mobile equipment.

TABLE III–3—FANS RECOMMENDED FOR EXCLUSION BY THE WORKING GROUP AND THE CORRESPONDING CEC PROPOSED EXCLUSIONS

Fans recommended for exclusion by the working group *	Corresponding term and definition proposed for exclusion in CEC proposed regulatory text
Radial housed unshrouded fan with diameter less than 30 inches or a blade width of less than 3 inches.	Not excluded by the CEC proposed regulatory text.
Safety fan	"Safety Fan" *See* section III.C.2 of this document.
Induced flow fan	"Induced flow fan" means a type of laboratory exhaust fan with nozzle and windband; the fan's outlet airflow is greater than the inlet airflow due to induced airflow. All airflow entering the inlet exits through the nozzle. Airflow exiting the windband includes the nozzle airflow as well as the induced airflow.
Jet fan	"Jet fan" means a fan designed and marketed specifically to produce a high-velocity air jet in a space to increase its air momentum. Jet fans are rated using thrust. Inlets and outlets are not ducted but may include acoustic silencers.
Cross-flow fan	"Cross-flow fan" means a fan with a housing that creates an airflow path through the impeller, in a direction at right angles to the axis of rotation and with airflow both entering and exiting the impeller at the periphery. Inlets and outlets can optionally be ducted.

* **Note:** The Working Group also recommended the exclusion of circulating fans, which are also excluded from the CEC proposed regulation and defined as a fan that is not a ceiling fan that is used to move air within a space, that has no provision for connection to ducting or separation of the fan inlet from its outlet. The fan is designed to be used for the general circulation of air. Circulating fans are discussed in section III.B.4 of this document.

In the July 2022 NOPR, DOE reviewed the exclusions recommended by the Working Group, the exclusions requested by the Petitioners, the exclusions provided in the proposed CEC regulations, and comments received and proposed to exclude from the proposed DOE test procedure the following fans and blowers: (1) radial housed unshrouded fans with a diameter less than 30 inches or a blade width of less than 3 inches; (2) safety fans; (3) induced flow fans; (4) jet fans; and (5) cross-flow fans. 87 FR 44194, 44202.

AMCA commented in support of the proposed exclusions of (1) radial housed unshrouded fans with a diameter less than 30 inches or a blade width of less than 3 inches; (2) safety fans; (3) induced flow fans; (4) jet fans; and (5) cross-flow fans. AMCA noted that these are consistent with the ASRAC term sheet. (AMCA, No. 41 at p. 6)

DOE did not receive any other comments on these exclusions and thus excludes from the DOE test procedure

[29] As defined in ANSI/AMCA 214–21: "A fan that is part of a manufactured assembly where the assembly includes functions other than air movement."

[30] CEC proposed excluding these fans because AMCA 214–21 is not applicable to this equipment. *See* CEC's Initial Statement of Reason, available at *efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=22-AAER-01.*

[31] When the NOPR was issued, the CEC defined an air curtain unit as equipment providing a directionally controlled stream of air moving across the entire height and width of an opening that reduces the infiltration or transfer of air from one side of the opening to the other and/or inhibits the passage of insects, dust, or debris. 87 44194, 44260 fn 25.

the following fans and blowers: (1) radial housed unshrouded fans with a diameter less than 30 inches or a blade width of less than 3 inches; (2) safety fans; (3) induced flow fans; (4) jet fans; and (5) cross-flow fans.

In the July 2022 NOPR, DOE also stated that it was considering including an exclusion, consistent with the findings of the CEC, for fans that create a vacuum of 30 in. wg or greater. DOE tentatively determined that a test using AMCA 210–16 may not result in a measurement of energy use or energy efficiency during a representative average use cycle for fans that are exclusively used to create a vacuum rather than produce airflow. 87 FR 44194, 44203.

In response to the July 2022 NOPR, the CEC recommended excluding fans that create a vacuum of 30 in. wg or greater because these fans have different operating conditions (run in stall) and will require a different way to measure their efficiency. (CEC, No. 30 at p. 2)

The CA IOUs requested that DOE exclude fans that create a vacuum of 30 in. wg or greater from the proposed scope. The CA IOUs explained that typically, fans that create a high vacuum operate in the unstable range and must be reinforced with heavy housings and oversized bearings to handle unstable operating conditions. The CA IOUs stated that DOE may consider the 30 in. wg. too low and if so, requested DOE find an appropriate level. (CA IOUs, No. 37 at . 8)

DOE has determined that a test using AMCA 210–16 may not result in a measurement of energy use or energy efficiency during a representative average use cycle for fans that are exclusively used to create a vacuum rather than produce airflow. As noted by the CEC and the CA IOUs, these fans operate in the stalling region (or unstable range). Further as noted by the CEC, such fans would require a different way to measure their efficiency. Therefore, in this final rule, DOE excludes fans that create a vacuum of 30 in. wg or greater. Additionally, as discussed in section III.C.2 of this document, DOE excludes fans that designed and marketed to operate at or above 482 degrees Fahrenheit (250 degrees Celsius).

3. Embedded Fans and Blowers Exclusions

In addition to the specific exclusions discussed in the prior section, DOE also proposed excluding certain ''embedded'' fans from the scope of the test procedure. Fans can be distributed in commerce as standalone equipment or can be distributed in commerce incorporated into other equipment that requires a fan to operate. 87 FR 44194, 44203.

Section 3.25.3 of AMCA 214–21 defines a ''standalone fan'' as ''a fan in at least a minimum testable configuration. This includes any driver, transmission or motor controller if included in the rated fan. It also includes any appurtenances included in the rated fan, and it excludes the impact of any surrounding equipment whose purpose exceeds or is different than that of the fan.'' [32] Section 3.25.4 of AMCA 214–21 defines the term ''embedded fan'' as ''a fan that is part of a manufactured assembly where the assembly includes functions other than air movement.''

The Working Group recommended excluding certain embedded fans. *See* Table III–4 of this document. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendations #2 and #3 at pp. 2–4)

TABLE III–4—EMBEDDED FANS RECOMMENDED FOR EXCLUSION BY THE WORKING GROUP

Fans embedded in:
Single-phase central air conditioners and heat pumps rated with a certified cooling capacity less than 65,000 British thermal units per hour (''Btu/h''), that are subject to DOE's energy conservation standard at 10 CFR 430.32(c).
Three-phase, air-cooled, small commercial packaged air-conditioning and heating equipment rated with a certified cooling capacity less than 65,000 Btu/h, that are subject to DOE's energy conservation standard at 10 CFR 431.97(b).
Residential furnaces that are subject to DOE's energy conservation standard at 10 CFR 430.32(y).
Transport refrigeration (*i.e.,* Trailer refrigeration, Self-powered truck refrigeration, Vehicle-powered truck refrigeration, Marine/Rail container refrigerant), and fans exclusively powered by internal combustion engines.
Vacuum cleaners.*
Heat Rejection Equipment: • Packaged evaporative open circuit cooling towers. • Evaporative field-erected open circuit cooling towers. • Packaged evaporative closed-circuit cooling towers. • Evaporative field-erected closed-circuit cooling towers. • Packaged evaporative condensers. • Field-erected evaporative condensers. • Packaged air-cooled (dry) coolers. • Field-erected air-cooled (dry) coolers. • Air-cooled steam condensers. • Hybrid (water saving) versions of all of the previously listed equipment that contain both evaporative and air-cooled heat exchange sections.
Air curtains.
Air-cooled commercial package air conditioners and heat pumps (CUAC, CUHP) with a certified cooling capacity between 5.5 tons (65,000 Btu/h) and 63.5 tons (760,000 Btu/h) that are subject to DOE's energy conservation standard at 10 CFR 431.97(b).**
Water-cooled and evaporatively-cooled commercial air conditioners and water-source commercial heat pumps that are subject to DOE's energy conservation standard at 10 CFR 431.97(b).**
Single package vertical air conditioners and heat pumps that are subject to DOE's energy conservation standard at 10 CFR 431.97(d).**
Packaged terminal air conditioners (PTAC) and packaged terminal heat pumps (PTHP) that are subject to DOE's energy conservation standard at 10 CFR 431.97(c).**
Computer room air conditioners that are subject to DOE's energy conservation standard at 10 CFR 431.97(e).**

[32] Additionally, AMCA 214–21 defines a minimum testable configuration as ''A fan having at least an impeller; shaft and bearings and/or driver to support the impeller; and its structure or its housing.'' *See* Section 3.53 of AMCA 214–21.

TABLE III–4—EMBEDDED FANS RECOMMENDED FOR EXCLUSION BY THE WORKING GROUP—Continued

Fans embedded in:
Variable refrigerant flow multi-split air conditioners and heat pumps that are subject to DOE's energy conservation standard at 10 CFR 431.97(f).**

* Although the term sheet specifies ''vacuum,'' the term was intended to designate vacuum cleaners. (Docket No. EERE–2013–BT–STD–0006; AHRI, Public Meeting Transcript, No. 166 at p. 11).

** The recommendation only applies to supply and condenser fans embedded in this equipment.

Stated more generally, the exclusions recommended by the Working Group would exclude from the scope of the test procedure fans that are embedded in regulated equipment for which the DOE metric captures the energy consumption of the fan.[33]

The Working Group further recommended for fans embedded in non-regulated equipment, and/or embedded in regulated equipment other than listed in Appendix B of the term sheet, and/or any fans that are not supply and condenser fans in regulated equipment listed in Appendix B of the term sheet, that the first manufacturer of a testable configuration[34] would be responsible for certifying the standalone fan performance to DOE. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #4 at p. 4)[35]

The Petitioners requested that the scope of any DOE test procedure be consistent with the scope of the term sheet. The Petitioners also requested the test-procedure scope for commercial fans be consistent with ASHRAE 90.1–2019, and additionally exclude embedded fans that are part of equipment listed in section 6.4.1.1 of ASHRAE 90.1–2019. ASHRAE 90.1–2019 (*See* Table III–6 of this document). (Docket No. EERE–2020–BT–PET–0003, The Petitioners, No. 1, attachment ''AMCA Petition to DOE Cover Letter and Petition [sic] 2020110'' at pp. 7–8)

The additional exclusions for embedded fans that are part of equipment listed in section 6.4.1.1 of ASHRAE 90.1–2019 as requested by AMCA are included in the fan and blower exclusions to section 6.5.3.1.3 of ASHRAE 90.1–2019, ''Fan Efficiency Requirements,'' and presented in Table III–5 of this document.

TABLE III–5—EMBEDDED FAN AND BLOWER EXCLUSIONS TO SECTION 6.5.3.1.3 OF ASHRAE 90.1–2019 ''FAN EFFICIENCY REQUIREMENTS''

Embedded fan and blower exclusions to section 6.5.3.1.3 of ASHRAE 90.1–2019, ''fan efficiency requirements''	Included in the exclusion recommended by the working group?
Embedded fans and fan arrays with a combined motor nameplate horsepower of 5 hp or less or with a fan system electrical input power of 4.1 kW or less.	No.
Embedded fans that are part of equipment listed under section 6.4.1.1.	*See* Table III-7.
Embedded fans included in equipment bearing a third party-certified seal for air or energy performance of the equipment package.	No.

TABLE III–6—EQUIPMENT LISTED IN SECTION 6.4.1.1 OF ASHRAE 90.1–2019 ''MINIMUM EQUIPMENT EFFICIENCIES—LISTED EQUIPMENT—STANDARD RATING AND OPERATING CONDITIONS''

Fans embedded in:	Included in the embedded fan exclusions recommended by the working group?
Electrically Operated Unitary Air Conditioners	Partially. This category includes equipment above 760,000 Btu/h. The exclusions in the term sheet apply only to fans embedded in equipment above 65,000 Btu/h and below 760,000 Btu/h (equivalent to 5.5 tons and 63.5 tons, respectively as stated in the term sheet). In addition, the term sheet specifies that the exclusions would apply only to embedded ''supply and condenser fans.''
Electrically Operated Air-Cooled Unitary Heat Pumps	Partially. This category includes equipment above 760,000 Btu/h. The exclusions in the term sheet apply only to fans embedded in equipment below 760,000 Btu/h. In addition, the term sheet specifies that the exclusion would apply only to embedded ''supply and condenser fans.''
Air-, water-, and evaporatively cooled Condensing Units	Yes, these fans are below 1 hp. In addition, it is specified in Table 6.8.1–1 of ASHRAE 90.1–2019 that this category only includes equipment greater than or equal to 135,000 Btu/h.
Water-Chilling Packages	No.
Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, and Single-Package Vertical Heat Pumps.	Yes. However, the term sheet specifies that the exclusion would apply only to embedded ''supply and condenser fans.''

[33] The Working Group created a subgroup to propose potential embedded fan exclusions, which were subsequently voted on by the Working Group. The information used by the subgroup to develop the proposal is available in the fans energy conservation standard rulemaking docket. (Docket No. EERE–2013–BT–STD–0006, No. 125.2)

[34] AMCA 214–21 defines the ''minimal testable configuration'' as a fan having at least an impeller; shaft and bearings and/or driver to support the impeller; and its structure or its housing.

[35] As part of this recommendation, the Working Group also recommended that if a manufacturer purchases a standalone fan to incorporate in a product or in equipment, that manufacturer must ensure that the design operating range (or design point) of the embedded fan is within the certified operating range of the standalone fan and disclose the design operating range (or design point) of the embedded fan to the end-user. This issue does not relate to the test procedure and is not discussed in this document.

TABLE III–6—EQUIPMENT LISTED IN SECTION 6.4.1.1 OF ASHRAE 90.1–2019 "MINIMUM EQUIPMENT EFFICIENCIES—LISTED EQUIPMENT—STANDARD RATING AND OPERATING CONDITIONS"—Continued

Fans embedded in:	Included in the embedded fan exclusions recommended by the working group?
Room Air-conditioners and Air-conditioner Heat pumps	Yes. These fans are below 1 hp.
Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters.	No.
Gas- and Oil-Fired Boilers	Partially. Some of these fans are below 1 hp.
Heat-Rejection Equipment	Yes.
Electrically Operated Variable-Refrigerant-Flow Air Conditioners	Yes. However, the term sheet specifies that the exclusion would apply only to embedded "supply and condenser fans."
Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps.	Partially. This category includes ground water source and ground source equipment that is not regulated by DOE and that was not included in the term sheet exclusions. In addition, the term sheet specifies that the exclusion would apply only to embedded "supply and condenser fans."
Floor-Mounted Air Conditioners and Condensing Units Serving Computer Rooms.	Partially. This category includes equipment greater than or equal to 760,000 Btu/h, which are not regulated by DOE.
Commercial Refrigerators, Commercial Freezers, and Refrigeration	Yes. These fans are below 1 hp.
Vapor-Compression-Based Indoor Pool Dehumidifiers	Yes. These fans are below 1 hp.
Electrically Operated direct-expansion dedicated outdoor air system Units, Single-Package and Remote Condenser, without Energy Recovery.	No.
Electrically Operated direct-expansion dedicated outdoor air system Units, Single-Package and Remote Condenser, with Energy Recovery.	No.
Electrically Operated Water-Source Heat Pumps	Partially. This category includes ground water source and ground source equipment that is not regulated by DOE and was not included in the term sheet exclusions. In addition, the term sheet specifies that the exclusion would apply only to embedded "supply and condenser fans."
Heat Pump and Heat Recovery Chiller Packages	No.
Ceiling-Mounted Computer-Room Air Conditioners	Partially. The term sheet only excludes embedded fans in computer room air conditioners that are subject to DOE energy conservation standards.
Walk-In Cooler and Freezer Display Door	Yes. These fans are below 1 hp.
Walk-In Cooler and Freezer Non-Display Door	Yes. These fans are below 1 hp.
Walk-In Cooler and Freezer Refrigeration System	Yes. These fans are below 1 hp.

In the July 2022 NOPR, DOE noted that in its proposed regulation, the CEC proposed to exclude embedded fans, as defined in AMCA 214–21, including embedded fans in air curtain units.[36] In its staff report, the CEC stated that its proposal would exclude fans embedded in regulated and non-regulated equipment where the main function is other than the movement of air, as long as the fan is not sold or offered for sale as a standalone product.[37] As reasons for exclusion, the CEC stated that these fans are either manufactured by an original equipment manufacturer (OEM), who embeds the fan in a piece of equipment where the main function is something other than the movement of air, or because they are manufactured for the purpose of being embedded into an appliance after market.[38] The CEC also discussed the potential complexity of testing embedded fans and the accuracy of the results. See section III.E.9 of this document for further discussion related to testing 87 FR 44194, 44206–44207.

In the July 2022 NOPR, DOE proposed to exclude fans embedded in equipment listed in Table III–4 of this document, as long as the fan is not distributed in commerce as a standalone product, consistent with the Working Group term sheet scope recommendations related to embedded fans. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendations #2 and #3 at pp. 2–4) DOE noted that the equipment listed in Table III–4 of this document includes equipment that is separately regulated by DOE (''covered equipment'') as well as non-covered equipment (*i.e.,* transportation refrigeration equipment, vacuum cleaners, heat rejection equipment, and air curtains). 87 FR 44194, 44207. The rest of this section discusses the comments received on each proposed exclusion and DOE's decision for this final rule.

Greenheck commented that DOE should consider adopting the ASAP/NRDC/ACEEE proposal to CEC[39] regarding the issue of embedded fans in equipment. Greenheck commented that the recommendation includes a two-phase rulemaking approach allowing for expeditious rulemaking in phase one for fans, while continuing to provide additional opportunities for energy savings in phase two for built-up equipment that includes embedded fans. Greenheck commented that including embedded fans in the scope adds significant complexity and a two-phase approach would provide time for additional investigation of all impacts for embedded fans. In addition, Greenheck noted that equipment incorporating fans are already tested at a component level, or as an entire system to AHRI test standards, building energy codes, and in some cases, DOE test standards (*e.g.,* dedicated outdoor air systems equipment). Further,

[36] *See* Proposed regulatory language for Commercial and Industrial Fans and Blowers, Docket No. 22–AAER–01 at *efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=22-AAER-01.* **Note:** Since the publication of the July 2022 NOPR, on September 9, 2022, the CEC has published Express terms with implemented amendments to the proposed regulation for Commercial and Industrial Fans and Blowers Efficiency.

[37] *See* CEC Commercial and Industrial Fans and Blowers Staff Report, Docket No. 22–AAER–01, TN #241951 at p. 16.

[38] *Id.*

[39] *See: efiling.energy.ca.gov/GetDocument.aspx?tn=224830.*

Greenheck commented that it, as well as other manufacturers of equipment that include a combination of fans, heating, cooling, filtration, energy recovery, and/or other components, publishes performance data for embedded fans as installed in the equipment. Greenheck commented that performance data for the fan in the minimum testable configuration is typically not available and to comply with the scope of the DOE NOPR, manufacturers would have to retest embedded fans in their minimum testable configuration. Greenheck commented that the testing burden is significant and will force manufacturers to prioritize their resources on the testing required to comply with this regulation, rather than improving the overall efficiency of the equipment. Greenheck asserted that the embedded fans are only a portion of the overall energy consumption of these products and that regulating the equipment holistically like AHRI 920 for direct-expansion dedicated outdoor air systems (''DX–DOASes'') will result in the largest reduction in energy consumption. (Greenheck, No. 39 at pp. 5–6)

AHAM opposed the development of test procedures, energy conservation standards, and/or certification requirements for categories of commercial and industrial fans and blowers that are component parts of home appliances and supported a finished-product approach to energy efficiency regulation. AHAM commented that expanding the test procedure or coverage to embedded fans used in home appliances could push finished product manufacturers to more expensive components and increase the cost of appliances and equipment, while not necessarily improving the energy performance of the finished product and potentially impacting the efficacy of products such as range hoods. AHAM added that it would significantly increase burden on manufacturers if manufacturers of products that incorporate embedded fans are suddenly forced to certify compliance with standards for component parts, including the testing, paperwork, and record-keeping requirements that accompany certification and the risks associated with enforcement. AHAM commented that the manufacturer additional burden would not be outweighed by a corresponding benefit. Further, AHAM stated a concern that for both for embedded fans and air circulating fans, the proposed efficiency requirements could drive performance challenges due to reduced air flow. AHAM commented that given that many products using fans are used to improve indoor air quality, such as range hoods/downdraft fans, this is an undesirable result, which could impact consumer health and safety for the long term. In addition, for air circulating fans, AHAM commented that this would reduce the performance of the primary function of the fan. AHAM also commented that for covered products, there is no benefit to requiring embedded fans to meet an energy conservation standard or to be tested. AHAM stated that those products are already regulated by DOE and many manufacturers turn to more efficient designs that include components, such as more efficient fans to meet more stringent energy conservation standards. (AHAM, No. 35 at pp. 6–7)

AHRI commented that DOE is proposing changes to the scope of test procedures for commercial fans that would include fans destined for particular applications in finished goods. AHRI stated disagreement with DOE's plan to expand the existing scope of coverage of commercial fans to include these products. AHRI commented that embedded fan testing, and ultimately energy conservation standards, would save minimal, if any, energy and would create needless testing, paperwork, and record-keeping requirements that would raise costs for consumers. In addition, AHRI commented that the foreword of AMCA 214–21 notes, ''AMCA Standard 214 primarily is for fans that are tested alone or with motors and drives; it does not apply to fans tested embedded inside of other equipment.'' AHRI commented that there is no normative procedure for applying a stand-alone fan metric to embedded applications and therefore recommended to only include stand-alone fans in this regulation. (AHRI, No. 40 at p. 8) In addition, AHRI commented that there are a variety of safety standards affected by air flow in addition to the performance standards. AHRI commented that testing of all legacy equipment because of a fan change will be cost and resource prohibitive. AHRI added that if a replacement fan is not compliant then, in most cases, an engineered-to-fit substitution would be required, along with requisite reliability, robustness assurance actions, and safety standard compliance. AHRI commented that costs, risks, and time required to retest heating, ventilation, air-conditioning and refrigeration (''HVACR'') and water heating equipment would all be prohibitive and could be impractical if the HVACR and water heating equipment are out of production. Further, AHRI commented that manufacturers would be forced to rebuild an out-of-production unit solely for the purpose of testing the new fan or risk abandoning a reasonable repair path for consumers. AHRI further stated that there may be instances where such part substitution makes sense, but that is not a reasonable basis for a broad scope to a component's test procedure. (AHRI, No. 40 at pp. 9–10)

JCI commented that the proposed changes will likely result in elimination of current fans for those products ''outside the scope'' of this rulemaking as an unintended consequence as fan manufactures will seek to standardize designs and eliminate options. Therefore, per the recommendation of the term sheet, JCI recommends that all embedded fans be excluded from the scope of this rulemaking. JCI further commented that there also appears to be a major design limitation as there are few if any existing outdoor condenser fan designs, which have a FEI > 1.0. JCI stated that this issue by itself presents a major design and test hurdle as direct drive plenum fans are not designed to be utilized in a traditional outdoor, condenser exhaust configuration such as a rooftop unit. (JCI, No. 34 at p. 2)

DOE notes that this final rule does not establish any certification requirements and energy conservation standards for fans and blowers and would not require any fan replacements or redesigns and would not result in any changes in fan performance, or in the elimination of fan models, or in the need to retest HVARC equipment, or added certification burden. In addition, as discussed in section III.B.3.b of this document, DOE is implementing exclusions for fans embedded in covered equipment where the DOE metric already captures the energy use of the fans, such as supply and condenser fans embedded in DX–DOASes subject to any DOE test procedures in appendix B to subpart F of part 431. Finally, as discussed in section III.E.9 of this document, DOE determined that some fan manufacturers test embedded fans as standalone fans and therefore DOE has determined that there is value in establishing a standardized test method for these fans.

AHRI commented that as DOE has indicated in a prior notice of proposed determination and request for comment on small electric motors, DOE should maintain consistency in its rulemaking process and seek to establish regulatory coverage over equipment rather than the components in such equipment. (AHRI, No. 40 at p. 9)

Trane commented that if changing an embedded fan necessitates the re-optimization or redesign of Trane's products, it will be forced to make trade-offs within the design of the product itself in order to maintain the most cost-competitive price point. Trane stated that for products which must already meet an energy performance metric that captures the fans, including the majority of fans in large commercial unitary air conditioners and air compressors, this will mean an energy-neutral change to the overall performance of the product. As an example, if a Trane large commercial air conditioner must be redesigned to accommodate a larger supply fan, downgrades to the compressors and/or heat exchangers would have to be made in order to control costs. The new product would have a similar Integrated Energy Efficiency Ratio (IEER)—washing out the energy savings from the supply fan—but would be larger, more expensive, and sub-optimal. (Trane, No. 38 at p. 3)

DOE notes that this final rule does not establish any energy conservation standards for fans and blowers and would not impact the efficiency and performance of fans embedded in covered equipment or products. In addition, EPCA provides that no standard prescribed for small electric motors (*i.e.,* those regulated in 10 CFR part 431, subpart X) shall apply to any such motor that is a component of a covered product under EPCA or of covered equipment under EPCA. (42 U.S.C. 6317(b)(3)) EPCA does not establish any such prohibition for fans and blowers. DOE further notes that EPCA does not establish any such prohibition for electric motors either. *See* 42 U.S.C. 6313(b)(1) (providing that standards for electric motors be applied to electric motors manufactured ''alone or as a component of another piece of equipment'').

AHRI commented that requests have been made to lower the power threshold from less than or equal to 1hp, to less than or equal to 0.25hp, which would include a large swath of fans used in residential products, including residential central air conditioners and heat pumps. AHRI stated that in order to regulate ''industrial equipment articles'' that are component parts of consumer products, DOE must determine that ''such articles are, to a significant extent, distributed in commerce other than as component parts for consumer products.'' (42 U.S.C. 6312(c)(1)) AHRI commented that in general, DOE regulates products as a whole and not by component. Although DOE has previously regulated furnace fans and electric motors, AHRI commented that DOE did so under unique authority provided in the sections of EPCA specific to those products and equipment.[40] AHRI commented that under the general industrial component requirement to show that embedded fans are distributed in commerce other than as component parts in a consumer product, DOE does not have the authority to regulate fans that are embedded in consumer products. (AHRI, No. 40 at pp. 5–6)

As discussed, on August 19, 2021, DOE published a final determination classifying certain fans and blowers as covered equipment and determining that fans and blowers meet the three statutory criteria for classifying industrial equipment as covered (42 U.S.C. 6311(2)(A)), including that fans and blowers are to a significant extent distributed in commerce for industrial or commercial use. *See* 86 FR 46579, 46586–46588. Further, ''covered equipment'' consists of certain industrial equipment, which in turn excludes covered products, other than industrial equipment that is a component of a covered product. (42 U.S.C. 6311(1) and (2)(A)(iii) DOE also noted, in a footnote, that distribution for residential use does not preclude coverage as covered equipment so long as to a significant extent the equipment is of a type that is also distributed in commerce for industrial and commercial use. *See* 86 FR 46579, 46586. As such, DOE disagrees with AHRI's assessment of DOE's authority. DOE can regulate fans and blowers embedded in a covered product.

a. Fans and Blowers Embedded in Non-Covered Equipment

Consistent with the Working Group term sheet scope recommendation (Docket No. EERE–2013–BT–STD–0006–0179, Recommendation #2 at p. 2), DOE proposed to exclude fans that are exclusively embedded in transport refrigeration (*i.e.,* trailer refrigeration, self-powered truck refrigeration, vehicle-powered truck refrigeration, and marine/rail container refrigeration) from the scope of the test procedure. 87 FR 44194, 44207.

In response to the July 2022 NOPR, the CEC recommended excluding fans mounted in motor vehicles or other mobile equipment since the fans are smaller in size and, although they require electricity to operate, the source of electrical power is generated by the engine of the motor and not the public electrical grid. The CEC noted that Table III–8 of the July 2022 NOPR may provide the exclusion for these fans, but that the wording was unclear (CEC, No. 30 at p. 2)

DOE did not receive any additional comments on this exclusion. Further, because DOE is not adopting a definition of ''exclusively embedded fan'' (see section of this III.B.3.c document) in this final rule, DOE excludes fans that are embedded in transport refrigeration and removed the term ''exclusively'' as proposed in the July 2022 NOPR. In addition, DOE discusses the exclusion of fan powered by combustion engines in section III.B.5 of this document.

In the July 2022 NOPR, consistent with the Working Group term sheet scope recommendation (Docket No. EERE–2013–BT–STD–0006–0179, Recommendation #2 at p. 2), DOE proposed to exclude fans exclusively embedded in vacuum cleaners from the scope of the test procedure. 87 FR 44194, 44207.

In response to the July 2022 NOPR, AHAM agreed that fans embedded in consumer/residential vacuum cleaners should be exempt from the scope. (AHAM, No. 35 at p. 5)

AHAM commented that it opposes including fans embedded in consumer home appliances, whether those products are DOE ''covered products'' or not, in the scope of the test procedure and/or energy conservation standards. AHAM noted that fans embedded in most home appliances would not be implicated by DOE's currently proposed definition of embedded fans because most are under 1 horsepower. However, AHAM noted that a lower threshold of 0.25 hp would include fans used in a number of covered products.[41] AHAM added that there are a few products that might use fans that meet DOE's definition and AHAM objects to those fans being considered commercial and industrial fans. AHAM is concerned that coverage of such fans could negatively impact the product performance of products such as range hoods/downdraft fans that are critical for improving indoor air quality in homes. AHAM commented that DOE should exclude embedded fans used in residential products such as range hoods/downdraft fans and hand dryers as well as dryer booster fans and fans used in commercial clothes dryers.

[40] AHRI commented that DOE is required by EPCA to consider and prescribe new energy conservation standards or energy use standards for electricity used for purposes of circulating air through duct work. *Id.* 42 U.S.C. 6295(f)(4)(D); *Id.* 42 U.S.C. 6313(b)(1) (covering electric motors ''alone or as a component of another piece of equipment'').

[41] These products include but are not limited to: residential refrigerator/freezers, clothes washers and dryers, dishwashers, room air conditioners, portable air conditioners, dehumidifiers, and (in the future) room air cleaners.

Additionally, AHAM is concerned that commercial clothes washers could be implicated even by the 1 horsepower limitation and requested that DOE specifically exclude fans used in commercial clothes washers from the scope of its regulation. (AHAM, No. 35 at pp. 4–5)

In this final rule, DOE excludes fans that are embedded in vacuum cleaners from the scope of the test procedure, as proposed. Further because DOE is not adopting a definition of ''exclusively embedded fan'' (see section III.B.3.c of this document), DOE removes the use of the term ''exclusively'' as proposed in the July 2022 NOPR. DOE notes that this final rule establishes a test procedure for fans and blowers and does not adopt any energy conservation standards. This final rule will not have any impacts on the performance of the fan of the larger equipment in which the fan is embedded. In addition, as noted in section III.B of this document, DOE establishes a lower shaft input power limit of 1 hp (0.89 kW of electrical input power) and that the lower power limit of 1 horsepower (0.89 kW) excludes most fans used in regulated and non-regulated consumer products, including range hoods. Finally, as discussed in section III.B.3.b of this document, DOE is implementing exclusions for fans embedded in covered equipment where the DOE metric already captures the energy use of the fans.

In the July 2022 NOPR, consistent with the Working Group term sheet scope recommendations (Docket No. EERE–2013–BT–STD–0006–0179, Recommendation #2 at p. 2), DOE also proposed to exclude fans exclusively embedded in heat rejection equipment from the scope of the test procedure (*See* Table III–4 of this document for a list of the heat rejection equipment). DOE noted that fans used in heat rejection equipment are primarily fabricated in-house by the heat rejection equipment manufacturer and that these fans are not sold in a standalone configuration.[42] 87 FR 44194, 44207.

In response to the July 2022 NOPR, Trane commented that DOE should align with the CEC proposed regulation in which the definition of embedded fans includes fans used in heat rejection equipment. Trane commented that heat rejection fans for HVAC systems are not designed for specific flow of air, and thus a metric based on air flow is not valid for heat rejection fans such as condenser fans. Trane noted that because a heat rejection fan's purpose is to reject heat from a system, these fans are designed in conjunction with a heat exchanger solely for optimizing removal of heat from a system. Trane commented that enforcing fan efficiency requirements on these definite purpose fans will require re-optimization of the heat rejection system that will not impact overall system efficiency and building energy consumption. Trane stated that this would impact manufacturer design cost, manufacturing cost, and end customer cost with no measurable energy benefit or payback. (Trane, No. 38 at p. 2)

Trane added that in order to align with CEC and the definitions of AMCA 214–21, DOE should add to the list of exclusions: (1) Air cooled chillers; and (2) Unitary package units above 760k btu (whose system metric is covered in ASHRAE 90.1–2019). (Trane, No. 38 at p. 2)

The CA IOUs recommended that DOE exclude all condenser fans from the scope of the test procedure. The CA IOUs explained that DOE proposed to accept the Cooling Tower Institute's recommendation to exclude heat rejection fans on various unregulated equipment and agreed with this decision as these fans would be difficult or impossible to test using the underlying procedures. Furthermore, the CA IOUs stated that improving the fan's efficiency would not necessarily improve the system's efficiency because of its embedment in a larger system. The CA IOUs commented that the same logic would apply to condenser fans in other types of equipment (*e.g.,* chillers and unregulated commercial unitary air conditioners). (CA IOUs, No. 37 at p. 10)

Daikin commented that fans used in air-cooled condensers have the same issues as fans used in cooling towers and other heat rejection equipment. (Public Meeting, No. 18 at p. 16) DOE notes that the Working Group did not list chillers and air-cooled condensers, and specifically limited the exemption to regulated commercial unitary air conditioners with a certified cooling capacity between 5.5 tons (65,000 Btu/h) and 63.5 tons (760,000 Btu/h). As previously noted, the embedded fan exclusions recommended by the Working Group would exclude from the scope of the test procedure fans that are embedded in regulated equipment for which the DOE metric captures the energy consumption of the fan. In line with the approach taken by the Working Group, and as discussed in section III.B.3.b of this document, DOE is implementing exclusions for fans embedded in covered equipment where the DOE metric already captures the energy use of the fans. Chillers are currently not a covered equipment and DOE does not regulate commercial unitary air conditioners with a certified cooling capacity above 760,000 Btu/h. Air cooled condensers are also not regulated by DOE. Although fans used in these equipment may face similar issues than fans used in heat rejection equipment, both pieces of equipment were not specifically listed for exemption by the Working Group. Therefore, DOE is not excluding fans used in these categories of equipment. Further, DOE excludes other condenser fans in several types of covered equipment, if the DOE metric captures the energy use of these fans. (*See* section III.B.3.b of this document.) In addition, in this final rule, DOE is not establishing any energy conservation standards and the adoption of a test procedure will not impose fan efficiency requirements. For these reasons, DOE is maintaining the exclusion of fans embedded in heat rejection equipment as proposed in the July 2022 NOPR. Further, because DOE is not adopting a definition of ''exclusively embedded fan'' (see section of this III.B.3.c document), DOE removes the use of the term ''exclusively'' as proposed in the July 2022 NOPR.

In addition, in the July 2022 NOPR, DOE proposed that fans embedded in air curtains be excluded from the scope of the proposed test procedure. 87 FR 44194, 44207. In response to the July 2022 NOPR, The CEC commented in support of the proposed exclusion of air curtains. (CEC, No. 30 at p. 2) DOE did not receive any additional comments on this issue and is excluding fans in air curtains as proposed.

b. Fans and Blowers Embedded in Covered Equipment

In the July 2022 NOPR, DOE also proposed that the test procedure would exclude fans in covered equipment in which the fan energy use is already captured in the equipment specific test procedures. DOE proposed to adopt an exclusion for fans embedded in equipment listed in Table III–4,[43] as long as the fan is not distributed in commerce as a standalone product. DOE proposed to additionally exclude fans embedded in DX–DOASes to reflect the DOE proposed test procedure and metric for DX–DOASes that, if adopted,

[42] In some cases, the heat rejection equipment manufacturer may purchase the impeller and assemble the fan in a housing which is tied to the structure of the heat rejection equipment.

[43] DOE notes that while the Working Group recommended to exclude fans in residential furnaces that are subject to DOE's energy conservation standard at 10 CFR 430.32(y), furnace fans are excluded from the definition of ''fan and blower'' and therefore do not need to be listed as a proposed exclusion.

would incorporate fan energy use.[44] DOE noted that the proposed exclusions were consistent with the recommendations of the Working Group. DOE also noted that the proposed approach would avoid regulating fans for which existing DOE regulations account for their energy use by excluding such fans from the test procedure if distributed exclusively embedded in the listed equipment. DOE proposed that to the extent a fan is distributed in commerce as a stand-alone fan, and therefore is not limited to use in specific equipment, or embedded in equipment in which its energy use is not addressed in a DOE test procedure, such a fan would be subject to the DOE test procedure. 87 FR 44194, 44207. Table III–7 of this document summarizes the embedded fans proposed for exclusion from the scope of the test procedure.

TABLE III–7—EMBEDDED FANS EXCLUDED FROM THE SCOPE OF THE TEST PROCEDURE

Fans embedded in:
DX–DOASes subject to any DOE test procedures in appendix B to subpart F of part 431.*
Single-phase central air conditioners and heat pumps rated with a certified cooling capacity less than 65,000 British thermal units per hour (“Btu/h”), that are subject to DOE’s energy conservation standard at 10 CFR 430.32(c).
Three-phase, air-cooled, small commercial packaged air-conditioning and heating equipment rated with a certified cooling capacity less than 65,000 Btu/h, that are subject to DOE’s energy conservation standard at 10 CFR 431.97(b).
Transport refrigeration (*i.e.,* Trailer refrigeration, Self-powered truck refrigeration, Vehicle-powered truck refrigeration, Marine/Rail container refrigerant), and fans exclusively powered by combustion engines.
Vacuum cleaners.
Heat Rejection Equipment:
• Packaged evaporative open circuit cooling towers.
• Evaporative field-erected open circuit cooling towers.
• Packaged evaporative closed-circuit cooling towers.
• Evaporative field-erected closed-circuit cooling towers.
• Packaged evaporative condensers.
• Field-erected evaporative condensers.
• Packaged air-cooled (dry) coolers.
• Field-erected air-cooled (dry) coolers.
• Air-cooled steam condensers.
• Hybrid (water saving) versions of all of the previously listed equipment that contain both evaporative and air-cooled heat exchange sections.
Air curtains.
** Air-cooled commercial package air conditioners and heat pumps (CUAC, CUHP) with a certified cooling capacity between 5.5 tons (65,000 Btu/h) and 63.5 tons (760,000 Btu/h) that are subject to DOE’s energy conservation standard at 10 CFR 431.97(b).
** Water-cooled and evaporatively-cooled commercial air conditioners and water-source commercial heat pumps that are subject to DOE’s energy conservation standard at 10 CFR 431.97(b).
** Single package vertical air conditioners and heat pumps that are subject to DOE’s energy conservation standard at 10 CFR 431.97(d).
** Packaged terminal air conditioners (PTAC) and packaged terminal heat pumps (PTHP) that are subject to DOE’s energy conservation standard at 10 CFR 431.97(c).
** Computer room air conditioners that are subject to DOE’s energy conservation standard at 10 CFR 431.97(e).
** Variable refrigerant flow multi-split air conditioners and heat pumps that are subject to DOE’s energy conservation standard at 10 CFR 431.97(f).

** DX–DOASes are not currently subject to a DOE test procedure. However, there is an ongoing rulemaking to establish a test procedure for DX–DOASes that DOE anticipates will be finalized before the final rule of the fans and blowers rulemaking. Information about this rulemaking can be found at *www.regulations.gov* under Docket No. EERE–2017–BT–TP–0018.

* The exclusion only applies to supply and condenser fans embedded in this equipment.

NEEA commented in support of DOE’s definitions and scope for inclusion and exemptions of embedded fans, but recommended DOE establish a consistent approach to ensure fan efficiency is accounted for in other regulated products. NEEA commented that this would include a similar methodology for each product, even if the exact conditions are not the same across all products. Conceptually, NEEA stated that this could function as a checklist to ensure fans are appropriately accounted for: (1) the total fan energy use is accounted for in the ‘‘average period of use’’ of that product (*e.g.,* economizing fan energy use for CUAC); (2) the testing conditions represent the operating conditions of the fan (*e.g.,* representative static pressure for packaged HVAC); (3) the benefits of variable speed fans and right sizing of a fan are accounted for (*i.e.,* will these energy saving measures increase the regulated rating). (NEEA, No. 36 at pp. 7–8)

DOE accounts for fan energy use on a product-by-product basis. Any consideration of fan energy use in other covered product or equipment would be addressed in the test procedure rulemakings specific to each such product or equipment.

AHRI recommended that DOE exclude fans embedded in commercial water heaters and boilers from the rulemaking. AHRI commented that the metric for commercial water heaters includes the embedded fan’s energy, meeting the criteria which was the basis for limited exclusions in regulated products recommended by the Working Group. AHRI commented that the test procedure and energy conservation standards for commercial boilers do not capture the fan power. However, AHRI commented that the actual energy savings potential from applying the proposed fan regulation to a boiler or water heater fan itself is likely to be small and the total energy consumption of the equipment may be increased due to effects on combustion. In addition, AHRI stated that the complexity of integrating a new fan system into a boiler or water heater is considerable as fans are integral parts of the combustion

[44] *See* 86 FR 72874, 72889–72890 (December 23, 2021).

systems, raising costs that are ultimately passed on to consumers. AHRI commented that the appropriate approach is to work through the commercial boiler test standard's consensus process and find a path to incorporate the electrical energy used in a boiler system into the test procedure and the equipment ratings to include electrical power consumption from the fan is currently being drafted. AHRI added that it estimates the market of the commercial boiler and water heater industries is small, with annual shipments of approximately 20,000 boiler units and under 2,000 hot water supply boilers. In addition, AHRI noted that fans used in commercial storage water heaters are virtually all under 1 horsepower and only exceed 1 horsepower in commercial boilers and hot water supply boilers with input rates exceeding two million Btu/h. For hot water supply boilers, AHRI commented that approximately 12 percent of models exceed 2 million Btu/h, or approximately 250 boilers per year nationally.[45] Based on these shipments, AHRI estimated that the potential 30-year electricity savings from commercial boiler fans would be on the order of 0.016 quads nationally and noted a potential that fan changes will result in increased standby losses and reduction in thermal efficiency that would result in a net energy loss. AHRI added that given the small degree of energy savings and the small shipment volume relative to the significant redesign, testing, and certification costs associated with incorporating a new fan, it is highly unlikely that there are significant positive consumer benefits. (AHRI, No. 40 at pp. 11–12)

As noted by AHRI, the metric for commercial water heaters includes the embedded fan's energy, meeting the proposed criteria to identify the embedded fan exemption. However, as AHRI noted, fans in this equipment are below 1 hp shaft power and therefore are already excluded based on the adopted power limits discussed in section III.B.1 of this document. Therefore, DOE did not propose and is not adopting to specifically list this equipment in the list of covered equipment for which the fan is excluded from the test procedure. For embedded fans in commercial boilers, as noted by AHRI, only the larger units would incorporate fans that meet the scope criteria discussed in section III.B.1 of this document. However, as noted by AHRI, the current DOE test procedure for commercial boilers does not capture the fan energy use; therefore, DOE did not propose and is not adopting to list this equipment as part of the covered equipment for which the fan is excluded from the test procedure. Instead, DOE is exempting fans embedded in the equipment listed in Table III–7, as proposed in the July 2022 NOPR and continues to exclude fans in covered equipment in which the fan energy use is already captured in the equipment specific test procedures. Further, because DOE is not adopting a definition of ''exclusively embedded fan'' (see section of this III.B.3.c document), DOE removes the use of the term ''exclusively'' as proposed in the July 2022 NOPR. In addition, DOE notes that this final rule does not adopt energy conservation standards or certification requirements and any impacts from setting potential energy conservation standards (including equipment redesign and consumer benefits) will be analyzed as part of any separate energy conservation standard rule.

Daikin commented that it was appropriate to exempt embedded fans in DOE-regulated products and added that DOE should also exempt fans in equipment that are regulated by IECC and [ASHRAE] 90.1 (Public Meeting transcript, No. 18 at p. 15–16)

As noted previously, DOE is exempting fans embedded in the equipment listed in Table III–7, as proposed in the July 2022 NOPR and continues to exclude fans in covered equipment in which the fan energy use is already captured in the equipment specific test procedures. In addition, DOE is not exempting fans that are in equipment that are regulated by IECC and ASHRAE 90.1, consistent with the term sheet. Instead, DOE excludes fans embedded in equipment listed in Table III–7, consistent with the Working Group term sheet scope recommendations related to embedded fans.

c. Exclusively Embedded Fans

In the July 2022 NOPR, DOE further clarified that DOE proposed to exclude embedded fans that are not distributed in commerce as standalone fans. DOE acknowledged that in a number of instances, a standalone fan purchased by a manufacturer for incorporation into a unit of listed equipment may be indistinguishable based on physical features from a fan that is purchased by a manufacturer for incorporation into non-listed equipment or from a fan used as a standalone fan. DOE noted that during the ASRAC negotiations, AHRI conducted a survey of its members to determine the number of fans purchased versus manufactured by the equipment manufacturer. (Docket No. EERE–2013–BT–STD–0006, AHRI, No. 125.3 at p. 1) AHRI estimated that over 80 percent of all fans that are used as components across all commercial regulated equipment are manufactured by the equipment manufacturer. *Id.* This percentage was higher for commercial air-conditioning and heat pump equipment and was estimated to be between 94 and 99 percent. 87 FR 44194, 44208.

In order to provide additional specificity as to the fans that would be subject to the embedded fan exclusion, in the July 2022 NOPR, DOE proposed to use the term ''exclusively embedded fans'' to designate the fans covered by the embedded fan exclusion. DOE proposed to define ''exclusively embedded fan'' as: a fan or blower that is manufactured and incorporated into a product or equipment manufactured by the same manufacturer and that is exclusively distributed in commerce embedded in another product or equipment. Based on this information, DOE tentatively determined that the vast majority of fans used as components in regulated commercial HVACR equipment would meet the proposed definition of exclusively embedded fan and would not be subject to the test procedure as proposed in the July 2022 NOPR. DOE further provided examples illustrating how the proposed definition of exclusively embedded fan would impact whether a fan must be tested and certified to DOE. 87 FR 44194, 44208.

In response to the July 2022 NOPR, ebm-papst commented that it does not believe it to be common practice that original equipment manufacturers (''OEMs'') fabricate fans in the literal sense. ebm-papst added that very few OEMs, if any, in the U.S. fabricate their own impellers and that in its experience no American OEMs fabricate their own fan motors or their own electronic fan speed controller. However, ebm-papst added that it is common practice for OEMs to purchase major sub-components from independent suppliers, such as ebm-papst. (ebm-papst, No. 31 at p. 6)

Morrison commented that 95 percent of fans it manufactures are used in HVAC equipment. (Morrison, No. 42 at p. 3)

As noted in the July 2022 NOPR, DOE relied on data from AHRI to estimate the share of embedded fans that are manufactured in-house by OEMs vs. purchased and notes that these

[45] AHRI cited U.S. Department of Energy, Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Water Heating Equipment, April 18, 2016, Figure 3.10.26, p. 3–29).

estimates may not reflect individual manufacturer practices.

In response to the July 2022 NOPR, DOE received several comments related to the proposed definition of ''exclusively embedded fan''.

AHRI stated support for the AMCA 214–21 definition of an embedded fan as ''a fan that is part of a manufactured assembly where the assembly includes functions other than air movement.'' (AHRI, No. 40 at p. 8)

NEEA commented in support of DOE's proposals related to embedded fans and supports the definition of exclusively embedded fans, which adds additional clarity to what is included or excluded from regulation. (NEEA, No. 36 at p. 7)

The Efficiency Advocates supported DOE's proposal regarding embedded fans. The Efficiency Advocates commented that generally fans can be sold as standalone products or they may be embedded within a piece of equipment that requires the fan to operate. The Efficiency Advocates commented that in the NOPR, DOE defines ''exclusively embedded'' fans and excludes various types of exclusively embedded fans consistent with the Working Group recommendations. The Efficiency Advocates stated that these exclusions, summarized in Table III–8 of the July 2022 NOPR, essentially apply only to embedded fans in regulated equipment for which the DOE metric captures the energy consumption of the fan. The Efficiency Advocates support this approach to help ensure that inefficient fans are not embedded into products for which energy use is not captured by a DOE efficiency metric. (Efficiency Advocates, No. 32 at p. 2)

Morrison commented that the exclusively embedded fans it manufactures have a clearly identified label with a unique part number and are exclusive per the manufacturer, with full traceability through the sales order process to a ship-to site. Morrison stated a concern about double regulation for parts that are instrumental to the equipment's already existing regulation and now an added layer of regulation that adds to the cost of products but provides no additional energy savings. (Morrison, No. 42 at p. 4) Morrison added that the fans it manufactures are built to order for the customer and are application-specific designs with unique part numbers on the label that identify the customer and location. Morrison stated that all shipments have a unique Sales Order that confirms the ship-to location and part number and would be traceable to the OEM's appliance. Morrison commented that the fans it manufactures are assembled into an appliance and nearly all are in the covered product category that has a metric inclusive of the fan energy. In addition, Morrison pointed out that this proposed added layer of test for standalone fans before embedding amounts to duplicate regulation and double counting of the energy savings, and that these fans are currently tested by the OEMs in the appliance and would not need the added cost of regulation as a fan. (Morrison, No. 42 at p. 3)

AHAM commented that embedded fans used in covered products should be excluded. AHAM commented that it is critical that those fans be excluded regardless of whether they are imported or sold for inclusion in a domestically manufactured product or are imported as part of that product. AHAM requested that should DOE include fans that are embedded in consumer products, DOE ensure that all embedded fans—whether sold for incorporation into the product or imported already in the product—are treated the same. Otherwise, AHAM commented that domestically manufactured products could be at a disadvantage, which is contrary to the Administration's goals to increase domestic manufacturing. (AHAM, No. 35 at p. 5)

AHRI commented that all embedded fans, and replacement fans for these finished goods, regardless of whether they are domestically produced or imported as part of the product, should be exempt. Under DOE's proposal, AHRI commented that finished goods manufactured overseas would be treated differently from those manufactured domestically. AHRI stated that, as proposed, a manufacturer would be able to buy and embed a standalone fan and not be subject to the regulation if the finished product was imported. However, AHRI added, a domestic manufacturer buying a fan for manufacture domestically would be subject to the proposed rule, as written, and DOE has not considered the burden this places on domestic manufacturers. (AHRI, No. 40 at pp. 7–8)

Morrison commented that the exemption for exclusively embedded fans would lead to trade-restrictive issues. Morrison commented that using a scenario of covered equipment with an exempted embedded fan: (1) If the OEM produces the testable fan configuration, then those fans are exempt from fan regulation (2) But if an identical fan construction is delivered as a testable configuration by a supplier to an OEM factory in the U.S., then the fan is considered a standalone fan and therefore will be in the scope of the regulation and testing will be required (3) On the other hand, if the U.S. OEM has a joint venture north or south of the border, then it can receive and install unregulated fans there and sell the unit back in the U.S. without any fan regulation (4) Another scenario is possible with the OEM factory in a foreign country and under that scenario, the embedded fan is exempt from fan regulation. Morrison commented that this would appear to promote the use of offshore production and would not just favor foreign-made equipment but would encourage more use of imported equipment. (Morrison, No. 42 at p. 3) Similarly, ebm-papst did not support the proposed definition of standalone fans in the NOPR and provided the following scenario: If an OEM fabricates the testable fan configuration itself, the fans will be exempt from fan regulation. However, ebm-papst stated, if an identical fan construction is supplied as a testable configuration by a supplier to an OEM factory in the U.S., then the fan will become a standalone fan and therefore will be in the scope of the regulation. ebm-papst added that if the U.S.-based OEM owns a factory outside of the U.S., then it will be permitted to receive and install unregulated fans there, and sell the unit in the U.S. ebm-papst further commented that if the OEM factory is in a foreign country altogether, then the embedded fan will be exempt from the fan regulation. ebm-papst commented that the proposed exclusions would be a restraint of domestic trade, while favoring foreign OEM factories. (ebm-papst, No. 31 at p.2)

ebm-papst requested clarification regarding the proposed approach to exclude embedded fans if they are fabricated by the OEM, while all external fabricators would be burdened by the regulation. (ebm-papst, No. 31 at p. 1) ebm-papst requested that DOE ensure that all embedded fans—whether sold for incorporation into the product or imported already in the product—be treated the same. Otherwise, ebm-papst commented that domestically manufactured products could be at a disadvantage, which is contrary to the Administration's goals to increase domestic manufacturing. Further, ebm-papst commented that there are no unique physical features that could be used to distinguish a fan that is exclusively designed for use in equipment listed in Table III 8 of the NOPR. However, ebm-papst opposes the attempt to treat exclusively embedded fans differently, merely due to potential differences in the fans' supply chains. (*Id.* at p. 6)

As noted previously, the proposed exclusions for certain embedded fans listed in Table III–8 of the July 2022 NOPR, would only apply to fans that are manufactured in-house by the manufacturer of the equipment or to fans that are imported already embedded in equipment listed in Table III–8 of the July 2022. Fans purchased by OEMs in the U.S. to be incorporated into equipment listed in Table III–8 of the July 2022 NOPR would not be excluded, while fans purchased and incorporated by an OEM outside of the U.S. would be excluded. As noted by the stakeholders, the proposed definition of exclusively embedded fans could therefore disadvantage domestic fan suppliers. For this reason, DOE is not establishing a definition of ''exclusively embedded fan''. As this time, DOE is not differentiating the embedded fan listed for exclusion in Table III–7 depending on whether it is exclusively distributed in commerce embedded in another product or equipment listed in that table (*i.e.,* depending on whether it is manufactured and incorporated into a product or equipment manufactured by the same manufacturer). By removing the proposed ''exclusively embedded fan'' definition, all embedded fans, whether sold for incorporation into the product or already incorporated in the product, would be exempted if embedded in equipment listed in Table III–7 of this document. In the future, DOE may consider an approach to provide additional specificity as to how to identify fans that would be sold for incorporation in equipment listed in in Table III–7 of this document.

JCI requested clarifications on how DOE will verify the performance of a fan or blower in a finished-goods unit in the field. JCI asked if the fans would have to be removed from equipment and sent to a lab for testing. (JCI, No. 34 at p. 2)

DOE's regulations apply to the point of manufacture and not to the equipment as installed in the field. If the fan is embedded in another equipment, testing would be performed in accordance with the provisions described in section III.E.9 of the document.

AHAM commented that it does not support an approach that would require OEMs to certify embedded fans used in their finished products and that would hold OEMs responsible for certification, testing and record-keeping for the fans embedded in their products. AHAM commented that the fan manufacturers should bear this burden given that they have the expertise and facilities to conduct the testing, etc. (AHAM, No. 35 at p. 7)

DOE notes that the fan manufacturer would be responsible for testing and certifying the fan. If the OEM is also the fan manufacturer (and fabricates the fan in-house), then that OEM would be responsible for testing and certifying the fan if included in the scope of the test procedure.

4. Air Circulating Fans

In the July 2022 NOPR, DOE noted that AMCA 230–15 (with errata) did not include any limitation in terms of input power of the air circulating fans that can be tested in accordance with the test procedure. DOE further noted that the AMCA committee was considering limiting the scope of AMCA 230–15 (with errata) to air circulating fans with input power of 125 W and above to focus on commercial and industrial fan applications and exclude residential fans, such as tower fans and bladeless fans. 87 FR 44194, 44210.

In the July 2022 NOPR, DOE tentatively determined that the proposed test procedure would provide a representative measurement of energy use or energy efficiency during a representative average use cycle for all air circulating fans. Therefore, at the time, DOE proposed to include all categories of air circulating fans in the scope of the proposed test procedure; *i.e.,* including equipment with input power less than 125 W. DOE noted that should additional information justify excluding fans with input power less than 125 W from the scope (or any other power limit that may be justified), DOE may consider applying a power limit in the final rule as considered by the AMCA committee and supported by stakeholders. In addition, DOE noted that it may consider specifying that 125 W corresponds to the air circulating fan's input power at maximum speed. 87 FR 44194, 44210.

The Efficiency Advocates stated support for including air circulating fans within the test procedure scope, so that published efficiency information for these products is based on a standardized test procedure and to allow DOE to consider future potential energy conservation standards. (Efficiency Advocates, No. 32 at p. 2)

AMCA commented that the stakeholders of residential circulating fans are not represented by AMCA and have not previously been involved in the fans-and-blowers rulemaking. Additionally, AMCA noted that the demarcation of the scope of the AMCA 230 test standard under revision will start above 125 W. AMCA questioned if DOE has alerted stakeholders of residential circulating fans that they are in the process of being regulated as it would be fair to enable them to weigh in on the proposed test procedure. (AMCA, No. 41 at p. 5) AMCA recommended the exclusion of ACFH with less than 125–W nameplate electrical power, which is the demarcation between the published IEC Standard 60879:2019, ''Comfort fans and regulators for household and similar purpose,'' [46] and AMCA 230 (next revision). AMCA commented that fans covered by IEC 60879 generally are mass-produced, mass-imported, mass-sales residential products, which are made by stakeholders that have not been represented in any U.S. fan-regulation activity to date, such as ASRAC, California Title 20, or model/state energy codes. (AMCA, No. 41 at pp. 7–8)

ebm-papst recommended limiting the scope of the circulation fan test procedure to fans with nameplate power ratings of at least 125 W in an effort to keep the focus of this rulemaking on commercial and industrial fans. ebm-papst added that the scope of EU 327/2011 is limited at 125 W and that lower-power circulation fans are in the scope of IEC 60879. (ebm-papst, No. 31 at p. 6)

Since the publication of the July 2022 NOPR, AMCA published AMCA 230–23, and this latest version of the industry standard only covers air circulating fans with input power greater than or equal to 125 W. Further, to date, stakeholders representative of the market of circulating fans with input power less than 125 W s have not commented on this rulemaking. In addition, in the NOPR, DOE did not review IEC 60879:2019, which stakeholders indicated would be the most appropriate industry test procedure for these fans. For these reasons, at this time, DOE is limiting the scope of the test procedures to air circulating fans with input power greater than or equal to 125 W, as measured by the test procedure at high speed.

AHAM commented that consumer fans such as desk fans, box fans, pedestal fans, should not be included in the scope of commercial and industrial fans and blowers. AHAM commented that this would be in direct contradiction to EPCA, and consumer fans have different average representative uses than commercial and industrial fans. AHAM urged DOE

[46] IEC 60879:2019 specifies the performance-measuring methods of comfort fans and regulators for household and similar purposes, including conventional fans, tower fans, and bladeless fans, their rated voltage being not more than 250 V for single-phase fans and 480 V for other fans, and their rated power input being less than 125 W.

to either specifically exclude consumer air circulating fans from the scope of coverage and noted that a 125 W limit would be an effective way to distinguish consumer fans so long as the 125–W threshold applies to the fan rating alone and not to the entire product or the fan and motor. AHAM noted this could implicate products like residential fan-heaters and stated it was unclear whether the relevant definitions in the applicable AMCA and IEC 60879 standards would take the products out of scope. As such, AHAM requested that DOE make it clear that all residential/consumer fans are exempt. AHAM added that it was their understanding that DOE's proposal did not include bladeless circulation fans in the scope of air circulating fans based on the proposed definitions. AHAM agrees that such fans should not be included. AHAM added that DOE should treat other consumer fans the same way, *i.e.,* no consumer fan should be included in the scope of the commercial and industrial fan test procedure or energy conservation standards). (AHAM, No. 35 at p. 6)

AHAM commented against DOE's proposal to include consumer (residential) air circulating fans and embedded fans used in consumer (residential) products in the scope of its commercial and industrial fans and blowers test procedure. AHAM commented that this would be contrary to EPCA, DOE's coverage determination, and essential EPCA public policy. AHAM commented that consumer fans and fans used in consumer products are, by definition, not commercial/industrial fans or blowers. AHAM added that Congress's intent was to include only commercial and industrial fans and blowers under the scope of ''fans'' and ''blowers'' in 42 U.S.C. 6311(2)(B). First, AHAM noted that fans and blowers are listed as types of industrial equipment, which indicates an intent to cover commercial and industrial equipment, not residential/consumer products. Second, AHAM added that in EPCA, fans and blowers are not included in Part A, which is for Consumer Products other than Automobiles. Third, AHAM stated that fans and blowers by definition are industrial equipment, which EPCA defines as equipment that ''to any significant extent, is distributed in commerce for industrial or commercial use, without regard to whether such article is in fact distributed in commerce for industrial or commercial use.'' (42 U.S.C. 6311(2)(A)(ii)) In particular, AHAM commented that residential air circulating fans by definition are clearly consumer products—they are not, ''to any significant extent'' distributed in commerce for industrial or commercial use and are distributed for use in homes. AHAM commented that fans such as desk fans, box fans, and pedestal fans that are used in homes are regularly distributed in commerce for personal use or consumption by individuals. AHAM commented that if particular SKUs are labeled as consumer fans and, in fact, are primarily marketed and distributed into the very different commercial/industrial sectors, then they can be dealt with through compliance and enforcement efforts rather than by over-incorporation of all consumer fans into test procedures and standards. AHAM noted that commercial clothes washers also appear in the same list of ''covered equipment.'' (42 U.S.C. 6311(1)(H)) AHAM commented that despite the fact that commercial and residential clothes washers share similar construction and are often both used by individual consumers, EPCA differentiates them. Thus, AHAM stated it was evident that Congress intended to include only truly commercial/industrial fans and blowers in the scope of industrial equipment. AHAM added that DOE's proposal to include embedded fans used in consumer products and residential/consumer air circulating fans in the scope of the commercial and industrial fans and blowers rulemaking is inconsistent with its previous decision for these products. AHAM commented that DOE's final determination of coverage stated that ''[t]o qualify as 'industrial equipment,' fans and blowers must be, to a significant extent, distributed in commerce for industrial and commercial use.'' (42 U.S.C. 6311(2)(A)(ii)) AHAM noted that in footnote 26 of the final coverage determination, DOE notes that distribution for residential use does not preclude coverage as covered equipment so long as to a significant extent the equipment is of a type that is also distributed in commerce for industrial and commercial use. However, AHAM commented that is not the case with fans embedded in consumer products (whether they are DOE covered products or not) or fans used in homes to circulate air. Thus, AHAM commented that DOE should not be including either type of fan under the scope of the commercial and industrial fans and blowers test procedure or energy conservation standards. AHAM commented that DOE's proposal is not consistent with its own guidance on the consumer/commercial distinction in EPCA.[47] Specifically, AHAM noted that residential/consumer fans are typically smaller than commercial and industrial fans because they are meant to circulate air in smaller spaces and have lower wattage, have different durability requirements, and have different safety requirements. AHAM commented that UL 507: Standard for Electric Fans applies to consumer fans and some commercial fans, but that there are also additional safety requirements for commercial fans (*e.g.,* OSHA requirements) and UL 507 specifically excludes certain fans. AHAM further noted that there are industrial technical guidance requirements such as ISO13348 (''Industrial fans—Tolerances, methods of conversion and technical data presentation'')[48] that distinguish household and industrial fans. Finally, AHAM noted that residential fans as a product type are primarily used in residential applications. AHAM commented that the same was true for fans embedded in consumer products. (AHAM, No. 35 at pp. 1–4)

AMCA commented in support of AHAM's comment regarding the scope of the [air] circulating fan coverage extending below 125 W. (AMCA, No. 41 at p. 4)

DOE notes that air circulating fans are tested in a configuration that measures electrical input power to the fan, inclusive of the motor, and that the existing test procedures (*i.e.,* AMCA 230–23 or IEC 60879:2019) do not allow measuring the mechanical shaft power to the fan, exclusive of the motor. Therefore, DOE has determined that a limit in terms of electrical input power (applicable to the fan and motor) is more appropriate. Regarding DOE's authority to regulate fans and blowers that are distributed in commerce for residential use, as noted previously (*See* section III.B of this document), DOE has determined that distribution for residential use does not preclude coverage as covered equipment so long as to a significant extent the equipment is of a type that is also distributed in commerce for industrial and commercial use. EPCA defines ''industrial equipment'' as any article of equipment[49] ''of a type'' that ''to any

[47] AHAM referenced the following: *www1.eere.energy.gov/buildings/appliance_standards/pdfs/cce_faq.pdf.*

[48] *See www.iso.org/standard/45118.html.*

[49] The types of equipment are ''(in addition to electric motors and pumps, commercial package air conditioning and heating equipment, commercial refrigerators, freezers, and refrigerator-freezers, automatic commercial ice makers, commercial clothes washers, packaged terminal air-conditioners, packaged terminal heat pumps, warm air furnaces, packaged boilers, storage water heaters, instantaneous water heaters, and unfired

significant extent, is distributed in commerce for industrial or commercial use'' and ''is not a covered [consumer] product [ ] without regard to whether such article is in fact distributed in commerce for industrial or commercial use.'' 42 U.S.C. 6311(2)(A). Accordingly, any equipment that meets the definition of air circulating fan, has an input power greater than or equal to 125 W, as measured by the test procedure at high speed, and is of a type that, to any significant extent, is distributed in commerce for industrial or commercial use is included in the scope of the test procedure, regardless of whether it is sold for use in commercial, industrial, or residential settings. In addition, as previously stated, DOE is not setting test procedures for air circulating fans with input power less than 125 W and DOE believes this would exclude most fans used in residential applications.

Morrison commented that air circulating fans should be covered in a separate rulemaking as their utility, function, and testing process are different from other fans and blowers. Morrison added that this should be done so the appropriate fan manufacturers are engaged in this process to reduce adding burden and complexity to this rulemaking. (Morrison, No. 42 at p. 1)

AMCA recommended that air circulating fans that are not ceiling fans be handled with a separate rulemaking. AMCA commented that this would provide stakeholders of covered fans less than 125 W an opportunity to participate and provide separation between residential and commercial/industrial products. (AMCA, No. 41 at p. 17) In addition, AMCA commented that such request seemed practical and fair seem practical and fair, especially for the circulating fan stakeholders that were not in the scope of the ASRAC process, and which are in the final stages of revising the AMCA 230 test standard for circulating fans. AMCA requested DOE to allow that standard committee to complete its work before issuing the final rule on this test procedure. Already, with the final rule for the ceiling fan test procedure causing problems for the AMCA 230 revision, AMCA commented that it would really hurt the standard to have it out of synch with the fans and blowers test procedure sections that cover circulating fans. (AMCA, No. 41 at pp. 3–4

Greenheck commented that the inclusion of air circulating fans in the fans and blowers test procedure is problematic as they are a completely different type of equipment and utilize different industry test standards, procedures, and metrics as defined in AMCA 230–15. Greenheck commented that the inclusion of air circulating fans makes the test procedure rulemaking confusing and contradictory. (Greenheck, No. 39 at p. 8)

DOE notes that although the test procedures for fans and blowers other than air circulating fans, and air circulating fans are combined in a single notice, DOE is adopting separate test procedures for each category of equipment and explicitly indicates the scope of application of each test procedure. In addition, as noted previously, DOE is not setting test procedures for air circulating fans with input power less than 125 W. Therefore, DOE is continuing to include air circulating fans in the same rulemaking docket as fan and blowers. Although DOE is including air circulating fans in the same rulemaking as fans and blowers other than air circulating fans, DOE notes that this final rule establishes the test procedures for fans and blowers other than air circulating fans and the test procedures for air circulating fans as separate appendices. In addition, as previously stated, DOE is not setting test procedures for air circulating fans with input power less than 125 W. In addition, as discussed in section III.D of this document, DOE is incorporating by reference the latest version of AMCA 230–23, which addresses AMCA's concerns about this rulemaking being completed before AMCA 230–23 published.

AHRI commented that DOE expanded the scope of the NOPR to include fans that were not discussed in the 2015 ASRAC negotiations. In addition, AHRI commented that the October 2021 RFI was narrowly limited to one classification of fans, the air circulating fan heads (''ACFH''). (AHRI, No. 40 at pp. 4–5)

DOE notes that neither the term sheet nor the scope of the RFI limits DOE's authority to initiate a rulemaking on additional categories of fans and blowers. DOE proposed a test procedure for air circulating fans in the July 2022 NOPR and considered comments received in response to the NOPR in determining the test procedure established in this final rule.

5. Non-Electric Drivers

Some fans operate with non-electric drivers, such as engines or generators, and such fans may be used in non-stationary applications or stationary applications. The Working Group recommended that DOE exclude fans that are exclusively powered by internal combustion engines from the test procedure and related energy conservation standards. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #2 at p. 2)

AMCA 214–21 does not provide for the testing of fans and blowers powered by internal combustion engines. In order to measure the energy efficiency or energy use of non-electric drivers during a representative average use cycle, separate test methods would be necessary for each type of driver (*e.g.,* engine, generators). DOE is not currently aware of a relevant industry test procedure and does not have information regarding the test set-up required to test fans powered by internal combustion engines. As such, in the July 2022 NOPR, DOE did not propose test procedures for fans and blowers powered exclusively by an internal combustion engine,[50] regardless of whether such fan or blower is used in a stationary or non-stationary application. 87 FR 44194, 44210.

Certain bare shaft fans can be powered by either electric drivers (*i.e.,* motors) or non-electric drivers. In the July 2022 NOPR, DOE tentatively determined that to the extent such a fan can be powered by an electric driver, the proposed test procedure would provide for measurement of the energy efficiency or energy use during a representative average use cycle when powered by an electric driver. As such, DOE proposed that such a fan would be subject to the test procedure. 87 FR 44194, 44210–44211.

The CEC commented in support of the exclusion of fans that are operated by an internal combustion engine that is used for personal (consumer), commercial, or industrial transportation only. The CEC recommended defining the term ''fan combustion engines,'' since it is unclear if the term ''fan combustion engine'' is meant to be that of a turbo fan engine, a fan driven by an internal combustion engine in any context, or the fans driven by an internal combustion engine used for the purpose of personal (consumer), commercial, or industrial transportation. (CEC, No. 30 at p. 3)

hot water storage tanks) as follows: (i) compressors; (ii) fans; (iii) blowers; (iv) refrigeration equipment; (v) electric lights and lighting power supply circuits; (vi) electrolytic equipment; (vii) electric arc equipment; (viii) steam boilers; (ix) ovens; (x) kilns; (xi) evaporators; (xii) dryers; and (xiii) other motors.'' 42 U.S.C. 6311(2)(B).

[50] DOE notes that the July 2022 NOPR included a typographical error in Table III–8 of the NOPR, stating ''fans exclusively powered by fan combustion engines'' instead of ''fans exclusively powered by an internal combustion engine.''

AMCA stated its support for the exclusion of fans and blowers that are exclusively powered by internal combustion engines from the scope of this test procedure because such fans include Positive Pressure Ventilators (''PPV''), which are portable fans for fire-rescue operations and excluded from having FEI ratings calculated using AMCA 214–21. (AMCA, No. 41 at p. 8)

AMCA noted that to help distinguish fans powered by combustion engines, PPVs are portable tube-axial fans and can be powered by batteries, combustion engines, and hydraulics while having no provisions for duct installations. AMCA added that PPVs sometimes are confused with floor-drying fans, which are housed centrifugal fans, whereas PPVs are not supplied in bare shaft configuration. (AMCA, No. 41 at p. 8)

New York Blower commented that fans with internal combustion engines are extremely rare and not likely to increase due to regulation and that exclusion of these fans seems appropriate. New York Blowers stated that it is possible at lower power ranges that there might be a significant quantity of products and consequently, units driven by internal combustion applications that they are not aware of. Aside from a clutch mechanism to keep the fan disengaged from the motor when idling, New York Blower commented that it does not know of any distinguishing feature of the fan that would indicate the fan would be driven by an internal combustion engine. (New York Blower, No. 33 at p. 9)

Robinson stated a lack of awareness of any physical features of a fan design that would distinguish those as exclusively powered by internal combustion engines other than the presence of an internal combustion engine or potentially a fluid clutch. (Robinson, No. 43 at p. 6)

Morrison commented that many fans for internal combustion engines are specific designs intended for direct attachment to the engine and others have low voltage motors consistent with vehicle electrical systems. Morrison commented that such fans should be part of the equipment regulation (autos, buses, trucks, generators, and heavy equipment) as opposed to being included in this effort as detailed in the ASRAC term sheet. In addition, Morrison noted that these fans have low-voltage motors and heavy construction features. (Morrison, No. 42 at p. 4)

DOE notes that the July 2022 NOPR included a typographical error in Table III–8 of the NOPR, stating ''fans exclusively powered by fan combustion engines'' instead of ''fans exclusively powered by an internal combustion engine.'' In this final rule, consistent with the July 2022 NOPR, and as recommended by stakeholders, DOE excludes fans and blowers powered exclusively by an internal combustion engine, regardless of whether such fan or blower is used in a stationary or non-stationary application from the scope of the test procedure. DOE is not adopting additional definitions as the reference to internal combustion engines clearly specifies the fans excluded from the scope of the test procedure. As noted by stakeholders such fans can be distinguished based on the presence of a clutch mechanism or designs intended for direct attachment to the engine.

6. Replacement Fans and Blowers

The Working Group did not address the issue of replacement parts in the term sheet. (Docket EERE–2013–BT–TP–0055, No. 179, Appendix F at p. 19). In the July 2022 NOPR, DOE proposed to include all fans and blowers that: (1) meet the criteria for scope of inclusion as described in section III.A.1 of that document, and (2) are not proposed for exclusion as listed in section III.A.2 of that document or Table III–8 of the July 2022 NOPR, regardless of whether that fan is a replacement fan. 87 FR 44194, 44211.

Morrison commented that replacement blowers for HVAC appliances need to be fully excluded for safety reasons as appliance limit controls may cause malfunction that could result in loss of life and/or property. (Morrison, No. 42 at p. 2)

AHAM commented that replacement fans, as well as those that are not considered covered products, should be excluded from the scope of the test procedure and applicable standards. (AHAM, No. 35 at p. 5)

AHRI commented that any potential regulation should consider the impact on replacement fans and added that the consequences of a replacement fan made non-compliant because of these new regulations could be catastrophic. AHRI commented that in many cases, such as supply-air fans with air flow through gas fired heat exchangers, hot-water, coils or electric resistance units, a variety of safety standards in addition to performance standards are affected. AHRI commented that the testing of all legacy equipment because of a fan change will be cost- and resource-prohibitive, and that if a replacement fan is not compliant, in most cases, an unsafe, engineered-to-fit substitution would be required. AHRI asserted that the costs, risks, and time required to retest the HVACR and water-heating equipment would all be prohibitive and that testing would also be impractical if the HVACR and water heating equipment is out of production. AHRI added that manufacturers would be forced to rebuild an out-of-production unit solely for the purpose of testing a new fan. AHRI concluded by stating that there may be instances in which such part substitution makes sense, but that is not a reasonable basis for a broad, minimum standard. (AHRI, No. 40 at p. 13)

Trane commented that replacement fans should be exempt if embedded fans fall under regulation. Trane encouraged DOE to align with the CEC regulation that provides an exemption for ''embedded fans as defined in ANSI/AMCA 214–21, including embedded fans sold exclusively for replacement of another embedded fan.'' Trane commented that fans embedded in equipment such as residential or commercial HVAC have downstream or upstream impacts on airflow distribution. Trane commented that many applications of this equipment have heating coils and/or natural gas heat exchangers that are developed, tested and certified for safety. Trane stated that when a fan is changed in the field at the application point, an exact model should be used for replacement to comply with safety requirements to ensure that no equipment failure results that may compromise the safety of the building occupants. Trane commented that, additionally, fan efficiency challenges the ability to replace ''like for like'' fans. Trane commented that more-efficient fans are often larger than less efficient ones and as such, this may increase associated product size. Trane noted that while a similar impeller-diameter fan may be available at a higher efficiency, it is imperative to consider that differing fan types have different non-impeller fan geometries and constraints, such that the overall fan footprint increases dramatically. Trane commented that with space constraints being a constant pressure, new products may be too large to replace smaller existing ones without significant design changes and associated costs that would serve to dissuade building owners from purchasing the more efficient fans contained in new products and instead repair existing, less efficient products. Trane commented that retrofit curbs can be used, but they generally come with associated pressure drop, which negates any efficiency improvement associated with the more efficient fan. (Trane, No. 38 at p. 3)

DOE includes all fans and blowers that meet the criteria for scope inclusion as described in section III.B.1 of this document and are not listed for exclusion in section III.B.2 of this document or Table III–7 of this document, regardless of whether that fan is a replacement fan. At this time, DOE is not adopting energy conservation standards for fans and blowers, and the test procedure would not impact the availability of current models. The test procedure does not set any energy conservation standards and does not result in any non-compliant fans. DOE will consider the impacts from setting potential energy conservation standards on replacement fans (*e.g.,* costs, design, safety, and availability) as part of any potential energy conservation standards rulemaking.

7. Material Handling and Heavy Industrial Processing Fans and Blowers

In response to the July 2022 NOPR, Robinson commented that fans that provide mass transfer or are subjected to significant wear will not benefit from a switch to highly efficient aerodynamic designs. In fact, stated Robinson, shorter equipment life was highly likely and end use customers would bear the additional cost of replacement. For this reason, Robinson stated it does not support the inclusion of fans that provide mass transfer or are subjected to wear (whether abrasion or corrosion). (Robinson, No. 43 at p. 5)

At this time, DOE is not adopting energy conservation standards for fans and blowers, and the test procedure would not impact the availability of current models. The test procedure does not set any energy conservation standards and does not result in any non-compliant fans. In addition, as noted in the July 2022 NOPR, based on input from AMCA during the ASRAC negotiations, DOE has determined that radial housed unshrouded fans with a diameter less than 30 inches or a blade width of less than 3 inches are designed for materials-handling applications. These fans have specific design features (*e.g.,* built to resist the impact and erosive wear from large quantities of various materials passing through the fan housing) that generally limit the opportunity for improved efficiency. (Docket No. EERE–2013–BT–STD–0006, Public Meeting Transcript, No. 85 at p. 60). 87 FR 44194, 44202–44203. Furthermore, testing these fans based on the test method for clean air fans would not provide a measurement of energy use or energy efficiency that is representative of an average use cycle. For these reasons, as discussed in section III.B.2 of this document, DOE is excluding radial housed unshrouded fans with a diameter less than 30 inches or a blade width of less than 3 inches at this time.

Robinson further commented that the proposed rule would create an extreme challenge for the heavy industrial processing industry (*e.g.,* mining, refining, metal making, rock product processing, food production, chemical processing, and much more) in the United States. Robinson commented that specialty heavy industrial process fans are significantly different from fans used in commercial or light industrial applications as they operate in heavy industrial process facilities that are constrained by significant regulations as well as engineering requirements. Robinson stated that this means that the design of the whole process, which requires each part to play a specific application, is quite complicated and under multiple reviews. Robinson commented that the fans, as part of the process, are often designed to perform at several load points, as the design and then the actual operation of the plant may experience variability. Robinson also noted that the fans are placed throughout the heavy industrial process and, depending upon the role of each specific fan, will be forced to handle particulate, extreme temperatures, dramatic temperature changes, moisture, corrosive matter, and other items in the air stream. Robinson noted that the most efficient fan designs are only able to operate in clean air applications (*i.e.,* where they draw in outside air and blow it into a part of the heavy industrial process) and that the number of clean air fans in any heavy industrial process and the amount of energy they consume, relative to the rest of the process, is small. Instead, Robinson commented that fans handling air movement through the more challenging parts of the process are much more likely to consume more energy, but also deal with variables that limit the efficiency improvement of that fan. Robinson added that these fans are connected to the larger whole of the heavy industrial process in which they operate and are subject to the conditions as they change through the entire system. Further, if the end goal is to require fans to all comply with minimum levels of efficiency, Robinson commented that entire industrial processes will need to be retrofitted to allow all of the fans within the process to be clean air handling fans. Robinson commented that not only would this require the reconstruction of entire heavy industrial processing facilities, but also require that each fan be bigger or that there be more fans, which would draw greater energy and therefore be less efficient. Robinson added that it is necessary for many heavy industrial plant precipitators and baghouses (Air Pollution Control—APC devices) to operate in a positive pressure environment to prevent combustion of pollutants captured and collected in the cleaning device hoppers. In these applications, stated Robinson, it is necessary for the fans to be located upstream (or in the dirty air) of the APC device to minimize the risk of fires that would significantly damage the internals of the APC device. Robinson commented that the repair/replacement cost of these devices alone, if damaged by fire, is in the $5 to $10 million range for each, not including the plant lost production time. Robinson commented that the cost of adding additional particulate collection equipment upstream of the existing heavy industrial process fans and APC devices coupled with the added pressure drop of this equipment will offset any efficiency benefits since the existing fans will need to be replaced with larger horsepower fans. In short, Robinson summarized, it would not be surprising if this forced all heavy industrial processing out of the United States. (Robinson, No. 43 at pp. 2–3)

At this time, DOE is not adopting energy conservation standards for fans and blowers, and the test procedure would not impact the availability of current models. The test procedure does not set any energy conservation standards and does not result in any non-compliant fans or necessary redesigns. Any future energy conservation standard rulemaking would, as part of the analyses conducted to support the rulemaking, analyze the markets in which fans and blowers are used, conduct a technology assessment, and evaluate any potential impacts on technological feasibility, practicability to manufacture, install or service, equipment utility or equipment availability, health, and safety as a result of potential standards. In addition, although DOE is not specifically excluding material handling fans and heavy industrial processing fans, DOE notes that the test procedure is limited to fan design points with air power less than 150 hp. In addition, radial housed unshrouded fan with diameter less than 30 inches or a blade width of less than 3 inches, safety fans and fans that designed and marketed to operate at or above 482 degrees Fahrenheit (250 degrees Celsius) are excluded from the scope of the test procedure. As such, DOE notes that any fan that meets the scope criteria described in section III.B.1 of this document, and is not listed for exemption as discussed in section III.B.2 and III.B.3 of this document would be in the scope of the test procedure.

C. Definitions

This section discusses DOE's adopted definitions for specific terms used in the test procedure for fans and blowers.

1. Fan and Blower Categories

The classification of fans and blowers recommended by the Working Group for coverage under a test procedure and the corresponding terms and definitions in AMCA 214–21 and the proposed CEC regulations [51] are presented in Table III–8 of this document.

TABLE III–8—SCOPE RECOMMENDED BY THE WORKING GROUP, CORRESPONDING TERMS AND DEFINITIONS

Working group scope recommendations	Corresponding term and definition in AMCA 214–21	Corresponding CEC definitions
Axial cylindrical housed fan.	"Axial inline fan" means a fan with an axial impeller and a cylindrical housing with or without turning vanes.	"Axial-inline fan" means a fan with an axial impeller and a cylindrical housing with or without turning vanes. Inlets and outlets can optionally be ducted.
Panel fan	"Axial panel fan" means an axial fan, without cylindrical housing, that is mounted in a panel, an orifice plate or ring.	"Axial-panel fan" means a fan with an axial impeller mounted in a short housing, non-cylindrical, that can be a panel, ring, or orifice plate. The housing is typically mounted to a wall separating two spaces, and the fans are used to increase the pressure across this wall. Inlets and outlets are not ducted.
Centrifugal housed fan, excluding inline fan and radial fan.	"Centrifugal housed fan" means a fan with a centrifugal or mixed flow impeller in which airflow exits into a housing that is generally scroll-shaped to direct the air through a single fan outlet. A centrifugal housed fan does not include a radial impeller*.	"Centrifugal housed fan" means a fan with a centrifugal or mixed flow impeller in which airflow exits into a housing that is generally scroll-shaped to direct the air through a single fan outlet. Inlets and outlets can optionally be ducted. It does not include a radial impeller.
Centrifugal unhoused fan, excluding radial fan.	"Centrifugal unhoused fan" means a fan with a centrifugal or mixed flow impeller in which airflow enters through a panel and discharges into free space. Inlets and outlets are not ducted. This fan type also includes fans designed for use in fan arrays that have partition walls separating the fan from other fans in the array**.	"Centrifugal unhoused fan" means a fan with a centrifugal or mix-flow impeller in which airflow enters through a panel and discharges into free space. Inlets and outlets are not ducted. This fan type also includes fans designed for use in fan arrays that have partition walls separating the fan from other fans in the array.
Inline and mixed-flow fan.	"Centrifugal inline fan" means a fan with a centrifugal or mixed flow impeller in which airflow enters axially at the fan inlet and the housing redirects radial airflow from the impeller to exit the fan in an axial direction.	"Centrifugal inline fan" means a fan with a centrifugal or mixed-flow impeller in which airflow enters axially at the fan inlet and the housing redirects radial airflow from the impeller to exit the fan in an axial direction. Inlets and outlets can optionally be ducted.
Radial housed fan	"Radial-housed fan" means a fan with a radial impeller in which airflow exits into a housing that is generally scroll-shaped to direct the air through a single fan outlet. Inlets and outlets can optionally be ducted.	"Radial-housed fan" means a fan with a radial impeller in which airflow exits into a housing that is generally scroll-shaped to direct the air through a single fan outlet. Inlets and outlets can optionally be ducted.
Power roof ventilator	"Power roof/wall ventilator (PRV)" means a fan with an internal driver and a housing to prevent precipitation from entering the building. It has a base designed to fit over a roof or wall opening, usually by means of a roof curb.	"Power roof ventilator (PRV)" or "power wall ventilator (PWV)" means a fan with an internal driver and a housing to prevent precipitation from entering the building. It has a base designed to fit over a roof or wall opening, usually by means of a roof curb.

* The inclusion of "scroll-shaped" in this definition excludes inline fans.
** Radial fans are housed and therefore not included in this definition.

In the July 2022 NOPR, DOE proposed to utilize the terminology and definitions specified in AMCA 214–21 to define the categories of fans and blowers proposed in the scope of applicability of the test procedure and tested using AMCA 210–16 as follows: (1) axial inline fan; (2) centrifugal housed fan; (3) centrifugal unhoused fan; (4) centrifugal inline fan; (5) radial-housed fan; and (6) PRVs. DOE proposed to modify the definition of "axial panel fan" as provided in AMCA 214–21 to distinguish these fans from air circulating axial panel fans, as follows: an axial panel fan is an axial fan, without cylindrical housing, that includes a panel, orifice plate, or ring with brackets for mounting through a wall, ceiling, or other structure that separates the fan's inlet from its outlet. 87 FR 44194, 44211–44212.

In the July 2022 NOPR, DOE noted that the CEC definitions are similar to the AMCA 214–21 definitions. DOE noted that the inclusion of additional language in the CEC definitions to indicate a fan's intended application or whether a fan's inlet or outlet is (optionally, as relevant) ducted was informative, but did not further distinguish the terms. In addition, for axial panel fans, DOE noted that the CEC definitions specified that the housing is typically mounted to a wall separating two spaces, and the fans are used to increase the pressure across this wall. DOE stated that the CEC description distinguishes axial panel fans from axial air circulating panel fans, which do not have provisions for connection to ducting or separation of the fan inlet from its outlet. However, DOE noted that the CEC distinction was based on how the fan was installed and not on a physical design feature of the fan. Therefore, DOE proposed to rely on physical features and to define axial panel fans instead. 87 FR 44194, 44211–44212.

[51] *See* Proposed regulatory language for Commercial and Industrial Fans and Blowers available in the following Docket: 22–AAER–01 at: *efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=22-AAER-01.*

In addition, to support the exclusions proposed in the July 2022 NOPR and clarify which fans would fall under the proposed exclusions, DOE proposed to adopt definitions of the terms ''induced flow fan'' and ''jet fan'' as established in AMCA 214–21 and ''cross-flow fan'' as defined in AMCA 208–18. *Id.* at 87 FR 44212.

In response to the July 2022 NOPR, New York Blower commented that the definitions in AMCA 214–21 are adequate. (New York Blower, No. 33 at p. 10) AMCA commented in support of the DOE-proposed definitions of axial inline fan, centrifugal housed fan, centrifugal unhoused fan, centrifugal inline fan, radial-housed fan, and power roof ventilator, which are consistent with definitions found in AMCA 214–21. However, AMCA noted that there would be additional alignment with the CEC's resultant definitions for the Title 20 fan regulation if DOE were to add, ''inlets and outlets can optionally be ducted'' to the definitions of axial inline fan, centrifugal housed fan, and centrifugal inline fan. In addition, AMCA commented in support of the DOE-proposed definitions of induced flow fan, jet fan, and cross-flow fan, as they are consistent with definitions found in AMCA 214–21 and AMCA 208–18. (AMCA, No. 41 at p.9)

As noted previously, DOE did not include the additional language for the CEC definitions as DOE notes that although it provides additional description of optional features of the equipment, or of the equipment installation configuration, the additional language does not describe the equipment's unique physical characteristics and therefore does not further distinguish the definitions. Therefore, DOE adopts the definitions of (1) axial inline fan; (2) centrifugal housed fan; (3) centrifugal unhoused fan; (4) centrifugal inline fan; (5) radial-housed fan; (6) PRVs; (7) induced flow fan; (7) jet fan; and (8) cross-flow fan as proposed.

AMCA noted that DOE may want to consider revising the definition of axial panel fan to state, ''without cylindrical or box housing,'' as in the definition of air circulating axial panel fan. (AMCA, No. 41 at p. 9)

DOE agrees with AMCA that adding ''or box housing'' would align the definitions of axial panel fan and air circulating axial panel fan. However, DOE notes that this is not specified in the AMCA 214–21 definitions and unlike for air circulating fans heads where AMCA 230–23 includes a separate definition of box fans and distinguishes these fans from air circulating axial panel fan, AMCA 214–21 does not distinguish box fans using a separate definition. DOE retains the proposed definition to continue to align with AMCA 214–21.

2. Safety Fans

In the July 2022 NOPR, DOE proposed a definition of safety fan to support the exclusion of safety fans from the scope of the test procedure, as discussed in section III.B.2 of this document. 87 FR 44194, 44213.

In the July 2022 NOPR, DOE reviewed the following definition of safety fan as proposed by the CEC: (1) a fan that is designed and marketed to operate only at or above 482 degrees Fahrenheit (250 degrees Celsius); (2) a reversible axial fan in cylindrical housing that is designed and marketed for use in ducted tunnel ventilation that will reverse operations under emergency ventilation conditions; (3) a fan bearing an Underwriter Laboratories (UL) or Electric Testing Laboratories listing for ''Power Ventilators for Smoke Control Systems''; (4) an open discharge exhaust fan with integral discharge nozzles which develop or maintain a minimum discharge velocity of 3,000 feet per minute (''fpm''); (5) a fan constructed in accordance with AMCA type A or B spark resistant construction as defined in ANSI/AMCA Standard 99–16 Standards Handbook; (6) a fan designed and marketed for use in explosive atmospheres and tested and marked according to EN 13463–1:2001 Non-electrical Equipment for Potentially Explosive Atmospheres; or (7) an electric-motor-driven Positive Pressure Ventilator as defined in ANSI/AMCA Standard 240–15 Laboratory Methods of Testing Positive Pressure Ventilators for Aerodynamic Performance Rating.[52] In the July 2022 NOPR, based on a review of the existing industry and regulatory definitions of ''safety fan,'' DOE tentatively determined that the definition proposed by the CEC (at the time) was representative of the equipment considered ''safety fans.'' 87 FR 44194, 44214.

In the July 2022 NOPR, DOE proposed to adopt a definition in line with the definition proposed by the CEC with the following edits. Regarding item (1) of the CEC definition: DOE proposed not to include the term ''only'' from ''a fan that is designed and marketed to operate only at or above 482 degrees Fahrenheit (250 degrees Celsius)'' because DOE tentatively determined that a fan that can operate at or above a certain temperature can also operate below. Regarding item (4) DOE tentatively determined that the definition of safety fans is equivalent to ''laboratory exhaust fans'' as defined in section 3.52 of AMCA 214–21: fans designed and marketed specifically for exhausting contaminated air vertically away from a building using a high-velocity discharge. DOE noted it was considering replacing item (4) with ''laboratory exhaust fans'' and to define it in accordance with AMCA 214–21. DOE also reviewed item (6) and noted that the referenced industry standard is no longer current and has been replaced. In 2008, the International Electrotechnical Commission System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres replaced EN 13463–1 by ISO 80079–36, ''Explosive atmospheres—Part 36: Non-electrical equipment for explosive atmospheres—Basic method and requirements.'' [53] The latest version of ISO 80079–36 is the 2016 edition. Therefore, DOE proposed to reference ISO 80079–36:2016, instead of EN 13463–1:2001. *Id.*

In response to the July 2022 NOPR, the CEC recommended that DOE incorporate the following definition of safety fan: safety fan means (1) a reversible axial fan in cylindrical housing that is designed and marketed for use in ducted tunnel ventilation that will reverse operations under an emergency ventilation condition; (2) a fan for use in explosive atmospheres tested and marked according to EN ISO Standards 80079–36:2016, Explosive atmospheres—Part 36: Non-electrical equipment for explosive atmospheres—Basic method and requirements; (3) a Positive Pressure Ventilator; or (4) a fan bearing a listing for ''Power Ventilators for Smoke Control Systems'' in compliance with ANSI/UL 705 Power Ventilators (dated August 23, 2021). Specifically, the CEC recommended removing fans that are designed and marketed to operate only at or above 482 degrees Fahrenheit (250 degrees Celsius) from the safety fan definition and instead listed together with the exclusions as proposed in Table III–8 of the July 2022 NOPR. The CEC commented that fans that are designed and marketed to operate only at or above 482 degrees Fahrenheit (250 degrees Celsius) can be designed for uses other than safety and are subject to different performance requirements, for example fans used for industrial processes that require operation at higher temperatures. The CEC also

[52] *See* CEC Docket No. 22–AAER–01, TN #241950, Proposed regulatory language for Commercial and Industrial Fans and Blowers, at pp. 7–8.

[53] *See www.intertek.com/blog/2019-03-14-hazloc/.*

recommended that laboratory exhaust fans not be included in the definition for safety fan, nor be included as a separate exclusion from the proposed scope of applicability of the test procedure. The CEC noted that although laboratory exhaust fans exhaust possible dangerous gasses, the fans are used for routine non-emergency lab procedures and are fully capable of achieving efficient operation without compromising the purpose for which they are installed. (CEC, No. 30 at pp. 2–3)

In response to the July 2022 NOPR, AMCA provided a comparison of the CEC safety fan definition as provided in the Title 20 express terms, noting elements that differed or were consistent with the proposed safety fan definition. AMCA commented that in Title 20 express terms,[54] the CEC removed the high-temperature section from the safety fan definition and inserted it in the list of fan-type exemptions instead. AMCA added that the rationale for this is that high-temperature fans are not always safety-related; they also are specified for commercial-kitchen exhaust and other demanding applications. (AMCA, No. 41 at p. 6, 12) AMCA recommended that DOE move item (1) of the DOE proposed safety fan definition to the list of explicit exemptions. Regarding item (4) of the DOE proposed definition, AMCA noted that it submitted comments to the CEC recommending that the CEC should seek to clean up some of the language because AMCA felt that the 3,000-fpm criterion could provide a loophole for fans that provide 3,000 fpm but are not used for safety purposes and was intended to describe a ''laboratory exhaust fan'' without naming it. AMCA commented that the 3,000-fpm discharge velocity with integral discharge nozzles appears to reference similar verbiage in ANSI/AIHA Z9.5, Laboratory Ventilation, and recommended exhaust velocities for safely exhausting contaminants without re-entrainment and added that laboratory exhaust fans would be considered safety fans regardless of exhaust velocity for the simple fact they service laboratories requiring numerous safety protocols for the protection of occupants and the surrounding area. For this reason, AMCA noted that in its comment to the CEC, AMCA commented that the CEC proposed regulatory language and supporting information indicated laboratory exhaust fans should be excluded and proposed using the term ''laboratory exhaust fan.'' AMCA recommended that the CEC add the ANSI/AMCA Standard 214–21 definition for safety fans: ''Laboratory exhaust fan means a fan designed and marketed specifically for exhausting contaminated air vertically away from a building using a high-velocity discharge.'' AMCA commented that rather than agree to AMCA's attempt to remove perceived loopholes from the proposed exemption, CEC removed the exemption altogether. AMCA commented that it would prefer to have this exemption remain in the DOE test procedure. In addition, AMCA recommended the removal of item (5) of the DOE proposed definition of safety fan. As AMCA commented to CEC, while AMCA recognizes the spark-resistant-construction types defined in ANSI/AMCA Standard 99–16, Standards Handbook, the definitions are not consistent with industry standards, and exempting spark resistant fans also is somewhat of a loophole in that a fan should be able to be designed to different types of spark-resistant construction with no impact on performance. For these reasons, AMCA recommended striking this item, and, if there were no other uses of AMCA 99, striking the citation of ANSI/AMCA Standard 99–16 in the referenced-documents portion of this NOPR. (AMCA, No. 41 at p. 12)

New York Blower stated support for the safety fan definition proposed by AMCA. (New York Blower, No. 33 at p. 10)

Robinson requested clarification regarding why AMCA Class C spark resistant construction was not included. (Robinson, No. 43 at p. 6)

Regarding fans designed and marketed to operate only at or above 482 degrees Fahrenheit (250 degrees Celsius), DOE's research confirms CEC's comment that some fans designed and marketed to operate only at or above 482 degrees Fahrenheit (250 degrees Celsius) can be designed for uses other than safety (*e.g.,* manufacturing). Therefore, in this final rule, DOE is removing this category from the definition of safety fans and listing these fans as a separate exclusion instead. In addition, DOE is adopting its proposal to remove the term ''only'' from ''a fan that is designed and marketed to operate only at or above 482 degrees Fahrenheit (250 degrees Celsius)'' because DOE has determined that a fan that can operate at or above a certain temperature can also operate below.

As discussed in the July 2022 NOPR, DOE tentatively determined that ''open discharge exhaust fans with integral discharge nozzles which develop or maintain a minimum discharge velocity of 3,000 FPM'' as listed in the CEC definition of safety fans are equivalent to ''laboratory exhaust fans'' as defined in section 3.52 of AMCA 214–21: fans designed and marketed specifically for exhausting contaminated air vertically away from a building using a high-velocity discharge. 87 FR 44194, 44214. Therefore, DOE is using the term ''laboratory exhaust fans'' and describes these fans in accordance with the AMCA 214–21 definition. In addition, DOE did not propose to include these fans in the scope of applicability of the test procedure and at this time. See 87 FR 44194, 44214. DOE is keeping these fans in the definition of safety fans, such that they are excluded from the scope of applicability. In addition, as noted in the NOPR, this would align with the recommended definition of safety fan provided in appendix D of the term sheet,[55] which includes fans designed for use in toxic, highly corrosive, or flammable environments [or in environments] with abrasive substances. 87 FR 44194, 44213 For these reasons, although DOE notes that such fans may be used for other in non-emergency situations, DOE is including laboratory exhaust fans as part of safety fans.

DOE reviewed the definition recommended by the CEC and notes that it no longer includes fans constructed in accordance with AMCA type A or B spark resistant construction as defined in the ANSI/AMCA Standard 99–16 Standards Handbook. In addition, as highlighted by CEC, DOE understands that such designations are no longer consistent with industry standards. DOE has determined that spark resistant fans used in explosive atmospheres are already included under fans tested and marked according to EN ISO Standards 80079–36:2016, Explosive atmospheres—Part 36: Non-electrical equipment for explosive atmospheres—Basic method and requirements. Therefore, DOE is removing this category from the definition of safety fans and is not incorporating AMCA 99–16 by reference.

In the July 2022 NOPR, DOE proposed to include fans bearing an Underwriter Laboratories (UL) or Electric Testing Laboratories listing for ''Power Ventilators for Smoke Control Systems'' in the definition of safety fans. 87 FR 44194, 44214. As previously noted, the CEC-recommended safety fan definition

[54] DOE notes that this refers to the CEC Express Terms for Commercial and Industrial Fans and Blowers document available at: *efiling.energy.ca.gov/GetDocument.aspx?tn=245898&DocumentContentId=80074.*

[55] The Working Group stated that the definition recommended in appendix D may be subject to potential edits necessary to accomplish the same intent.

further specifies referencing ANSI/UL 705 Power Ventilators (dated August 23, 2021). DOE has determined that this additional specification included in the CEC definition is necessary to identify fans included in this description. In addition, DOE notes that a more recent ANSI-approved version of ANSI/UL 705 Power Ventilators is available (dated August 19, 2022) and, therefore, DOE is adding this language into the safety fan definition and incorporating by reference the latest version of UL 705 available.

In summary, DOE defines safety fan as: (1) a reversible axial fan with cylindrical housing that is designed and marketed for use in ducted tunnel ventilation that will reverse operation under an emergency ventilation condition; (2) a fan for use in explosive atmospheres tested and marked according to EN ISO Standards 80079–36:2016, Explosive atmospheres—Part 36: Non-electrical equipment for explosive atmospheres—Basic method and requirements; (3) an electric-motor-driven Positive Pressure Ventilator as defined in ANSI/AMCA Standard 240–15, Laboratory Methods of Testing Positive Pressure Ventilators for Aerodynamic Performance Rating; (4) a fan bearing a listing for ''Power Ventilators for Smoke Control Systems'' in compliance with ANSI/UL 705 Power Ventilators (dated August 19, 2022); or (5) a laboratory exhaust fan designed and marketed specifically for exhausting contaminated air vertically away from a building using a high-velocity discharge.

3. Definitions Related To Heat Rejection Equipment

As stated in the July 2022 NOPR, DOE proposed to exclude from the scope of the test procedure fans and blowers embedded in heat rejection equipment, specifically fans and blowers embedded in packaged evaporative open circuit cooling towers; evaporative field-erected open circuit cooling towers; packaged evaporative closed-circuit cooling towers; evaporative field-erected closed-circuit cooling towers; packaged evaporative condensers; field-erected evaporative condensers; packaged air-cooled (dry) coolers; field-erected air-cooled (dry) coolers; air-cooled steam condensers; and hybrid (water saving) versions of such listed equipment that contain both evaporative and air-cooled heat exchange sections. In the July 2022 NOPR, DOE proposed to define each of these equipment types according to the recommendations of the Working Group. 87 FR 44194, 44217. DOE did not receive any comments on these definitions and adopts them as proposed.

4. Air Circulating Fans

In the July 2022 NOPR, DOE proposed definitions for air circulating fans and related terms using the definition being considered by the AMCA 230 committee at the time. DOE proposed to define air circulating fans as ''a fan that has no provision for connection to ducting or separation of the fan inlet from its outlet using a pressure boundary, operates against zero external static pressure loss, and is not a jet fan.'' 87 FR 44194, 44215. Further, DOE proposed to define an unhoused ACFH as follows: ''An air circulating fan without housing, having an axial impeller with a ratio of fan-blade span (in inches) to maximum rate of rotation (in revolutions per minute) less than or equal to 0.06. The impeller may or may not be guarded.'' DOE also proposed to define a housed ACFH as an air circulating fan with an axial or centrifugal impeller, and a housing. 87 FR 44194, 44216.

DOE further proposed definitions for the four categories of housed air circulating fans. DOE proposed to adopt the definitions of air circulating axial panel pan, box fan, cylindrical air circulating fan, and housed centrifugal air circulator as considered by the AMCA 230 committee, with the following clarifications: (1) replace ''air circulating fan'' considered by the AMCA 230 committee by ''housed air circulating fan head'' to explicitly indicate that each of these fans are housed ACFHs; (2) replace the term ''circulator'' as used by the AMCA 230 committee with ''circulating fan'' for consistency in terminology; and (3) remove the examples of additional terms used commonly by industry. *Id.*

In response to the July 2022 NOPR, AMCA commented that it submitted a comment on July 7, 2022, that included definitions of air circulating fans and related terms that were approved by the AMCA 230 committee, and that this submission was not included in the July 2022 NOPR. (AMCA, No. 41 at pp. 12–13) AMCA further commented that the AMCA 230 committee supported the proposal to use the categories defined in revisions under way for the AMCA 230 standard, namely housed ACFH, unhoused ACFH, and ceiling fans. (AMCA, No. 41 at p. 7)

Although AMCA submitted the comment prior to the publication date of the July 2022 NOPR, DOE notes that the comments were not received early enough to be incorporated at the time of drafting and were made on the pre-publication version of the NOPR, which is intended to provide stakeholders additional time to review and prepare comments (see discussion related to this comment in section III.A.).[56] However, DOE reviewed the definitions included in the additional comments provided by AMCA (AMCA, No. 13 at pp. 6–9) and these match the definitions considered by the AMCA 230 committee as discussed in the July 2022 NOPR. In addition, these definitions align with those published in AMCA 230–23. DOE therefore concludes that the proposed definitions align with the latest definitions published in AMCA 230–23 and adopts the definitions of air circulating fans and related terms as proposed.

5. Outlet Area

In the July 2022 NOPR, DOE noted that section 5.5.4 of AMCA 230–15 (with errata) defined the discharge area of an air circulating fan as the area of a circle having a diameter equal to the blade tip diameter. DOE noted that this definition was only applicable to unhoused ACFHs as the discharge area of a housed ACFH is determined based on the surface area at the exit of the housing and is not based on the fan blade tip diameter. DOE proposed a definition for fan outlet area specific to air circulating fans as (*i.e.,* ''air circulating fan outlet area''): (1) for unhoused ACFHs, the area of a circle having a diameter equal to the blade tip diameter; (2) for housed ACFHs, the inside area perpendicular to the airstream, measured at the plane of the opening through which the air exits the fan. In the July 2022 NOPR, DOE further noted that the AMCA 230 committee is considering revising the definition of discharge area to include housed ACFHs, and to replace the term ''discharge area'' by ''fan outlet area,'' which is a more commonly used term. 87 FR 44194, 44217.

Generally, DOE further specified that for all definitions related to air circulating fans, DOE was aware that the revisions being considered by the AMCA 230 committee are subject to change and could further be revised in the next version of AMCA 230. DOE added that should the revised version of AMCA 230 publish prior to the publication of any DOE test procedure final rule, DOE intended, after considering stakeholder feedback received in response to the proposals in the July 2022 NOPR, to revise the definitions in line with the latest AMCA 230 standard, provided the updates in

[56] The comment was submitted on July 6, 2022. See *www.regulations.gov/comment/EERE-2021-BT-TP-0021-0013* and the October 2021 RFI comment period ended on November 15, 2022, as discussed in section I.B of this document.

this standard are consistent with the definitions DOE proposed in the July 2022 NOPR or the updates are related to topics that DOE has discussed and for which DOE has solicited comments in the July 2022 NOPR. *Id.*

AMCA commented that it agreed with DOE's use of outlet area for air circulating fans where the outlet area is smaller than the discharge area, as this solves one potential issue with the discharge-area definition in AMCA 230–15. However, AMCA stated that DOE's proposed use of air circulating-fan outlet area creates an issue with historical test data. AMCA commented that the Bioenvironmental and Structural System (BESS) Laboratory's historical performance data for air circulating-panel, box, and tube fans is based on area determined using impeller diameter (not the cross-sectional outlet area of the housing). As the BESS Lab data is the largest set of publicly available, third-party air circulating-fan performance data, it is likely DOE based much of its analysis on this historical performance data. For all potential future users of the data, the AMCA 230 technical committee proposes the following definitions, which will be included in the upcoming edition of AMCA 230: (1) discharge area: area of a circle having a diameter equal to the blade tip diameter; and (2) fan outlet area: the gross inside area measured at the plane of the outlet opening. In addition, AMCA commented that the revised AMCA 230 would specify that the airflow rate and efficiency calculations for unhoused air circulating fan heads must use the discharge area, while airflow rate and efficiency calculations for housed air circulating fan heads must use the lesser of the values for fan outlet area and discharge area. (AMCA, No. 41 at pp. 13–14)

DOE reviewed the definitions of discharge area and fan outlet area provided by AMCA and concluded that the AMCA definition of discharge area aligns with the proposed definition of outlet area for unhoused air circulating fans and that the definition of fan outlet area aligns with the proposed definition of outlet area for housed air circulating fans. To align with industry terminology, DOE distinguishes between fan discharge area and fan outlet area as characterized by AMCA. DOE notes that the distinction is not based on the presence or absence of housing, but rather in the physical area considered. In addition, to further distinguish between housed and unhoused air circulating fans, DOE is adopting the additional instructions in section 8.4 of AMCA 230–23 to specify that the airflow rate and efficiency calculations for unhoused air circulating fan heads must use the discharge area while airflow rate and efficiency calculations for housed air circulating fan heads must use the lesser of the values for fan outlet area and discharge area. DOE has determined that including this distinction as part of the test instructions, rather than in the definitions ensures alignment with industry terminology and reflects current testing practices.

For fans and blowers other than air circulating fans, in the July 2022 NOPR, DOE noted that Annex H of AMCA 210–16 includes requirements for determining where the fan outlet area is measured for different fan categories and references AMCA 99–16, which includes further diagrams to aid in the determination of the outlet area. DOE tentatively determined that for fans and blowers other than air circulating fans, the current definition in AMCA 214–21 and the existing requirements in Annex H of AMCA 210–16 were sufficient to determine the outlet area and did not propose any edits. 87 FR 44194, 44217.

Robinson commented that the definition of outlet area provided by AMCA 99–16 is the industry standard and that the only time this is potentially questioned was when there is more than one outlet plane. Otherwise, Robinson commented that it did not see an issue with the definition of fan outlet and fan outlet area. (Robinson, No. 43 at p. 7) In this final rule, DOE makes no changes to how the fan outlet area is determined for fans and blowers other than air circulating fans, based on Annex H of AMCA 210–16, which references AMCA 99–16. Robinson noted a potential improvement of the definition may be needed in the case when there is more than one outlet plane. However, Robinson did not provide additional details and at this time, DOE is not changing how the fan outlet area is determined for fans and blowers other than air circulating fans.

6. Air Curtains

In the July 2022 NOPR, DOE proposed to exclude fans and blowers embedded in air curtains and noted that the CEC defined an air curtain unit as equipment providing a directionally controlled stream of air moving across the entire height and width of an opening that reduces the infiltration or transfer of air from one side of the opening to the other and/or inhibits the passage of insects, dust, or debris. However, DOE did not propose a definition for this equipment. 87 FR 44194, 44207–44208 at fn. 25.

The CEC recommends defining ''air curtain unit'' as follows: Air curtain unit means equipment that produces a directionally controlled stream of air with a minimum width-to-depth aspect ratio of 5:1 and a discharge that is not intended to be connected to unitary ductwork. The controlled stream of air is designed to span the height and width of an opening and reduce the infiltration or transfer of air from one side of the opening to the other and/or inhibit the passage of insects, dust, or debris. (CEC, No. 30 at p. 2)

DOE did not propose a definition for air curtain. As noted in the July 2022 NOPR, air curtains are used in entrances to buildings or openings between two spaces conditioned at different temperatures. Air curtains include fans packaged with a motor, filter, outlet section (a nozzle, discharge grille, etc.), and in some cases a mounting plate, and/or an electric heater or water heater. 87 FR 44194, 44207. DOE did not find any ambiguity in identifying this equipment and as such, is not adopting a definition of air curtain at this time.

7. Basic Model

The basic model concept allows manufacturers to group like models for the purpose of making representations of energy efficiency and/or energy use, including for the purpose of demonstrating compliance with DOE's energy conservation standards to the extent DOE has established such standards. The concept of basic model may allow manufacturers to reduce the amount of testing they must do to rate the energy use or efficiency of their products. DOE's current regulations provide equipment-specific basic model definitions, which typically state that models within the same basic model group have ''essentially identical'' energy or water use characteristics; as well as a general definition that provides (with some exceptions noted in the regulatory text) that a basic model means ''all units of a given type of product (or class thereof) manufactured by one manufacturer, having the same primary energy source, and which have essentially identical electrical, physical, and functional characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency.'' *See for example* 10 CFR 430.2; 431.62, 431.152, 431.192, 431.202, 431.222, and 431.292.

In the July 2022 NOPR, DOE proposed a definition of a basic model specific to fans as follows: ''all units of fans and blowers manufactured by one manufacturer, having the same primary energy source, and having essentially identical electrical, physical, and functional (*e.g.,* aerodynamic) characteristics that affect energy consumption. In addition: (1) all variations of blade pitches of an adjustable-pitch axial fan may be considered a single basic model; and (2) all variations of impeller widths and impeller diameters of a given full-width impeller and full-diameter impeller centrifugal fan may be considered a single basic model.'' DOE further proposed to define ''full-width impeller'' and ''full-diameter impeller'' as ''the maximum impeller width and the maximum impeller diameter with which a given fan basic model is distributed in commerce.'' 87 FR 44194, 44213.

In general, Morrison commented that the definition of a basic model is acceptable but noted the considerable number of basic models—in the thousands in many categories. (Morrison, No. 42 at p. 4) In general, AMCA stated acceptance of the definition of a basic model, but noted there will be a very large number of basic models being registered in the CCMS. AMCA provided an example of one axial-fan product line, for which 60 basic models resulted from the variety of blade spans, hub diameters, blade counts, and blade pitches. (AMCA, No. 41 at pp. 9–10)

NEEA commented that in the definition of a basic model, DOE assumes that a fan experiences similar impeller trimming to a pump. NEEA commented that in practice, however, fans are rarely if ever trimmed from the full-impeller diameter so identifying this feature is not necessary. NEEA noted that by contrast, features like hub diameter are specific to fans, but do not exist in pumps and DOE should consider them in defining a basic model for fans. (NEEA, No. 36 at p. 6)

Fan and blower manufacturers may offer for sale the same bare shaft fan assembled, packaged, or integrated with different motor, transmission, and control combinations. Based on DOE's proposed basic model definition, the same bare shaft fan, sold with different combinations of motor, transmission, and controls (or as a bare shaft fan) could be grouped under the same basic model. In addition, fan manufacturers would be able to elect to group similar individual fan models within the same basic model under the same ratings to reduce testing burden, provided that all representations regarding the energy use of fans within that basic model are identical and based on the most consumptive unit. *See* 76 FR 12422, 12428–12429 (March 7, 2011).[57] Manufacturers would have the option to certify separate ratings for each combination of bare shaft fan, motor, transmission, and/or control in order to make separate representations of the performance of each specific combination. In view of the substantial number of fans that could be subject to an individual certification requirement for each basic model, DOE notes that the proposed definition of basic model would allow variations of blade pitches of an adjustable-pitch axial fan to be considered a single basic model.

Additionally, DOE proposed that all variations of a given full-size impeller width and full-size impeller diameter may be considered to be part of a single basic model represented by the fan with the full-size impeller width and full-size diameter. 87 FR 44194, 44213. In the July 2022 NOPR, DOE did not propose to group fans with varying hub diameters and is not opting to add this in the definition of basic model at this time and adopts the definition of basic model as proposed in the July 2022 NOPR. See *id.* Further, DOE notes that in comments submitted to the CEC docket, several stakeholders[58] have expressed interest in grouping fans of variations of the same impeller into the same basic model and continues to believe that identifying the variations of impeller in the basic model definition is useful.

The CA IOUs requested that DOE adjust its definition of ''basic model'' to refer to the nominal diameter and width of impellers in place of ''full-width'' and ''full-diameter'' impeller since custom impellers may be adjusted to be larger or smaller than the nominal size. The CA IOUs explained that unlike pumps, fabricated fan impellers have adjustable widths and diameters that can increase or decrease and manufacturers typically make these adjustments to attain precise airflow and pressure at synchronous speed of an induction motor. (CA IOUs, No. 37 at pp. 9–10)

As previously stated, DOE proposed to define ''full-width impeller'' and ''full-diameter impeller'' as ''the maximum impeller width and the maximum impeller diameter with which a given fan basic model is distributed in commerce.'' As such, the impeller would only be adjusted to a smaller size as the larger size would then meet the definition of the full-impeller. Therefore, DOE is not adopting the term ''nominal.''

New York Blower commented that the proposed definition of a basic model for fans, which distinguishes on the basis of energy consumption, contributes to the volume of testing required. Specifically, New York Blower commented that not being able to group a fan series of different sizes and geometric similarity (*i.e.,* ''fan product line'') results in at least each size having to be considered a basic model. New York Blower added that ideally a single size fan or a subset of all the sizes offered to the market could be used to certify an entire fan series. New York Blower commented that this would result in a significant reduction in clerical and administrative activity to report ratings to the DOE to support offering products in the market. New York Blower added that such an approach was used in the Californian Commercial Fans and Blower rulemaking where the ratings of sizes within a product were distinguished as either a tested model or a calculated model. (New York Blower, No. 33 at pp. 5, 10)

New York Blower added that recertifying fans annually that are unlikely to change for years creates an overhead burden to keeping the product on the market, even if a sparse quantity of units are sold into the market. Specifically, New York Blower noted that the fan market, and in particular the industrial fan market, is a build-on-demand market. While there may be some designs that sell a large quantity of units, New York Blower commented that it is more likely that many distinct and different units across the broad spectrum of products and sizes available will be sold and manufactured to the wide variety of customer demands. New York Blower stated that placing an administrative burden and consequent cost on a multitude of products that are rarely sold but needed, valued, and installed efficiently in systems when they are required, created no value to the consumer and provided no energy savings considering the units are infrequently sold. Therefore, New York Blower commented that it would be administratively expedient to be able to reference certification of geometrically similar products to a reference, tested

[57] These provisions would allow manufacturers to group individual models with essentially identical, but not exactly the same, energy performance characteristics into a basic model to reduce testing burden. Under DOE's certification requirements, all the individual models within a basic model identified in a certification report as being the same basic model must have the same certified efficiency rating and use the same test data underlying the certified rating. The March 7, 2011, Final Rule also established that the efficiency rating of a basic model must be based on the least efficient or most energy consuming individual model *(i.e.,* all individual models within a basic model must be at least as energy efficient as the certified rating). 76 FR 12422, 12428–12429.

[58] AMCA and Joint Advocates (ASAP, NEEA, NRDC, ACEEE, and CA IOUs), Comments to the CEC Draft Staff Report, *efiling.energy.ca.gov/GetDocument.aspx?tn=224829* (p.9).)).

fan—similar to the CRP–8 [Certified Rating Program] form and process incorporated in the AMCA CRP program.[59] New York Blower added that an example would be for all sizes of a product line larger than 40 inches in diameter to reference, and be certified by, the 40-inch test results without an AEDM or administrative burden. (New York Blower, No. 33 at p. 10)

Robinson commented that the definition of basic model needs further explanation from the perspective of an industrial process custom fan manufacturer, and that the idea of a basic model makes sense for manufacturers of a standard product line. Robinson commented that it manufactures a number of fan designs that are modified to suit the needs of a customer's specific requirements. In other words, Robinson stated, a given design could operate anywhere between 1 and 150 hp and well beyond with varying efficiency (FEI). Robinson commented that the example provided on page 73 of the NOPR states, ''if a manufacturer offers the same fan model in the following full-impeller sizes: 60, 70, 80 and 90 inches, each full-impeller size would constitute a separate basic model. However, a fan with an impeller trimmed to 69 inches could be grouped with the same 70-inch untrimmed fan.'' Robinson commented that without an AEDM, this sounded like a custom fan manufacturer would have to more or less test everything that falls within the limitations as Robinson does not have catalog equipment. (Robinson, No. 43 at p. 6)

DOE notes that different-size fans would not operate at the same duty points and do not have essentially identical electrical, physical, and functional characteristics that affect energy consumption and energy efficiency. Therefore, an approach as described by New York Blower, where a manufacturer would only certify a subset of sizes within a product line, is not feasible. DOE notes that however, a manufacturer could test a subset of sizes within a product line and apply the fan laws as allowed in Annex E of AMCA 214–21 in order to calculate the performance data of all fans in the same product line without the application of an AEDM, thereby reducing manufacturer burden. With regard to custom fans for which a single made-to-order fan is manufactured, general sampling requirements for all covered equipment at 10 CFR 429.11(b), and § 429.11(b)(2) provides provisions for sampling when only one unit of a basic model is produced.[60] In accordance with these provisions, a single made-to-order product must be tested to ensure it complies with the standard. To reduce testing burden, DOE is adopting AEDM provisions that would allow certification of a made-to-order product in lieu of testing. (See section III.I of this document.) Certification would be based on the test results of the one unit, or AEDM ratings for the model. In addition, DOE notes that this test procedure would not result in any certification requirements.

D. Industry Standards

DOE's established practice is to adopt industry standards as DOE test procedures, unless such methodology would be unduly burdensome to conduct or would not produce test results that reflect the energy efficiency, energy use, water use (as specified in EPCA), or estimated operating costs of that product during a representative average use cycle. 10 CFR 431.4; 10 CFR part 430, subpart C, appendix A, section 8(c).

The Working Group recommended that the test procedure for fans and blowers other than air circulating fans:

(1) For standalone (non-embedded) fans, be based on a physical test performed in accordance with the latest version of AMCA 210 (*i.e.,* available at the time of publication of any test procedure final rule)[61] (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #7 at p. 5);

(2) Establish methods to determine the ''FEP'' either by: the direct measurement of the electrical input power to the fan, or by the measurement of the mechanical input power to the fan (*i.e.,* a fan shaft power test, which captures the performance of the bare shaft fan)[62] and by applying default values (*i.e.,* calculation algorithms) to reflect the additional motor, transmission, or motor controller energy use (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #9 at pp. 5–6); and

(3) Allow the use of equations (''fan laws'') to determine the performance of a bare shaft fan at a non-tested speed, based on the results of a test conducted at a different speed (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #17 at p. 10).

The Working Group also recommended specific test set-up and minimal testable configurations to use for each fan category.[63] (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #7 at p. 5)

The Working Group further made recommendations on calculation algorithms and reference values to use to represent the motor, transmission, and motor controller energy efficiency when testing a fan based on a fan shaft power test. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendations #10 through #15 at pp. 6–9) Additionally, the Working Group recommended that embedded fans be tested in a standalone fan configuration (*i.e.,* outside of the piece of equipment in which they are embedded). Because some components of embedded fans may not be removable without causing irreversible damage to the equipment, the Working Group recommended non-impeller components of the fan that are geometrically similar to the ones used by the fan as embedded in the larger piece of equipment be used to complete the fan testable configuration. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #8 at pp. 5–6) The Working Group also recommended calculating FEP as the ratio of the electrical input power of a reference fan (in this case, a fan that is exactly compliant with any future fan energy conservation standards) to the electrical input power of the actual fan for which the FEP is calculated, both established at the same duty point.[64] In addition, the Working Group recommended using either static or total pressure[65] to characterize the duty point of a fan and to calculate the associated reference FEP, depending on the fan category and the test set-up used.[66] (Docket No.

[59] DOE notes that this form is available at *www.amca.org/assets/crpdocument/CRP_8.pdf.*

[60] Section 429.11(b)(2) specifies that if only one unit of the basic model is produced, that unit must be tested and the test results must demonstrate that the basic model performs at or better than the applicable standard(s). If one or more units of the basic model are manufactured subsequently, compliance with the default sampling and representations provisions is required.

[61] Currently the latest version of AMCA 210 is AMCA 210–16.

[62] A bare-shaft fan is a fan without a motor or any other drive.

[63] AMCA 214–21 references AMCA 210–2016 as the physical test method to use for fans and blowers (except ACFHs). AMCA 210–16 describes four fan test set-ups (or ''installation categories'') designated by a letter, depending on the ducting at the inlet and outlet of the fan. ''A'': free inlet, free outlet; ''B'': free inlet, ducted outlet; ''C'': ducted inlet, free outlet; and ''D'': ducted inlet, ducted outlet.

[64] A duty point is characterized by a given airflow and pressure and has a corresponding operating speed.

[65] Fan total pressure is the air pressure that exists by virtue of the state of the air and the rate of motion of the air. It is the sum of velocity pressure and static pressure at a point. If air is at rest, its total pressure will equal the static pressure.

[66] Depending on the fan category, the fan performance is represented using a test set-up with a ducted outlet (*i.e.,* using total pressure) or a free outlet (*i.e.,* using static pressure) to reflect typical usage conditions. Fans with ducts attached to the fan's outlet are typically selected based on their performance at a given airflow and total pressure,

EERE–2013–BT–STD–0006, No. 179, Recommendations #18 and #19 at pp. 10–11) Finally, the Working Group recommended equations and default values to use when calculating the reference FEP of a fan at a given duty point. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendations #18 through #21 at pp. 10–12)

Since the publication of the term sheet, AMCA has revised and developed test standards consistent with the recommendations of the Working Group:

- In September 2016, AMCA published AMCA 210–16, which updated ANSI/AMCA 210–2007, ''Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating,'' to include a wire-to-air test method, which captures the performance of any motor, transmission, or motor controller present in the fan, in addition to the performance of the bare shaft fan (*i.e.,* a measurement of the FEP in kW), in addition to the previously existing methods for conducting laboratory tests to determine fan shaft power in hp, airflow in cubic feet per minute (''CFM''), pressure in in. wg, and at a given speed of rotation in ''RPM.''
- In April 2017, AMCA published ANSI/AMCA Standard 207–2017, ''Fan System Efficiency and Fan System Input Power.'' This publication provides calculation algorithms representing the performance of reference motors, transmissions, and motor controllers. These calculations can be directly applied to the results of a fan shaft power test in accordance with AMCA 210–16 to obtain the FEP of a fan at a given duty point.
- In January 2018, AMCA published ''AMCA 208–18.'' This publication defines FEI as the ratio of the electrical input power of a reference fan to the electrical input power of the actual fan for which FEI is calculated, both established at the same duty point. It provides equations to calculate the FEP of a fan as a function of airflow and pressure (either static or total depending on the fan category considered).

Building on these test standards, AMCA developed a new AMCA 214–21 test method, which was approved by ANSI on March 1, 2021. AMCA 214–21 combines provisions of AMCA 210–16, AMCA 207–17, and AMCA 208–18, as well as portions of AMCA 211–13 (R2018), ''Certified Ratings Program Product Rating Manual for Fan Air Performance'' (''AMCA 211–13'') into a single standard.[67] Consistent with the recommendations of the Working Group, AMCA 214–21 provides methods to establish the FEP either by: (1) the measurement of the electrical input power to the fan (*i.e.,* a ''wire-to-air'' test); or by (2) the measurement of the fan shaft power and the application of calculation algorithms to reflect additional motor, transmission, or control energy use. In each case, the fan power measurements are performed in accordance with AMCA 210–16 or ISO 5801:2017, which is referenced in AMCA 214–21 as an equivalent test procedure to AMCA 210–16. AMCA 214–21 also references laboratory test methods for additional categories of fans such as jet fans, circulating fans, and induced flow fans.[68] Specifically, AMCA 214–21 references AMCA 230–15 [69] as the industry test procedure to follow when conducting performance measurements on air circulating fans. In addition, AMCA 214–21 adds specific test instructions to ensure test repeatability and reproducibility. Specifically, AMCA 214–21 defines a single set of test set-ups that must be used when conducting a test to ensure comparability of results (See Table III–9). Further, AMCA 214–21 specifies how to select the speed(s) and duty points at which to conduct the test, as well as which accessories to include in the test (See Table III–10).

TABLE III–9—AMCA 214–21 TEST CONFIGURATIONS

[Table 7.1 of AMCA 214–21]

Fan configuration	Test standard	Required		Optional	
		Test configuration *	FEI pressure basis **	Test configuration	FEI pressure basis
Centrifugal housed	AMCA 210–16	B or D	Total	A or C	Static.
Radial housed	AMCA 210–16	B or D	Total	A or C	Static.
Centrifugal inline	AMCA 210–16	B or D	Total	A or C	Static.
Centrifugal unhoused	AMCA 210–16	A	Static	N/A	N/A.
Centrifugal PRV exhaust	AMCA 210–16	A or C	Static	N/A	N/A.
Centrifugal PRV supply	AMCA 210–16	B	Total	A	Static.
Axial inline	AMCA 210–16	D	Total	C	Static.
Axial panel	AMCA 210–16	A	Static	N/A	N/A.
Axial PRV	AMCA 210–16	A or C	Static	N/A	N/A.
Circulating Fans	AMCA 230–15	E	Total	N/A	N/A.

* Each letter corresponds to a test set-up described in Section 7.1 of AMCA 214–21. A: free inlet, free outlet; B: free inlet, ducted outlet; C: ducted inlet, free outlet; D: ducted inlet, ducted outlet.

** This indicates that reference FEP used in the FEI calculation is established using either static or total pressure as indicated in this table and as determined by the required test configuration.

because both the static pressure and fan velocity pressure are available to overcome system resistance. However, fans with a free outlet are typically selected based on their performance at a given airflow and static pressure, because the velocity pressure cannot be used to overcome system resistance. The Working Group recommended using total pressure for some categories of fans (*i.e.,* axial cylindrical housed fans, centrifugal housed fans, inline and mixed flow fans, and radial housed fans) and static pressure for others (*i.e.,* panel fans, centrifugal unhoused fans, and PRVs).

[67] AMCA 211–13 provides instructions on how to apply fan laws and on how to perform a test when establishing an AMCA-certified rating. Some of these instructions were revised and integrated in AMCA 214.

[68] AMCA 230–15, AMCA 250–12, ''Laboratory Methods of Testing Jet Tunnel Fans for Performance,'' and AMCA 260–20, ''Laboratory Methods of Testing Induced Flow Fans for Rating,'' for testing circulating fans, jet fans, and laboratory exhaust fans with induced flow.

[69] AMCA 230–15 provides methods for conducting laboratory tests to determine the performance characteristics of circulating fans including the FEP in W, speed in RPM, pressure in inches of mercury, airflow in CFM, thrust in pound force (lbf), efficacy in CFM/W, and overall efficiency in lbf/W.

TABLE III–10—AMCA 214–21 TEST OPTIONS

Test description (section 6 of AMCA 214–21)	Driver configuration	Motor controller configuration	Transmission configuration	Test speed(s)	FEP determination method
Wire to air test at all speeds	Motor	With or without a motor controller.	With or without transmission	All speeds **	Section 6.1 of AMCA 214–21.
Wire to air test at selected speeds.	Motor	With or without a motor controller.	With or without transmission	At least two speeds.	Section 6.2 of AMCA 214–21.
Fan shaft power test for fans without a motor *.	None	With or without a motor controller.	Without transmission	At least one speed.	Section 6.3 of AMCA 214–21.
Fan shaft power test for fans with a regulated motor *.	Electric motors subject to standards at 10 CFR 431.25.	With a variable frequency drive in accordance with section 6.4.1.4 of AMCA 214–21 or without a motor controller.	Direct drive, V-belt drive, flexible coupling, or synchronous belt drive.	At least one speed.	Section 6.4 of AMCA 214–21.
Fan shaft power test and motor/motor and controls test *.	Motor	With or without a motor controller.	Direct drive, V-belt drive, flexible coupling, or synchronous belt drive.	At least one speed.	Section 6.5 of AMCA 214–21.

* With or without the use of interpolation or fan laws as provided in Annex E.
** All speeds for which FEP values are generated.

In the July 2022 NOPR, DOE proposed to incorporate by reference AMCA 214–21 as the prescribed test method for evaluating the energy use of fans and blowers, with modifications discussed in section III.E of this document. DOE also proposed to incorporate by reference AMCA 210–16, ISO 5801:2017, and AMCA 230–15 (with errata) (or latest version available at the time of the any final rule),[70] which are the physical test methods referenced in AMCA 214–21 for fans and blowers and air circulating fans. 87 FR 44194, 44121.

In response to the July 2022 NOPR, AMCA commented that AMCA 214–21 itemizes which method of physical testing applies adequately to which fan category and that these physical measurements are perfectly suitable for deriving each of the energy performance ratings considered by this rulemaking. AMCA commented that each of those methods provides for the relevant fan types their fan air performance and input power. AMCA added that AMCA 210 and ISO 5801 were the only appropriate test methods for fans that generate fan static pressure when applied as intended. AMCA added that AMCA 230 is the single appropriate test method for measuring the performance of air circulating fans that operate at zero fan static pressure with at least 125 W electrical input power and noted that air circulating fans below 125 W electrical power are in the scope of IEC 60879, ‘‘Comfort fans and regulators for household and similar purposes.’’ AMCA noted that too few AMCA members supply low-power air circulating fans and that AMCA was unable to provide more detailed comments. AMCA added that these industry standards measure input power (W) and that prediction of energy consumption (kWh) requires knowledge of operating hours and load, which are too diverse to develop an average use cycle representing the fan industry at large. AMCA noted that the energy-conservation metric that is being defined by DOE references FEI as defined in AMCA 214–21, and because FEI is calculated for a given duty point, energy consumption is inversely proportional to FEI during any use cycle. (AMCA, No. 41 at pp. 14–15)

AMCA further commented that AMCA 210 and AMCA 230 establish uniform test methods to ensure test procedure repeatability. AMCA added that requirements within the standards, such as maintaining instrument accuracy and calibration, contribute to attaining repeatability. Additionally, to help achieve reproducibility between accredited laboratories, AMCA's laboratory accreditation program requires that AMCA audit instrument calibration, compare air-performance test results from AMCA's laboratory against results obtained in the laboratory under review, and conduct independent readings of certain parameters during the test for verification of instrumentation accuracy. AMCA commented that AMCA 214 specifies calculations based on data from various relevant laboratory methods of test and that AMCA does not recommend any changes to these standards in regard to repeatability and reproducibility. In addition, AMCA noted that: (1) AMCA 210 and ISO 5801 are mature test methods that have been used globally for many years; and (2) thrust-testing per AMCA 230 is straightforward. In addition, AMCA already notes that thrust-testing also is used in the DOE test method for large diameter ceiling fans (LDCFs); and (3) as part of the AMCA Lab accreditation program, the same fan is tested at AMCA accredited labs and retested at the AMCA Lab with strict tolerance limits, similar to what is done in a round robin and AMC added it could provide test data from multiple labs for the same fan. (AMCA, No. 41 at pp. 15–16)

AMCA also noted that AMCA 210–16 will be heading into its ANSI-required review/update cycle later in 2022. AMCA expected this to be a revision cycle, not an affirmation, as affirmations only comprise editorial corrections. AMCA commented that this revision would take some time and recommended that DOE not consider the upcoming revision update to AMCA 210. AMCA commented that since the last revision, public comments have accumulated via AMCA's website; however, AMCA does not recommend any changes with regard to AMCA 214–21 and AMCA 210–16. (AMCA, No. 41 at p. 16)

AMCA also commented that AMCA 230 is nearing the completion of its ANSI-required review/update cycle. AMCA commented that it expects this revision to be completed in the near future. AMCA recommended that DOE reference the updated version of AMCA 230 and advised DOE that AMCA 230's revision is nearing completion with the draft out for committee ballot. AMCA stated it expected AMCA 230 to be published as an ANSI/AMCA standard in late 2022 or early 2023. (AMCA, No. 41 at pp. 16–17)

ebm-papst commented that AMCA 210, ISO 5801, and AMCA 230 (as applicable) provided representative measurements of fan power consumption, which were suitable for determining fan efficiency. ebm-papst recommended adopting AMCA 210–16, AMCA 214–21, and AMCA 230–15

[70] In the July 2022 NOPR, DOE noted that it was aware that AMCA 230–15 is currently undergoing periodic review and may be revised in the future. Should a new version become available at the time of any final rule, DOE would incorporate by reference the latest available version of AMCA 230.

without any changes. (ebm-papst, No. 31 at pp. 7–8)

New York Blower commented that AMCA 214–21 and the corresponding FEI metric reasonably estimated energy efficiency and functioned as a viable measure of changes in energy consumption reflected by differences in the FEI values. New York Blower commented that the representative average use issue had been a troubling one to settle due to the wide variety of applications of fans and an industrial application can easily be considered to be continuous operation at the specified operating conditions for 3,000 hours annually (New York Blower, No. 33 at p. 11)

Trane commented that DOE should reference and adopt AMCA 214–21 as its principal test procedure for commercial fans and blowers. (Trane, No. 38 at p. 2)

Greenheck commented that DOE should adopt the test procedures and standards in AMCA 210,[71] 211, and 214 in lieu of the proposed test procedures detailed in the July 2022 NOPR. Greenheck commented that the proposal by DOE differed from the above AMCA standards in ways that would create an extreme burden on the entire fan industry and result in little benefit to the consumer or a reduction in energy consumption. (Greenheck, No. 39 at pp. 1–2)

Morrison commented that the AMCA 210 and AMCA 214 test procedures captured the performance and energy consumption of fans in a clear manner for the relevant fans other than air circulating fans. (Morrison, No. 42 at p. 4) Morrison commented that AMCA 210 established uniform test methods to ensure test-procedure repeatability and that requirements within the standard, such as maintaining instrument accuracy and calibration, contributed to attaining repeatability. Morrison commented that it does not recommend any changes to these standards in regard to repeatability and reproducibility as AMCA 210 was a mature test method that had been used globally for many years. (*Id.* at p. 5)

As noted by stakeholders, AMCA 210–16, AMCA 214–21, and AMCA 230–23 are established test standards used by industry to establish the performance of fans and blower, including air circulating fans. In addition, as previously noted, AMCA 214–21, which references AMCA 210–16 provides test methods that are consistent with the recommendations of the Working Group for fans and blowers other than air circulating fans. Therefore, in this final rule, DOE incorporates by reference AMCA 210–16 and AMCA 214–21 as proposed in the July 2022 NOPR. In addition, as discussed in the July 2022 NOPR, DOE is replacing the reference to AMCA 230–15 (with errata) with AMCA 230–23.[72] DOE did not propose to incorporate AMCA 211–22, ''Certified Ratings Program Product Rating Manual for Fan Air Performance,'' because it does not specify a test method but rather certification and rating procedures, and thus DOE is not adding this standard. In addition, DOE is modifying certain sections of these industry standards as discussed in section III.E of this document.

In addition, due to the comments received on the proposed metric (*see* section III.G of this document) and the adoption of an efficacy metric in CFM/W rather than FEI for air circulating fans, DOE is only incorporating by reference AMCA 230–23 for air circulating fans instead of referencing both AMCA 230–15 (with errata) and AMCA 214–21 as proposed. As noted in the July 2022 NOPR, AMCA 214–21 references AMCA 210–16 and AMCA 230–15 (with errata) as the physical test method, and further provides provisions for calculating the FEI. 87 FR 44194, 44221. Because DOE is adopting an efficacy metric for air circulating fans and is not opting to determine the FEI of air circulating fans, DOE is no longer referencing AMCA 214–21 for air circulating fans.

As stated, in the July 2022 NOPR, AMCA 214–21 provides methods to establish the FEP of a fan based on fan power measurements which are performed in accordance with AMCA 210–16 or ISO 5801:2017, which is referenced in AMCA 214–21 as an equivalent test procedure to AMCA 210–16. 87 FR 44194, 44218–44219. DOE proposed incorporating by reference AMCA 214–21, which allows testing fans other than air circulating fans in accordance with either AMCA 210–16 or ISO 5801:2017 and DOE requested feedback on whether these test methods produce equivalent test results.[73] 87 FR 44194, 44221–44222.

AMCA commented that the test methods prescribed in ISO 5801 and AMCA 210 produce equivalent results when the appropriate test setup is used. AMCA commented that the technical content of AMCA 210 and ISO 5801 are in agreement. AMCA added that products in AMCA's Certified Ratings Program (CRP) are tested in accordance with both ISO 5801 and AMCA 210, and there is reproducibility between both of these test methods, as has been observed through the CRP over decades. AMCA added that one AMCA member conducted comparative testing in its own ISO 5801 lab (inlet chamber) and compared the results with an AMCA 210 test (inlet chamber/Figure 15) and also with AMCA's labs in Chicago and Malaysia and agreement was excellent between each of these labs. (AMCA, No. 41 at p. 15)

New York Blower commented that it relies on the ISO standard and review process to ensure the purpose of the two standards is to produce a similar result. In general, considering this is a U.S. domestic test procedure, New York Blower recommended the use of AMCA 214–21 as the governing document in the test procedure. (New York Blower, No. 33 at p. 11)

ebm-papst commented that it has conducted intercompany round-robin testing to compare AMCA 210 results with ISO 5801 results and concluded that testing fans by these two standards provides equivalent results. (ebm-papst, No. 31 at p. 8) Similarly, Morrison commented that testing conducted with the same setup in either of these standards produced functionally equivalent results. (Morrison, No. 42 at p. 5)

As noted by AMCA, New York Blower, ebm-papst, and Morrison, AMCA 210–16 and ISO 5801:2017 provide equivalent test results and DOE continues to incorporate by reference AMCA 214–21, which references both AMCA 210–16 and ISO 5801:2017 for testing fans and blowers other than air circulating fans.

In addition, in the July 2022 NOPR, DOE further noted that Section 6.3.1 of AMCA 214–21 provides specific equations to be used for bare shaft fans that can only accommodate a direct-drive transmission (*i.e.,* fans that are directly coupled to the drive) and DOE requested comment on the physical features that could be identified to differentiate bare shaft fans that can accommodate only a direct-drive transmission from other bare shaft fans. 87 FR 44194, 44219, 44222.

AMCA commented that AMCA 99–16, Section 9, can be referenced for common belt and direct-drive fan-drive

[71] DOE notes that Greenheck's comment lists AMCA 210, AMCA 211, and AMCA 214 on page 1 of its comments and seems to include a typo on page 2 where it lists AMCA 11, AMCA 211, and AMCA 214. (Greenheck, No. 39 at pp. 1–2)

[72] In the July 2022 NOPR, DOE noted that it is aware that AMCA 230–15 was undergoing periodic review and may be revised in the future. Should a new version become available at the time of any final rule, DOE would incorporate by reference the latest available version of AMCA 230. 87 FR 44194, 44221.

[73] The July 2022 NOPR included a typographical error in the request for comment on the equivalency of AMCA 210–16 and ISO 5801–2017, which listed AMCA 214–21 instead of AMCA 210–16.

arrangements, auxiliary bearings, shaft(s), and/or pulley(s) typically indicate a belt-drive arrangement. (AMCA, No. 41 at p. 17) Similarly, Morrison commented that common belt and direct-drive fan-drive arrangements could be found in AMCA 99–16. Additionally, the presence of auxiliary bearings, shaft(s), and/or pulley(s) typically indicated a belt-drive arrangement. (Morrison, No. 42 at p. 5)

New York Blower commented that it was possible to convert an arrangement 1 fan (belt drive) to an arrangement 8 fan (direct drive) merely by replacing the drive sheave with a coupling and an extended pedestal to support the motor. New York Blower added that, in reality, the shaft and bearings for the drive system would be redesigned to accommodate the different drive system, but to the casual observer, it would look identical. New York Blower noted that arrangement 4 fans have the impeller mounted directly to the motor and so, technically, it would not be a fan without the motor. In summary, New York Blower commented that it was unable to provide distinguishing physical features to assist in the distinction requested and did not see it conceivable to do so. (New York Blower, No. 33 at p. 12)

DOE concludes that the presence of auxiliary bearings, shaft(s), and/or pulley(s) would indicate a belt drive arrangement and would constitute physical features that would differentiate fans that can operate in a belt drive configuration from bare shaft fans that can only accommodate a direct-drive transmission. Therefore, DOE is not modifying the provisions in section 6.3.1 of AMCA 214–21 which provides specific equations to be used for bare shaft fans that can only accommodate a direct-drive transmission.

E. Adoption and Modification of the Industry Standards

As discussed in section III.D, DOE is adopting through reference certain provisions of AMCA 214–21 and AMCA 230–23 as the prescribed test method for measuring the energy use and energy efficiency of fans and blowers. In the July 2022 NOPR, specifically, for fans and blowers that are not air circulating fans, DOE proposed that testing be performed in accordance with AMCA 214–21, with the modifications discussed in the remainder of this section. For air circulating fans, DOE proposed that testing be performed in accordance with AMCA 230–15 with errata, with the modifications discussed in the rest of this section. 87 FR 44194, 44221–44222

For fans other than air circulating fans, the industry test procedure (AMCA 214–21) provides methods to calculate the FEI and FEP of a fan at each of its duty points based on: (1) the fan electrical input measured by a wire-to-air test; or (2) the fan shaft input power measured by a shaft-to-air test, and the application of calculation algorithms to represents the performance of the motor or motor and controller. The industry test procedure (AMCA 214–21) also provides methods to calculate the FEP or fan shaft input power at untested duty points, based on the performance of test duty points and interpolation methods, including the fan laws. For air circulating fans, the industry test procedure provides methods to calculate the efficacy in CFM/W of a fan at maximum speed based on the fan electrical input measured by a wire-to-air test. The following sections discuss key elements of the test procedure and modifications to AMCA 214–21 and AMCA 230–23.

Regarding AMCA 214–21, AMCA recommended that DOE adopt the speed and size interpolations standardized in AMCA 214–21. (AMCA, No. 41 at p. 16) Morrison recommended that DOE adopt the speed and size interpolations standardized in AMCA 214. Further, Morrison recommended no changes be made to AMCA 214–21 and AMCA 210–16. (Morrison, No. 42 at p. 5) New York Blower requested that fan laws be declared a universally accepted AEDM where no testing would be required to apply these laws to create ratings. (New York Blower, No. 33 at p. 24)

In regards to AMCA, Morrison, and New York Blowers comments, DOE references section 8.2.1 of AMCA 214–21, ''Fan laws and other calculation methods for shaft-to-air testing,'' and section 8.2.3 of AMCA 214–21, ''Calculation to other speeds and densities for wire-to-air testing,'' which allow speed and size interpolations as proposed in the July 2022 NOPR. (*See* 87 FR 44194, 44222.)

Robinson commented that the July 2022 NOPR stated that when applying fan laws, the results of a tested fan are used to calculate the fan shaft power of a non-tested fan at a higher speed or with a larger diameter than the fan tested. Robinson asked whether DOE suggested that compressible fan laws can only be applied to fans that are larger or faster than the tested fan. (Robinson, No. 43 at p. 7)

DOE notes the July 2022 proposed to apply the fan laws as described in section 8.2.1 of AMCA 214–21, ''Fan laws and other calculation methods for shaft-to-air testing,'' which relies on the calculation methods in Annex E of AMCA 214–21.87 FR 44194, 44223. Section E.1.1 specifies the requirements to apply the fan laws including the requirement that the fan must have a greater diameter than the tested fan, (*See* section E.1.1.3 of AMCA 214–21) and must have a fan tip speed that is greater than or equal to the tested fan tip speed.

Motor Efficiency Calculation

For bare shaft fans and fans with an electric motor subject to energy conservation standards at 10 CFR 431.25 (''polyphase regulated motor''), sections 6.3 and 6.4 of AMCA 214–21 specify testing these fans using a shaft-to-air test (*i.e.,* a test that does not include the motor performance). When conducting a shaft-to-air test, the mechanical fan shaft input power is measured and the FEP is then calculated by using a mathematical model to represent the performance of the motor (*i.e.,* its part-load efficiency). The FEP is then used to calculate the FEI of the fan.

AMCA 214–21 provides two different methods to estimate the part-load efficiency of a polyphase regulated motor. A single equation presented in section 5.3 and section 6.3.3 of AMCA 214 is used to calculate the FEP of the reference fan (''FEP_{ref}'') and the actual FEP of bare shaft fans (''FEP_{act}''), while a more complex model based on several equations described in section 6.4.2.3 of AMCA 214 is used to calculate the actual FEP of fans sold with polyphase regulated motors without a variable frequency drive (''VFD''). 87 FR 44194, 44222. DOE proposed to maintain the equation as provided in section 5.3 (which are identical to the equations provided in section 6.3.3 of AMCA 214–21) and in section 6.4.2.3 of AMCA 214–21 to estimate the part-load motor efficiency when calculating FEP_{ref}, FEP_{act} of bare shaft fans,[74] and the FEP_{act} of fans sold with electric motors regulated at 10 CFR 431.25 (and without VFDs). *Id.*

In the July 2022 NOPR, DOE requested comment on the equations provided in section 5.3 and section 6.4.2.3 of AMCA 214–21. Specifically, DOE requested comment on whether applying the method outlined in section 6.4 of AMCA 214–21 and the equations

[74] The NOPR did not explicitly specify ''of bare shaft fans'' in the preamble; however, the discussion did previously mention that the equation in Section 6.3.3 of AMCA 214–21 is identical to the equation in Section 5.3 of AMAC 214–21 and applicable to the calculation of FEP_{act} for bare shaft fans. *See* 87 FR 44194, 44222. In addition, the proposed regulatory text specified testing bare shaft fans per Section 6.3 of AMCA 214–21 (*See* Table 1 to Appendix A to tSubpart J of Part 431), which includes Section 6.3.3 of AMCA 214–21. *See* 87 FR 44194, 44257.

provided in section 6.4.2.3 of AMCA 214–21 could result in a higher value of FEI than the FEI resulting from a wire-to-air test in accordance with Section 6.1 of AMCA 214–21. *Id.*

AMCA supports DOE's proposal to maintain the equations as provided in sections 5.3 and 6.4.2.3 of AMCA 214–21 to estimate the part-load motor efficiency when calculating FEP_{ref}, FEP_{act}, and the FEP_{act} of fans sold with electric motors regulated at 10 CFR 431.25 (and without VFDs). AMCA commented that the method outlined in section 6.4 of AMCA 214–21 will result in slightly higher or slightly lower value of FEI than the one outlined in section 6.1. AMCA agrees with DOE that this difference is extremely small and not significant enough to justify deviating from the established industry test procedure. In addition, AMCA recommended to additionally reference Section 6.3 of AMCA 214–21 and add it to the list of acceptable methods for the case of a bare shaft fan. AMCA stated that because bare shaft fans eventually will be paired with motors compliant with current federal regulations, and DOE has concluded the impact on FEI is not significant, section 6.3 should be mentioned along with section 6.4. AMCA added that if a bare shaft fan is likely to be paired with a regulated motor, the method outlined in AMCA 211–21 Section 6.3 provides a convenient and accurate method of calculating FEI when the specific motor size and type is unknown. (AMCA, No. 41 at pp. 17–18)

Morrison stated its general agreement with AMCA's position that the entire AMCA 214–21 be adopted including use of sections 6.4.2.3 and 6.3 of AMCA 214–21. (Morrison, No. 42 at p. 5)

In the July 2022 NOPR, DOE proposed to rely on Section 6.3 and discusses the equation in section 6.3.3 of AMCA 214–21 for determining the FEP of bare shaft fans. *See* 87 FR 44194, 44223, 44257.

In this final rule, DOE is maintaining the proposed equation as provided in section 5.3 and section 6.3.3 of AMCA 214–21 and maintaining the proposed equations in section 6.4.2.3 of AMCA 214–21 to estimate the part-load motor efficiency when calculating FEP_{ref}, FEP_{act} of bare shaft fans, and the FEP_{act} of fans sold with electric motors regulated at 10 CFR 431.25 (and without VFDs).

1. Combined Motor and Controller Efficiency Calculation

For fans with a polyphase regulated motor and a controller, AMCA 214–21 allows testing these fans using a shaft-to-air test (*i.e.,* a test that does not include the motor and controller performance). When conducting a shaft-to-air test, the mechanical fan shaft input power is measured and the FEP is then calculated by using a mathematical model to represent the performance of the combined motor and controller (*i.e.,* its part-load efficiency). The FEP is then used to calculate the FEI of the fan.

Section 6.4.2.4 of AMCA 214–21, which relies on Annex B, ''Motor Constants if Used With VFD (Normative),'' and Annex C, ''VFD Performance Constants (Normative),'' provides a method to estimate the combined motor and controller part-load efficiency for certain electric motors and controller combinations that meet the requirements in sections 6.4.1.3 and 6.4.1.4 of AMCA 214–21, which specify that the motor must be polyphase regulated motor (*i.e.,* an electric motor subject to energy conservation standards at 10 CFR 431.25).

In the July 2022 NOPR, DOE noted that it had previously developed a similar model to estimate the combined motor and controller part-load performance in support of the commercial and industrial pump test procedure final rule published on January 25, 2016 (''January 2016 Pump TP''), in the case where the motor is a polyphase regulated motor. *See* 81 FR 4086, 4128–4130. As noted in the test procedure NOPR pertaining to commercial and industrial pump published on April 29, 2015 (''April 2015 Pumps NOPR''), the model used in the pump test procedure represents a conservative estimate of part-load motor losses (and efficiency).[75] 80 FR 17585, 17628. As noted in the July 2022 NOPR, DOE noted that such approach minimizes the possibility that using the calculation approach to estimate the motor and controller performance would result in better energy efficiency ratings than when testing the equipment inclusive of the motor and controller. 87 FR 44194, 44223.

In the July 2022 NOPR, DOE compared the motor part-load efficiency resulting from applying the AMCA 214–21 motor and controller equations with the combined motor and controller part-load efficiency obtained when using the equation from the DOE pump test procedure and found that the AMCA model resulted in combined motor and controller part-load efficiency values that were generally higher than the DOE model. In addition, DOE reviewed motor and VFD efficiency data from the AHRI certified product database[76] and found existing motor and VFD combinations that performed at a lower efficiency than predicted by the AMCA 214 model. DOE also reviewed the reference motor and controller (''power drive system'') efficiency provided in IEC 61800–9–2:2017 ''Adjustable speed electrical power drive systems Part 9–2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications—Energy efficiency indicators for power drive systems and motor starters,'' which also provides equations to represent the performance of a motor and controller used with fans, and found that the IEC model predicted values of efficiency that were significantly lower (more than 10 percent on average) than the model included in AMCA 214–21. *Id.*

Based on this analysis, DOE stated its concerns that the equations described in section 6.4.2.4 of AMCA 214–21 may not be appropriately representative, resulting in fan FEI ratings that would be higher than FEI ratings obtained using the wire-to-air test method described in section 6.1 of AMCA 214–21. Therefore, DOE did not propose to allow the use of section 6.4.2.4 of AMCA 214–21. Instead, DOE proposed that fans with a motor and controller be tested in accordance with section 6.1 of AMCA 214–21. DOE indicated that manufacturers would still be able to rely on a mathematical model (including the same mathematical model as described in section 6.4.2.4 of AMCA 214–21, as long as the mathematical model meets the AEDM requirements discussed in Section III.I of this document) in lieu of testing to determine the FEI of a fan with a motor and controller. *Id.*

AMCA commented that, for some manufacturers offering fixed combinations of fan/motor/controller, the testing approach was appropriate and encouraged, while for other manufacturers offering standard fan models that can be paired with any standard, commercially available, regulated motor and standard, commercially available VFD, the testing approach of AMCA 214–21 Section 6.1 was not practical and would inhibit AMCA's ability to offer fan products with high-efficiency motors (above current regulation). AMCA stated its appreciation that DOE would consider AMCA 214–21 section 6.4.2.4 an acceptable method to be used as an AEDM; however, AMCA believed some mistakes were made in DOE's analysis

[75] The efficiency (Eff) of a motor at a given load (x) relates to the motor horsepower (hp) and losses (L) as follows: Eff = (x. hp)/(x.hp + L).)).

[76] AHRI Standard 1210, ''Standard for Performance Rating of Variable Frequency Drives,'' certified data from 2016, 2020, and 202. Available at: *www.ahridirectory.org/NewSearch?programId=71&searchTypeId=3.*

that affected the choice of not directly recognizing the calculation model from this section as an acceptable alternative to testing. AMCA commented that these were mistakes also made previously by AMCA that had not yet been sufficiently publicized to prevent them from recurring. AMCA provided supporting data and analysis to illustrate the representativeness of the equations in section 6.4.2.4. (AMCA, No. 41 at pp. 18–21) Specifically, AMCA commented that the DOE model used in the January 2016 Pump TP represented a conservative estimate of part-load motor losses (and efficiency). AMCA added that the model in AMCA 214–21, section 6.4.2.4, was not intended to be a conservative estimate of losses. Instead, according to AMCA, the model was intended to provide a level playing field between manufacturers that chose to test wire-to-air and those that chose to test fan shaft power and calculate wire-to-air losses. AMCA commented that the model used in the pump test procedure, therefore, should result in higher losses, and AMCA believed DOE's use of the pump model to assess AMCA 214 for the fan rulemaking was not valid. (AMCA, No. 41 at p. 18) Regarding AHRI data, AMCA commented that some motor and efficiency data in the AHRI certified product database previously included VFD models that performed at a lower efficiency than most others in the database. When AMCA interviewed the manufacturer of one of the lower-performing models, the manufacturer confided that the certified efficiency was much lower than the actual tested efficiency, but was intentionally rated lower for unrelated reasons. AMCA analyzed the current AHRI 1210 database and found that 59 percent of AMCA 214 calculations were within +/−1 percent of AHRI data and 96 percent were within +/−3 percent and provided graphical representations comparing the AHRI data to the AMCA 207 model.[77] (AMCA, No. 41 at pp. 18–19) AMCA added that the reference PDS model in IEC 61800–9–2:2017 was not typical of currently available products and that no VFDs nor motors were available at these low efficiency levels in the United States. AMCA noted that the equations representative of typical PDS were available in IEC TS 60034–31:2010, ''Rotating electrical machines—Part 31: Selection of energy-efficient motors including variable speed applications—Application guide.'' AMCA further provided a graphical comparison of its model against the equations available in IEC TS 60034–31:2010 as well as in the Motor Systems Tool published by 4E EMSA and demonstrating alignment between models. (AMCA, No. 41 at pp. 19–20) AMCA added that the next version of IEC 61800–9–2 will be expanded to cover VFD frequencies above 60 Hz which is a common condition for fans. AMCA recommended removing IEC 61800–9–2 from consideration for the CIFB rulemaking until at least Edition 2 of IEC 61800–9–2 has been published. Finally, testing at the AMCA lab and at members' labs has always shown excellent agreement with the AMCA 207 models. Figures 5 and 6 show recent testing on 3 and 10 hp motors covering a vast range of speeds and torques. Again, the AMCA 207 model[78] is labeled as the equivalent ISO 12759–2. (AMCA, No. 41 at p. 21)

New York Blower commented that it supports AMCA's analysis. (New York Blower, No. 33 at p. 13) Morrison stated its general agreement with AMCA's position that the entire AMCA 214–21 be adopted, including use of Section 6.4.2.4 of AMCA 214–21. (Morrison, No. 42 at p. 5)

Greenheck commented in support of including AMCA 214 Section 6.4.2.4 combining motor/controller efficiency. (Greenheck, No. 39 at p. 1) In addition, for embedded fans, Greenheck commented that the requirement for wire-to-air testing poses a specific challenge. Greenheck commented that many products are manufactured without motor controllers/VFDs that are provided by the field. Greenheck commented that the proposed testing requirements would, in these cases, put the certification burden on the installing contractor to validate FEI at that selection as the contractor would be completing the ''fan assembly'' as defined. Greenheck commented that this is an unrealistic expectation and would likely be violated regularly. Greenheck commented that DOE should align the testing procedure with existing AMCA standards that allow for calculation of efficiency for motor transmission and controllers. (Greenheck, No. 39 at p. 6)

Robinson commented that in its experience, the issues with making representative energy efficiency ratings with the presence of VFDs at reduced frequency is difficult without direct torque measurement. Robinson added that motor and VFD suppliers repeatedly refused to provide data to allow for calculation of motor and VFD efficiency and power factor at reduced frequency. (Robinson, No. 43 at p. 8)

As noted in the April 2015 Pumps NOPR, the model used in the pump test procedure represents a conservative estimate of part-load motor losses (and efficiency). 80 FR 17585, 17628. As stated, this approach is intended to minimize the possibility that using the calculation approach to estimate the motor and controller performance would result in better energy efficiency ratings than when testing the equipment inclusive of the motor and controller. As illustrated in AMCA's comment, the model in AMCA 214–21 section 6.4.2.4 was not intended to be a conservative estimate of losses and instead is representative of typical performance. In line with DOE's findings, the analysis provided by AMCA shows that there are many AHRI-certified motor and VFD combinations that have a tested efficiency that is lower than the model in section 6.4.2.4 of AMCA 214–21. Therefore, DOE continues to have concerns that applying the model in section 6.4.2.4 of AMCA 214–21 may result in fan FEI ratings that would be higher than FEI ratings obtained using the wire-to-air test method described in section 6.1 of AMCA 214–21. Therefore, DOE is not allowing the use of section 6.4.2.4 of AMCA 214–21. Instead, DOE requires that fans with motor and controller be tested in accordance with section 6.1 of AMCA 214–21. DOE notes that manufacturers would still be able to rely on a mathematical model (including the same mathematical model as described in section 6.4.2.4 of AMCA 214–21, as long as the mathematical model meets the AEDM requirements discussed in Section III.I of this document) in lieu of testing to determine the FEI of a fan with a motor and controller.

In addition, DOE notes that the fan manufacturer is responsible for certifying the equipment as distributed in commerce and a consumer or installer would not be responsible for additional certification. If a fan manufacturer sells a fan basic model without a controller, they would be responsible for certifying that fan basic model without a controller.

2. Annex A of AMCA 214–21

Annex A provides the reference nominal full-load efficiency values to use for polyphase regulated motors subject to energy conservation standards at 10 CFR 431.25 when calculating the motor part load efficiency in accordance with section 6.4.2.3 of AMCA 214–21. In the July 2022 NOPR, DOE proposed to replace Annex A of AMCA 214–21

[77] The AMCA 207 equations are identical to those found in Section 6.4.2.4 of AMCA 214–21 (*See* discussion in section III.D of this document).).

[78] The AMCA 207 equations are identical to those found in AMCA 214–21 (See discussion in section III.D of this document).)).

with a reference to Table 5 of 10 CFR 431.25. The values in Annex A and Table 5 of 10 CFR 431.25 are identical; however, referencing the Code of Federal Regulations would ensure that the values of polyphase regulated motor efficiencies remain up to date with any potential future updates established by DOE. 87 FR 44194, 44223. DOE did not receive any comment on this issue and is replacing Annex A of AMCA 214–21 by referencing Table 5 of 10 CFR 431.25.

3. Annex E of AMCA 214–21

Annex E of AMCA 214–21 allows a reduction in the number of tests potentially required by allowing the use of fan laws to calculate the fan shaft power of a non-tested fan using results from a fan shaft power test of a fan with a smaller impeller diameter. In the July 2022 NOPR, DOE noted that since the publication of AMCA 214–21, AMCA 211–22, ''Certified Ratings Program Product Rating Manual for Fan Air Performance,'' was published. Annex I of AMCA 211–22 allows the use of fan laws to additionally interpolate the fan shaft power of a non-tested fan using results from a fan shaft power test of two fans with a smaller and larger impeller diameter (*i.e.,* interpolation between two tested sizes). DOE considered adding a reference to Section I.6 of Annex I of AMCA 211–22 and allowing manufacturers to additionally interpolate the fan shaft power of a non-tested fan between two tested fans sizes. Alternatively, DOE considered referencing Annex I of AMCA 211–22 in place of Annex E of AMCA 214–21. In the July 2022 NOPR, DOE requested comments on whether it should add a reference to section I.6 of AMCA 211–22 or replace Annex E of AMCA 214–21 by Annex I of AMCA 211–22. 87 FR 44194, 44223–44224.

In response to the July 2022 NOPR, the CEC commented that it supports the reference of Annex E of AMCA 214–21 only. The CEC recommended that section I.6 of AMCA 211–22 not be added or referenced and recommended that Annex I of AMCA–211–22 not replace Annex E of AMCA 214–21. The CEC stated that although section I.6 of AMCA 211–22 and Annex E of AMCA 214–21 could be used to interpolate and compute the Fan Energy Index (FEI) of the interpolated fan for different diameter fans, Annex E of AMCA 214–22 clearly communicated the requirements for the applicability of the formulas provided in Annex E, including the type of units to be used and its distinct source. Including section I.6 could lead to incorrect data being generated for certification since it lacked clear explanations and would require more information to implement correctly. The CEC added that although Annex I of AMCA 211–22 could replace Annex E of AMCA 214–21, it lacks the detail conditions for the applicability of the formulas presented. The CEC commented that Annex I of AMCA 211–22 lacks connectivity to the main body of the test procedure and does not explain the applicability of the results to sections 6.3, 6.4, and 6.5 of AMCA 214–21. The CEC added that Annex I could lead to incorrect data to be generated for certification and would require more information to implement correctly. For these reasons, the CEC recommended referencing Annex E of AMCA 214–21 only. (CEC, No. 30 at pp. 3–4)

AMCA recommended that DOE add a reference to section I.6 of AMCA 211–22. This section covers interpolation between tested fan sizes when geometric similarity requirements were met and would result in more accurate ratings for non-tested sizes. (AMCA, No. 41 at p. 22) New York Blower stated support for AMCA's analysis of the issue. (New York Blower, No. 33 at p. 13)

As previously stated, DOE is not opting to reference AMCA 214–21 for air circulating fans. DOE reviewed the content of Annex I of AMCA–211–22 and of Annex E of AMCA 214–21 and notes that both appendices include identical equations describing the fan laws, interpolations between tested speeds, and general interpolations between tested fans when a single geometric feature is varied, with the following exceptions: (1) Section I.6 of Annex I of AMCA 211–22 allows the use of fan laws to additionally interpolate the fan shaft power of a non-tested fan using results from a fan shaft power test of two fans with a smaller and larger impeller diameter (*i.e.,* interpolation between two tested sizes), while Section E.3 of Annex E of AMCA 214–21 explicitly prohibits this and requires the use of fan laws instead; (2) the equations in Annex I of AMCA 211–22 include the compressibility coefficients, while the equations in Annex E of AMCA 214–21 assume the flow is incompressible; and (3) the symbols in Annex I of AMCA 211–22 are not consistent with the symbols used in AMCA 214–21. For these reasons, at this time to maintain clarity and consistency with the symbols and terms used through AMCA 214–21, DOE is keeping the reference to Annex E of AMCA 214–21 as proposed in the July 2022 NOPR. In addition, DOE is specifying that the equations in Section E.2 of Annex E of AMCA 214–21 must include the compressibility coefficients as applicable for compressible flows.

4. Section 6.5 of AMCA 214–21 and Annex F

Section 6.5 and Annex F of AMCA 214–21 provide methods to determine the FEP of the actual fan by conducting separate tests for the bare shaft fan and the motor or the combined motor and controller. Annex F specifies the industry test methods [79] to use when testing the motor or the combined motor and controller. As provided in Annex F, the motor and controller, if included, must be tested at the range of speeds and loads over which the fan is to be rated. The measurements result in a map of the input power (kW) versus speed and load and intermediate values can be determined through interpolation (linear interpolation or a polynomial curve fit). The methods in section 6.5 and Annex F of AMCA 214–21 are applicable to any electric motor (including non-DOE regulated motors that meet the definition of electric motor at 10 CFR 431.12) as long as it can be tested per the industry test procedures included in Annex F.

In the July 2022 NOPR, DOE noted that the test procedure for combined motor and controller in AMCA 214–21 deviates from the methods proposed in the December 2021 Electric Motors Test Procedure NOPR. 86 FR 71710, 71743 (December 17, 2021).[80] DOE further noted that for fans combined with regulated motors, the methods described in section 6.5 and Annex F of AMCA 214–21 would be less burdensome than multiple wire-to-air tests; however, it would likely be significantly more burdensome than applying the calculation methods described in section 6.3 of AMCA 24–21, since it would require physical tests of all motors with which the bare shaft fan could be paired. In addition, with the option to allow for an AEDM as discussed in Section III.I of this document, a manufacturer would be able to integrate the methods of Section 6.5 and Annex F of AMCA 214–21 into a mathematical model as long as the proposed AEDM requirements were met. 87 FR 44194, 44224.

Therefore, DOE proposed not to include section 6.5 and Annex F of AMCA 214–21. DOE noted that manufacturers would still be able to rely

[79] CSA C747–09 (R2014), ''Energy efficiency test methods for small motors''; CSA C838–13 (R2018), ''Energy efficiency test methods for three-phase variable frequency drive systems''; IEEE 112–2017, ''IEEE Standard Test Procedure for Polyphase Induction Motors and Generators''; and ANSI/ASHRAE Standard 222–2018, ''Standard Method of Test for Electrical Power Drive Systems.''

[80] Since then, DOE notes that the electric motors test procedure was finalized on October 19, 2022. 87 FR 63588.

on a mathematical model (including potentially the same model as described in section 6.5 of AMCA 214–21, as long as the models meet the AEDM requirements discussed in Section III.I of this document) in lieu of testing to determine the FEI of a fan with a motor or a motor and controller, provided that the mathematical model meets all the AEDM requirements proposed in Section III.I of this document. *Id.*

Greenheck commented that DOE's proposal to not adopt section 6.4.2.4 of AMCA 214–21 [81] invalidated a common practice where manufacturers complete bare shaft testing and combine this data with separate testing of the power drive system (PDS). Greenheck commented that the ability to test a PDS separate from the fan significantly reduced testing burden as a single PDS test could be applied across multiple validation classes and sizes. Greenheck commented that testing a PDS separate from the fan would also necessitate that those manufacturers complete wire-to-air testing for any instances where they wish to demonstrate the improved performance of special motor/drive combinations. According to Greenheck, this exclusion penalized manufacturers for offering a more energy efficient PDS through increased testing requirements. (Greenheck, No. 39 at p. 2)

As noted, the test procedure for combined motor and controller in section 6.5 and Annex F of AMCA 214–21 deviates from the methods finalized by DOE on October 19, 2022. In addition, for fans combined with regulated motors, the methods described in section 6.5 and Annex F of AMCA 214–21 would be less burdensome than multiple wire-to-air tests; however, it would likely be significantly more burdensome than applying the calculation methods described in section 6.3 of AMCA 24–21, since it would require physical tests of all motors with which the bare shaft fan could be paired. In addition, as stated, manufacturers would still be able to rely on a mathematical model (including potentially the same model as described in section 6.5 of AMCA 214–21, as long as the models meet the AEDM requirements discussed in Section III.I of this document) in lieu of testing to determine the FEI of a fan with a motor or a motor and controller, provided that the mathematical model meets all the AEDM requirements proposed in Section III.I of this document. For these reasons, DOE is not including Section 6.5 and Annex F of AMCA 214–21.

5. Annex H and Annex I of AMCA 214–21

Annex H ''Required Reported Values (Normative)'' of AMCA 214–21 provides reporting requirements. In the July 2022 NOPR, DOE did not propose to adopt Annex H. DOE stated that it may consider proposals to establish reporting requirements for fans and blowers under a separate rulemaking. 87 FR 44194, 44224.

Annex I ''Minimum Data Requirements for Published Ratings (Informative)'' provides guidance on what performance information to publish. In the July 2022 NOPR, DOE did not propose to adopt Annex I. DOE proposed to adopt requirements regarding represented values in Section III.J of that document. 87 FR 44194, 44224.

The CEC recommended incorporating by reference Annex H of AMCA 214–21 defining the efficiency boundaries of the fan by maximum airflow, maximum pressure, and maximum fan speed as these terms are defined in that section. (CEC, No. 30 at p. 6)

The CA IOUs commented that they were concerned that DOE's test procedure final rule may preempt aspects of the ongoing Title 20 Appliance Standards rulemaking. Specifically, the CA IOUs noted that DOE did not propose to adopt Annex H ''Required Reported Values (Normative)'' of AMCA 214–21 Test Procedure for Calculating FEI for Commercial and Industrial Fans and Blowers. The CA IOUs commented that DOE stated that it may consider reporting requirements in a separate rulemaking. However, the CA IOUs noted that the CEC has proposed adopting Annex H in its Express Terms to determine Maximum Airflow, Maximum Pressure, and Maximum Fan Speed at which the fan can achieve an FEI greater than or equal to 1.0. Therefore, the CA IOUs requested that DOE adopt appendix H to align with the CEC proposal. (CA IOUs, No. 37 at p. 7)

DOE is not adopting reporting requirements for fans and blowers in this rulemaking. DOE may consider proposals to establish reporting requirements for fans and blowers under a separate rulemaking. DOE notes that 180 days after publication of this final rule, any representations made with respect to energy use or efficiency of fans or blowers must be made based on testing in accordance with the test procedures established in this final rule. Further, in regard to the CA IOUs comments about preemption, EPCA states that section 6297 applies with respect to the equipment described in section 6311(1)(L) beginning on the date on which a final rule establishing an energy conservation standard is issued, except that any State or local standard prescribed or enacted for the equipment before the date on which the final rule is issued shall not be preempted until the energy conservation standard for the equipment takes effect. (42 U.S.C. 6316(a)(10))

6. Section 8.3 of AMCA 214–21

Section 8.3, ''Appurtenances,'' provides guidance on how to characterize fan performance in the case of a fan with additional appurtenances beyond what is required by the test procedure. In the July 2022 NOPR, DOE did not propose to adopt this section as DOE does not propose to establish fan performance with additional appurtenances beyond what is specified in the test procedure.[82] 87 FR 44194, 44224.

DOE did not receive any comment on this issue and is not including section 8.3 of AMCA 214–21, because DOE is not establishing fan performance with additional appurtenances beyond what is required in the test procedure. *See* section III.E.12 of this document.

7. Measurement of PVR Performance

Table 7.1 of AMCA 214–21 requires different test configurations for PRVs that supply air to a building and PRVs that exhaust air from a building. Some PRVs can operate both as supply and exhaust fans. In the July 2022 NOPR, DOE proposed that PRVs that can operate both as supply and exhaust fans be tested in both configurations. 87 FR 44194, 44224.

In response to the July 2022 NOPR, the Efficiency Advocates commented that they support DOE's proposal for PRVs requiring that models capable of operating as both supply and exhaust fans be tested as both as it would help ensure that PRVs are tested and rated in all configurations in which they may be installed. (Efficiency Advocates, No. 32 at p. 3)

AMCA supports testing in both configurations. If a PRV is marketed as being able to operate both as a supply and an exhaust fan, AMCA requires it to be tested and rated as both a supply PRV and an exhaust PRV. (AMCA, No. 41 at p. 22)

New York Blower noted that PRVs that operate both in supply and exhaust

[81] DOE believes this is a typographical error in the comment and should be referencing Section 6.5 of AMCA 214–21 which describes the separate bare shaft fans and PDS testing approach.

[82] Section III.D.7 of the July 2022 NOPR included an erroneous reference to Section 7.3 of AMCA 214–21, which DOE did not propose to adopt at the time. *See* 87 FR 44194, 44224. This error was noted in a comment by AMCA (AMCA, No. 41 at p. 23).

modes clearly display a significant difference in performance, and that it is clearly in the manufacturer's best interest to understand the different performance values. New York Blower added that an unintended consequence of deriving an efficiency level that eliminates a significant portion of a direction of PRV could, as unreasonable as it seems, imply two fans should be installed—each operating in its most efficient direction—to accomplish both supply and exhaust. (New York Blower, No. 33 at p. 13)

DOE requires that PRVs that can operate both as supply and exhaust fans be tested in both configurations. DOE would consider any issues related to efficiency levels, including differences in performance for PRVs that operate both in supply and exhaust modes in its separate energy conservation standards rulemaking.

8. Embedded Fans and Blowers

As discussed in Section III.B.3 of this document, DOE proposed to exclude fans that are embedded in equipment as listed in Table III–7 of this document. DOE explained that other embedded fans were included in the scope of the test procedure to the extent that they meet the test procedure scope criteria presented in Section III.B.1 of this document and do not fall under the exclusions discussed in Section III.B.2 of this document. 87 FR 44194, 44224.

The Working Group recommended that embedded fans be tested in a standalone fan configuration (*i.e.,* outside of the piece of equipment in which they are embedded). (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #8 at p. 5) DOE interprets this recommendation to apply to embedded fans that are not manufactured in a standalone configuration because standalone fans that are purchased by an OEM for incorporation into equipment can be tested prior to being embedded. Because embedded fans included in larger equipment may share structural or functional parts with that equipment, the fan may not be removable without causing irreversible damage to the equipment. To address such embedded fans, the Working Group recommended testing exclusively embedded fans using additional fan components, except for the fan impeller, that are geometrically identical to that of the embedded fan inside the larger piece of equipment. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #8 at p. 5) In addition, the Working Group recommended that embedded fans be certified over their standalone operating range. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #4 at p. 4)

In the July 2022 NOPR, DOE stated that fan performance information indicated that OEMs currently test and collect information on embedded fan performance and that OEMs understand a fan's typical operating range in terms of flow and pressure. DOE noted that the AMCA 214–21 foreword states that, ''AMCA Standard 214 primarily is for fans that are tested alone or with motors and drives; it does not apply to fans tested embedded inside of other equipment.'' To test exclusively embedded fans that are not manufactured in a standalone configuration, consistent with the Working Group recommendations, DOE therefore proposed that these fans be tested as standalone fans, outside of the equipment in which they are incorporated. In addition, DOE proposed that if any fan components are not removable without causing irreversible damage to the equipment into which the fan is embedded, the manufacturer must use additional fan components, except for the fan impeller, that are geometrically identical to that of the fan embedded inside the larger piece of equipment for testing. This would result in a range of FEI ratings at every operating point at which the fan is capable of operating, including at the flow and pressure point experienced by the fan when embedded inside the equipment. 87 FR 44194, 44425.

ebm-papst commented that its customers almost exclusively embed all purchased fans into equipment that is currently regulated, slated to be regulated, or not regulated. ebm-papst commented that all fans that it supplies in testable configurations are rated based on wire-to-air tests, either AMCA 210 or ISO 5801. However, ebm-papst commented that fans are often supplied in configurations that are not testable: (1) suppliers other than ebm-papst have supplied forward curve impellers loosely placed in scroll housings, thus initially without bearings/drivers, before the OEM furnishes the motors and thereby finally creates the housed centrifugal fan; (2) forward curve impellers complete with integrated motor supplied without scroll housing, as the eventual housing shape will be part of the larger HVAC unit; or (3) axial propellers complete with integrated motors but without panels, because the OEM has the eventual ''panel'' designed and supplied by the surrounding HVAC unit. Nevertheless, ebm-papst noted that it is common practice and the OEMs' expectation that suppliers document fan air performance. In the case of non-testable configurations, the fans would be tested with inlets, housings, and mounting. (ebm-papst, No. 31 at p. 3)

ebm-papst added that OEM customers expect fan performance representations from their suppliers when they purchase incomplete panel fans and or incomplete plenum fans: (1) motorized propellers are measured and rated in the form of axial panel fans but sold without panels; and (2) motorized impellers are measured and rated in the form of plenum fans but sold without inlet cones/rings and without inlet plates. (*Id.* at p. 7) emb-papst further commented that all ebm-papst fans are rated based on tests in standalone configuration, and that those supplied to OEMs without panels or inlet rings for embedding are tested in their laboratories with standardized components in place. emb-papst commented that the necessary geometries of these necessary peripheral components are comprehensively described for the customers and users. ebm-papst added that fans it supplies incomplete to OEMs can be tested with the missing components, that then are documented. In addition, emb-papst noted that motorized propellers should be tested with fan panels/orifices in place and that motorized impellers should be tested with inlet rings/cones and plates in place. (*Id.* at p. 10)

AMCA commented that fans purchased in a testable configuration typically are tested standalone and rated. According to AMCA, in these cases, a fan supplier can provide performance data of a standalone fan to an OEM. (AMCA, No. 41 at p. 6)

New York Blower commented that its involvement in HVACR equipment is limited. Regardless, New York Blower stated that for applications it had been involved in, New York Blower would consider ventilation and regularly use AMCA 210–16 to conduct the test in a standalone configuration. New York Blower stated that therefore, by reference, AMCA 214–21 would also be applicable. (New York Blower, No. 33 at p. 8)

Morrison commented that embedded fans and replacement fans, especially for HVAC and applications where safety was a consideration, should be excluded from the scope. Morrison added that fans tested as standalone do not have the same performance in the appliance as tested per this test procedure. Morrison stated that testing of fans per AMCA 210 requires many multiples of diameter clear of the inlet and exit to ensure proper airflow development and these conditions are never present in appliances, so optimum performance at the lowest energy may be different than the best FEI selection. (Morrison, No. 42

at p. 2) Morrison added that while fans supplied to HVAC equipment manufacturers may be tested as standalone, many are not as they are custom designed for the appliance and only tested in the appliance. Morrison commented that the goal of fans for HVAC equipment is to have the lowest energy consumed at the desired operating point in the equipment and that will often not correspond with the AMCA 210 or AMCA 214 tested FEI. In other words, according to Morrison, the standalone testing is generally of no value in the effort of identifying the fan with the best efficiency in the appliance. Morrison added that the benefit of standalone testing is very limited as end users need performance of the appliance tested as an appliance ready for customer installation. (*Id.* at pp. 2–3) Morrison further commented that testing embedded fans as standalone fans will add cost but provide no value. Morrison stated that AMCA 210 is a test standard for testing of a fan's performance with no obstruction within recommended distance of the inlet and exit to ensure the fundamental operation of the fan is not changed. Morrison commented this is never the case in embedded fans and in most cases, the most efficient standalone tested fan is not the fan that consumes the lowest energy in an application—this has been presented previously in this rulemaking process and is still a consideration today. Morrison commented that unit level testing or better full system level testing provides greater opportunity for energy savings. (*Id.* at p. 6)

As noted by ebm-papst, it is common practice for OEMs to expect fan performance information from their fan suppliers. As mentioned by ebm-papst and AMCA, fans sold in a testable configuration are tested in a standalone configuration. As specified by ebm-papst, fans supplied incomplete to OEMs can be tested with the missing components (*i.e.,* in a standalone configuration) that then are documented. Such approach aligns with the proposed approach for testing embedded fans that are not manufactured in a standalone configuration and is consistent with common industry practice. Therefore, consistent with the Working Group recommendations, DOE requires that embedded fans that are not manufactured in a standalone configuration be tested as standalone fans, outside of the equipment in which they are incorporated. In addition, in line with the Working Group recommendations and July 2022 NOPR, DOE requires that if any fan components are not removable without causing irreversible damage to the equipment into which the fan is embedded, the manufacturer must use additional fan components, except for the fan impeller, that are geometrically identical to that of the fan embedded inside the larger piece of equipment for testing. This will result in a range of FEI ratings at every operating point at which the fan is capable of operating, including at the flow and pressure point experienced by the fan when embedded inside the equipment. DOE further notes that the July 2022 NOPR omitted the corresponding provisions in the proposed regulatory text and DOE is adding the corresponding provisions in the final regulatory text.

The CA IOUs commented that the proposed test procedure would apply to fans embedded in non-regulated equipment such as air-handlers. The CA IOUs commented that neither proposed regulatory language nor the commentary provided guidance to manufacturers on how to provide fan performance data when the requirements of the NOPR take effect. The CA IOUs commented that Title 24, ASHRAE 90.1, and IECC 2021 require that designers meet a maximum fan system power and that the selected fans meet a minimum FEI. The CA IOUs commented that many manufacturers buy a fan represented as a bare shaft fan and bundle it with a motor, transmission, and/or controller. If the fan manufacturer created this bundle, it would have a different representation than the bare shaft fan. Moreover, many manufacturers build fan arrays (*i.e.,* fans with single-speed motors controlled by a single variable frequency drive controller supplied by the packager). The CA IOUs added that fan arrays are not in the scope of AMCA 214–21. Specifically, the CA IOUs requested clarification on the following issues: (1) Can packaged manufacturers use bare shaft performance data from the fan manufacturer and then apply an AEDM or one of the permitted modeling methods to determine the performance of the package with added motors and controllers? (2) When manufacturers package a fan with a motor, transmission, or speed controller, are they required to perform the same testing as a fan manufacturer? If not, can the manufacturer provide performance data based on testing inside the air handler? (3) How can fan manufacturers present performance data for fan arrays where one controller operates many motors? (CA IOUs, No. 37 at p. 8)

Regarding issue (1), DOE clarifies that if a manufacturer assembles a combined bare shaft fan and motor and controller and chooses to make representations of FEI for the combined equipment that it distributes in commerce, then the manufacturer would need to rate the combined equipment in accordance with DOE test procedures. Regarding items (2) and (3), DOE notes that the test procedure is applicable to the fan tested in a standalone fan configuration and does not apply to fan assemblies.

New York Blower commented that it provides a significant quantity of applications where the fan could be described as embedded in a device or system that provides an end service, such as dust collection and that structural design modifications may be required to install the fan in the resulting system. New York Blower commented that it tests the fan by extracting it from the system, creating a mounting interface to support testing and conduct the test. New York Blower commented that for more integrated systems, such as HVACR applications, this may pose significant challenges. (New York Blower, No. 33 at pp. 13–14)

DOE understands that the example described by New York Blower is of a standalone fan installed in a larger system in the field. Such a fan would be tested in the standalone configuration.

ebm-papst requested clarification regarding an OEM's obligation for air performance testing when a fan is incomplete without components that are part of a surrounding unit. (ebm-papst, No. 31 at p. 1)

As adopted, embedded fans that are not manufactured in a standalone configuration must be tested as standalone fans, outside of the equipment in which they are incorporated. As noted, if any fan components are not removable without causing irreversible damage to the equipment into which the fan is embedded, the manufacturer must use additional fan components, except for the fan impeller, that are geometrically identical to that of the fan embedded inside the larger piece of equipment for testing.

9. Wire-to-Air Performance for Air Circulating Fans

As discussed in the July 2022 NOPR, DOE did not find any circulating fans that were distributed in commerce without an electric motor. However, if an air circulating fan is sold without a motor, it would still meet the definition of an air circulating fan and would be included in the scope of the test procedure. Therefore, in the July 2022 NOPR, DOE proposed that air circulating fans distributed in commerce without an electric motor be tested using an electric motor as recommended in the manufacturer's catalogs or distributed in commerce with the air circulating fan. If more than one motor is available in a manufacturer's catalogs or distributed in commerce with the air circulating fan, DOE proposed requiring that it be tested using the least efficient motor capable of running the fan at the fan's maximum allowable speed. 87 FR 44194, 44225.

ebm-papst commented that it is not aware of any ACF sold without a motor. (ebm-papst, No. 31 at p. 10)

DOE did not receive any other comments on this topic and thus requires that air circulating fans distributed in commerce without an electric motor be tested using an electric motor as recommended in the manufacturer's catalogs or distributed in commerce with the air circulating fan. If more than one motor is available in manufacturer's catalogs or distributed in commerce with the air circulating fan, DOE requires that it be tested using the least efficient motor capable of running the fan at the fan's maximum allowable speed.

10. Total Pressure Calculation for Air Circulating Fans

In the July 2022 NOPR, DOE noted that AMCA 214–21 specifies that air circulating fans must rely on a FEI based on total pressure (sum of the static pressure and velocity pressure). (*See* Table III–9 of that document.) However, AMCA 230–15 does not specify the measurement or calculation of fan total pressure, which is a required input to the FEI calculation. In the July 2022 NOPR, DOE proposed to add provisions to specify how to calculate fan total pressure and to apply the equations in section A.2 of AMCA 208–18 when calculating the fan total pressure at a given airflow for fans tested per AMCA 230–15. 87 FR 44194, 44225.

ebm-papst commented that complete reports of AMCA 230 tests include all information necessary to calculate fan total pressure of circulation fans. (ebm-papst, No. 31 at p. 10)

As noted by ebm-papst, the information included in an AMCA 230 test report includes all the information needed to calculate the fan total pressure. Although DOE is not adopting FEI as the metric for air circulating fans (which required the determination of total pressure), section 8.7 of AMCA 230–23 includes equations for calculating total pressure (the same as proposed by DOE), and DOE is retaining these provisions by referencing section 8.7 of AMCA 230–23.

11. Appurtenances

Section 7.3 of AMCA 214–21 provides instructions on which appurtenances to include as part of the tested fan. It distinguishes between appurtenances that improve or reduce performance. For appurtenances that improve fan performance (including but not limited to inlet bells, diffusers, stators, or guide vanes), AMCA 214–21 specifies that these appurtenances should be included if always supplied with the fan when distributed in commerce. For appurtenances that reduce fan performance, which include, but are not limited to, safety guards, dampers, filters, or weather hoods, AMCA 214–21 states that if the appurtenance is always supplied with the fan when distributed in commerce, then it shall be tested with the fan. If the appurtenance is not always supplied with the fan when distributed in commerce, it shall not be tested with the fan.

For circulating fans, in the July 2022 NOPR, DOE noted that the AMCA 230 committee was considering adding the following provisions as part of the revised version of AMCA 230: any appurtenances sold with the fan shall be included in the minimum testable configuration. 87 FR 44194, 44225.

In the July 2022 NOPR, DOE reviewed the provisions related to accessories in AMCA 214–21 and as considered by the AMCA 230 committee and tentatively determined that testing using the provisions discussed by the AMCA 230 committee would provide results that are more representative of field conditions because consumers are likely to use the fan with the appurtenances they purchase. Therefore, for fans and blowers, including air circulating fans, DOE proposed to specify that any appurtenances sold with the fan must be included during the test. In the July 2022 NOPR, DOE requested comment on the proposed provisions related to the consideration of appurtenances when testing fans and blowers, including air circulating fans.[83] *Id.*

In response to the July 2022 NOPR, for air circulating fans, AMCA commented that if an air circulating fan is sold or supplied with a guard or other appurtenances, then it should be tested with the guard or other appurtenances, and if the fan is sold or supplied without a guard or appurtenances, then it should be tested without a guard or appurtenances. AMCA added that each combination of circulating fan and appurtenances would be a separate basic model or conservative ratings could be used to combine multiple basic models. AMCA commented that this was feasible due to the relatively limited number of air circulating fan models and combinations of guards/appurtenances offered by manufacturers. (AMCA, No. 41 at p. 23)

For fans and blowers other than air circulating fans, AMCA recommended that DOE use the provisions in section 7.3 of AMCA 214–21. AMCA explained that including appurtenances in the scope of testing would add burden on fan manufacturers. AMCA commented that historical data, in general, has been developed without appurtenances being tested with the fan, so that including appurtenances would negate the validity of all the historical data and the basic models would need to be tested again with multiple samples as proposed. AMCA added that some appurtenances are mutually exclusive, and that numerous accessories can be applied to fans, but it may not be possible, or reasonable, to apply all available appurtenances to a fan for testing. AMCA added that appurtenances that negatively impact fan air performance would clearly, at the margin, reduce the compliant region of the fan-performance map, *i.e.,* the FEI bubble would shrink. AMCA commented that one option might be for manufacturers to create different basic models, *i.e.,* model numbers for those that include certain appurtenances and separate model numbers for those that do not—a solution that would clearly add complexity and significant testing and AEDM costs. Finally, AMCA commented that DOE's analyses to date, such as those in the notice of data availability,[84] have been done without accessories and that changing the basis of analysis to include appurtenances would require the analyses to be completely redone to reasonably estimate the cost impacts and energy savings in a subsequent energy standard. Most importantly, this proposal would alter the definition of minimum testable configuration in AMCA 214–21, which is a ''fan having at least an impeller; shaft and bearings and/or driver to support the impeller; and its structure or its housing.'' AMCA

[83] As previously stated, Section III.D.7 of the July 2022 NOPR included an erroneous reference to Section 7.3 of AMCA 214–21, which DOE did not propose to adopt in the July 2022 NOPR. Instead, as described in Section III.D.12 of the July 2022 NOPR, and consistent with the proposed regulatory text, DOE proposed to apply the same provisions related to appurtenances as considered by the AMCA 230 committee for air circulating fans: any appurtenances sold with the fan shall be included in the minimum testable configuration.

[84] On November 1, 2016, DOE published a notice of data availability that presented an analysis based on the scope and metric recommendations of the term sheet. 81 FR 75742.

recommended that fans be tested in their minimum testable configuration—with considerations for appurtenances that are consistent with section 7.3 of AMCA 214–21. (AMCA, No. 41 at pp. 23–24)

New York Blower commented that adding appurtenances to the fan for the test procedure will increase testing costs. New York Blower added that not all appurtenances can be applied to a fan simultaneously and the proposal to include appurtenances would multiply the number of basic models and result in a high number of fan models offered to the market with different combinations of appurtenances. New York Blower noted the challenge represented by the complexity that would be generated from the multiple product configurations, testing, and administrative burden to support product certification. New York Blower added that the fan is the prime mover from an energy conversion perspective, and that it is unlikely a fan will be redesigned to be more efficient based on the addition of an appurtenance. In addition, New York Blower noted that many appurtenances are not manufactured by fan manufacturers and that it would be an additional burden for a fan manufacturer to engage in appurtenance redesign for a product it may not manufacture. New York Blower added that all the market impact analysis done to date was accomplished using appurtenance-free fan data and cannot be used to draw conclusions on the performance of appurtenance-laden fans in the future. Further, New York Blower commented adding appurtenances adds significant complexity. (New York Blower, No. 33 at pp. 5–6)

In addition, New York Blower commented that the inclusion of appurtenances when testing fans and blowers will increase the required testing to a degree that is unsupportable by the majority of manufacturers in the fan industry. New York Blower added that the fan is the prime energy conversion device and that redesigning the fan to improve efficiency to accommodate appurtenances is unlikely to achieve acceptable results. New York Blower added that the test should be limited to the minimum testable configuration as described in AMCA 214–21 with the appropriate modifications to the fan to represent the fan operating in a system. One example of such, stated New York Blower, would be the installation of an inlet bell to represent an inlet duct. (*Id.* at p. 14)

JCI stated that it shared AMCA's comments regarding the rejection of the currently accepted section 6.4.2.4 [85] of AMCA 214–21 on handling appurtenances, which invalidates industry's significant volume of historical testing. (JCI, No. 34 at p. 2)

Morrison commented that fans and blowers should be tested in their minimum testable configuration and consistent with the considerations for appurtenances that are found in section 7.3 of AMCA 214–21. (Morrison, No. 42 at p. 6)

Robinson commented that the testing procedure expectation placed on the manufacturers of heavy industrial process fans and blowers is burdensome and impracticable. Robinson commented that the challenge is pronounced for heavy industrial process fan manufacturers when it comes to testing with appurtenances. Robinson explained that most heavy industrial processes require several subprocesses, often over the stretch of significant acreage of an industrial plant facility (*i.e.,* paper mill, petroleum refinery, pharmaceutical plant, mining facility, chemical plant, food production plant, etc.). Robinson commented that the air movement equipment required to operate these processes and subprocesses is robust, designed and engineered specifically for each application and installation, and also connected to and affected by all of the appurtenances of the plant's system. Robinson commented it is unknown how a fan manufacturer would test the fan with its appurtenances at any point before full installation and by that time, the fan is fully constructed and sold. Robinson stated that the location and timing of the testing will also be difficult as fans are often sold as part of a new subprocess in the midst of construction or as a replacement for a fan currently operating, which when shut down requires the idling of an entire industrial process. Robinson commented it is unclear to what extent industrial fan manufacturers will have to go in order to comply with this part of the rule. Further, Robinson stated that all historical testing, done over l00 years, has been done without appurtenances, and this rule would render all of that testing useless. (Robinson, No. 43 at p. 3) Robinson added that the inclusion of appurtenances when testing fans and blowers will add exponentially to the testing required. Robinson pointed out that it is customary to certify designs or fan performance based off of test block conditions or with appurtenances in their least restrictive settings. Robinson commented that information provided by suppliers of appurtenances is often inadequate to establish losses at conditions other than design, and for industrial process custom fan manufacturers, this would be a very significant burden as each unique configuration and basic model would be either tested or validated. Robinson added that the addition of appurtenances also brings system effect factors into play, which create significant complications. Robinson added that the test should be limited to the fan only (with or without a motor or drive system) (*Id.* at p. 9)

Greenheck commented that DOE did not propose to adopt the AMCA 214–21 Section 7.3 provisions for appurtenances and has provided a confusing stance on what is to be tested. Greenheck commented that there are several appurtenances, and combinations of appurtenances, available on fan products. Greenheck added that many appurtenances are mutually exclusive and should not or cannot be tested together. Greenheck further commented that appurtenances are generally intended to aid the end customer in accommodating building limitations or overall system design requirements and are not part of the basic fan performance. As currently written, stated Greenheck, the DOE rulemaking appears to require two-sample tests for each appurtenance and appurtenance combination, which represents an additional, significant testing burden for all manufacturers. Greenheck further provided an example to illustrate the high number of appurtenances for a single model, where with the combination of a two-sample test and wire-to-air testing, appurtenances would lead to 6,336 tests for a fan series with 11 sizes. (Greenheck, No. 39 at pp. 2–3)

NEEA commented that the treatment of appurtenances in the definition of a basic model is unclear in the current NOPR. In addition, NEEA noted that in Section III.C.5 of the NOPR, DOE proposed to adopt section 7.3 of AMCA 214–21. However, NEEA noted that DOE used language inconsistent with section 7.3 of AMCA 214–21 and in the proposed regulatory text included in Section VI, DOE provided text that ''replaces the provisions in section 7.3 of AMCA 214–21.'' NEEA commented that DOE's current language has the potential of dramatically increasing the number of basic models, as it does not clearly identify how appurtenances impact a basic model. (NEEA, No. 36 at p. 3)

[85] Although JCI references Section 6.4.2.4 of AMCA 214–21, DOE notes that the appurtenances are addressed in Section 7.3 of AMCA 214–21.

Loren Cook Company commented that there is a burden associated to testing any appurtenances sold on a fan. Loren Cook added that it has several products each with many sizes and have a dozen or more accessories that could affect performance and would result in excessive amount of testing required. (Public Meeting Transcript, No. 18 at pp. 65–66)

For fans and blowers other than air circulating fans, in view of the substantially high number and combinations of appurtenances as noted by AMCA, New York Blower, JCI and Greenheck, and to remain consistent with the definitions of minimum testable configurations as described in AMCA 214–21 [86] as noted by AMCA, DOE requires testing in accordance with section 7.3 of AMCA 214–21, which distinguishes between appurtenances that improve or reduce performance. As such, DOE is no longer replacing the provisions in Section 7.3 of AMCA 214–21. For appurtenances that improve fan performance, which include, but are not limited to inlet bells, diffusers, stators, or guide vanes, AMCA 214–21 specifies that these appurtenances should be included if always supplied with the fan when distributed in commerce. For appurtenances that reduce fan performance, which include, but are not limited to, safety guards, dampers, filters, or weather hoods, AMCA 214–21 states that if the appurtenance is always supplied with the fan when distributed in commerce, then it shall be tested with the fan. If the appurtenance is not always supplied with the fan when distributed in commerce, it shall not be tested with the fan. To align with the adopted definition of ''minimum testable configuration,'' DOE requires testing in accordance with section 7.3 of AMCA 214–21. In addition, DOE clarifies that its regulations would apply to the fan as distributed in commerce and would not account for any potential additional appurtenances added in the field. As noted by AMCA, such approach would permit the preservation of historical data and reduces test burdens.

For air circulating fans, in line with the provisions in Section 6.3 of AMCA 230–23, DOE requires that any appurtenances sold with the fan shall be included in the minimum testable configuration, as proposed.

In addition, in the July 2022 NOPR, DOE noted that for air circulating fans, the AMCA 230 committee was considering additional provisions to include in the next version of AMCA 230 to describe what should be considered as part of the test (*i.e.,* the ''minimum testable configuration''). The committee was considering the following: (1) If sold with the fan, an on/off switch or speed control device would be included in the minimum testable configuration. The power consumption of the on/off switch or speed control device would be included in the active and standby mode power measurements. (2) If multiple control devices are sold with the fan, only the standard fan control device would be used for testing. (3) Optional product features not related to generating air movement would not be energized for the purpose of testing. Optional product features not related to generating air movement include, but are not limited to, misting kits, external sensors not required to operate the fan, and communication devices not required to operate the fan. 87 FR 44194, 44225.

For air circulating fans, in the July 2022 NOPR, DOE tentatively determined that it is unlikely that additional features not related to air movement would remain in the on-position unless intended by the consumer. As such, requiring testing in their ''as-shipped'' configuration would not provide a more representative measure of energy use for air circulating fans. DOE proposed to add clarification that additional features not related to air movement be installed, but either powered off or set at the lowest energy-consuming mode during testing. Further, to avoid confusion as to which controller is used for testing in the case where multiple advanced controllers are offered, DOE proposed to add additional clarification to its specifications for appurtenances. Specifically, DOE proposed to clarify that if the air circulating fan is offered with a default controller, testing would be conducted using the default controller. If the air circulating fan is offered with multiple controllers, testing would be conducted using the minimally functional controller (*i.e.,* ''standard controller''). Testing using the minimally functional controller is consistent with the direction to test with additional features not energized during the power consumption measurement. Controller functions other than the minimal functions (*i.e.,* the functions necessary to operate the air circulating fan blades) are akin to additional features that do not relate to the air circulating fan's ability to create airflow. This proposed addition clarifies which controller to select. These proposals were in line with the additional provisions considered by the AMCA 230 committee at the time. *Id.* at 87 FR 44225–44226.

DOE did not receive any comments on these specific proposals.

Since then, AMCA 230–23 has incorporated these provisions in section 6.3. DOE is referencing the provisions in section 6.3 of AMCA 230–23.

12. Voltage, Phase, and Frequency

This section is only applicable to fans with a motor that are tested wire-to-air, where the electrical power supplied to the fan needs to be specified.

Regarding frequency, fans and blowers can be rated to operate at 50 or 60 Hz, be supplied by single-phase or multi-phase electricity, and can operate at a single rated voltage (*e.g.,* 115 V) or within one or more rated voltage ranges, or a combination of both (*e.g.,* 115/208–230 V). In the July 2022 NOPR, DOE stated that section 7.8 of AMCA 214–21 specifies that for fan electrical power measurement (when conducting a wire-to-air test), the fan must be operated using a 60 Hz supply unless that frequency conflicts with nameplate values. The voltage during the test shall match the highest allowable value that corresponds with the relevant nameplate. 87 FR 44194, 44226.

In the United States, 60 Hz frequency is the most representative, and DOE tentatively determined that fans rated for operation with only 60 Hz power supply would be tested with 60 Hz electricity and that fans capable of operating with 50 Hz and 60 Hz electricity would also be tested with 60 Hz electricity. DOE tentatively determined that it does not need to consider fans rated for operation with only 50 Hz power, since these fans are not relevant in the U.S. market. *Id.*

Regarding the phase to select for testing, DOE proposed to clarify which phase to use during the test as follows. DOE proposed to specify to test fans and blowers, including circulating fans, rated for operation with only a single- or multi-phase power supply with single- or multi-phase electricity, respectively. For fans and blowers, including circulating fans, capable of operating with single- and multi-phase electricity, DOE proposed that such fans must be tested using a multi-phase power supply, which is the most common power supply for industrial and commercial equipment. *Id.*

Regarding the voltage to select for testing, DOE proposed to clarify which voltage to use during the test as follows. For fans and blowers other than air circulating fans, DOE proposed to retain the provisions in section 7.8 of AMCA

[86] DOE is incorporating by reference AMCA 214–21 and relies on the definitions included in Sections 3 of AMCA 214–21, including the definition of minimum testable configuration as proposed in the July 2022 NOPR. *See* 87 FR 44194, 44257.

214–21 to specify testing at the highest rated voltage and align with existing industry standards. *Id.* For air circulating fans, DOE reviewed the provisions related to the supply voltage in the ceiling fan test procedure, which are also tested based on AMCA 230–15 (with errata). Section 3.4.3 and 3.4.4 of 10 CFR part 430, appendix U. DOE proposed the same provisions for air circulating fans that it uses for ceiling fans, with additional language to distinguish how to select the supply voltage for fans tested using single-phase and multi-phase electricity. Specifically, DOE proposed that the supply voltage must be: (1) for air circulating fans tested with single-phase electricity, the supply voltage would be (a) 120 V if the air circulating fan's minimum rated voltage is 120 V or the lowest rated voltage range contains 120 V, (b) 240 V if the air circulating fan's minimum rated voltage is 240 V or the lowest rated voltage range contains 240 V, or (c) the air circulating fan's minimum rated voltage (if a voltage range is not given) or the mean of the lowest rated voltage range, in all other cases; (2) for air circulating fans tested with multi-phase electricity, the supply voltage would be (a) 240 V if the air circulating fan's minimum rated voltage is 240 V or the lowest rated voltage range contains 240 V, or (b) the air circulating fan's minimum rated voltage (if a voltage range is not given) or the mean of the lowest rated voltage range, in all other cases. *Id.*

ebm-papst stated that the electrical power supply (frequency, phase, and voltage) are specified by the fan supplier. ebm-papst commented that any surveillance testing for enforcement of a regulation should be performed at the supplier-specified electrical conditions. ebm-papst commented that DOE restrictions on the permitted power supply would potentially limit the usability of fan performance data for specific projects due the very diverse nature of the fan industry. (ebm-papst, No. 31 at p. 10)

For fans supplied for use in the United States, AMCA advised that the frequency, phase, and voltage be 60 Hz, 1- or 3-phase, and 110 VAC or 230/460 VAC, respectively. AMCA added that the test procedure should conform to U.S. standards for fans sold in the United States. Additionally, AMCA stated that because these are the most prevalent electrical properties of fans sold in the market, the test procedure should be based on those properties. Additionally, AMCA stated support for the adoption of section 7.8 of AMCA 214 and not ''consider[ing] other options such as specifying a voltage for test similar to that proposed . . . for air circulating fans.'' AMCA noted that doing otherwise could negate historical fan data that was tested in accordance with AMCA 214. (AMCA, No. 41 at p. 24)

New York Blower commented in support of testing at 60 Hz. New York Blower commented that fans with application motors can be configured regularly with 1- or 3-phase voltage configurations at a variety of voltage levels. New York Blower stated that if the fan is rated and offered for sale at a variety of motors that require different voltages and phases, then it should be tested as offered. New York Blower added that bare fans can be driven by a torque meter. (New York Blower, No. 33 at p. 15)

Morrison commented that it supports the use of voltage, phase, and frequency for U.S.-targeted products be 110 VAC or 230/460 VAC, 60 Hz, and 1- or 3-phase. (Morrison, No. 42 at p. 6)

Nidec requested clarity on the voltages to consider in the test procedure. (Public Meeting Transcript, No. 18, at p. 56)

The frequency, voltage, and phase selected for testing can impact the determination of the input power and in turn the determination of the FEI or CFM/W metrics. Therefore, DOE specifies how manufacturers must select the frequency, phase, and voltage when testing in accordance with the DOE test procedure and cannot permit testing each fan and at the supplier-specified electrical conditions.

Regarding the frequency, DOE requires that fans rated for operation with only 60 Hz power supply be tested with 60 Hz electricity and that fans capable of operating with 50 Hz and 60 Hz electricity also be tested with 60 Hz electricity. DOE is not adopting provisions for fans rated for operation with only 50 Hz power supply, as these are not relevant to the U.S. market.

Regarding the phase to select for testing, DOE clarifies which phase to use during the test as proposed in the July 2022 NOPR. DOE requires testing fans and blowers, including circulating fans, rated for operation with only a single- or multi-phase power supply with single- or multi-phase electricity, respectively. For fans and blowers, including circulating fans, capable of operating with single- and multi-phase electricity, DOE requires testing using multi-phase power supply, the most common power supply for industrial and commercial equipment.

Regarding the voltage to select for testing, DOE specifies which voltage to use during the test as proposed in the July 2022 NOPR. For fans and blowers other than air circulating fans, DOE retains the provisions in section 7.8 of AMCA 214–21. For air circulating fans, DOE adopts the same provisions as proposed in the July 2022 NOPR, to distinguish how to select the supply voltage for fans using single-phase and multi-phase electricity. DOE's provisions related to voltage are similar to those used for ceiling fans and DOE believes these provide sufficient clarity on how to select the voltage for testing based on the voltage(s) of the air circulating fan as rated by the manufacturer.

13. Test Speeds for Air Circulating Fans

In the July 2022 NOPR, for single speed air circulating fans, DOE proposed to require that testing be conducted at the single available speed. For multi-speed fans with discrete operating speeds, and for variable-speed fans with continuously adjustable speeds, while DOE believed it is preferable to align the DOE test procedure with the accepted industry test procedures—in this case AMCA 230—as much as possible, DOE explained that it did not have data to determine the typical field operating speed(s) of air circulating fans and DOE tentatively determined that testing at each discrete speed (for multi-speed fans) or at each of the five speeds currently specified in AMCA 230–15 (with errata), rather than only requiring testing at the maximum speed, may provide a more holistic representation of an air circulating fan's performance over a range of service levels, which may in turn facilitate easier comparisons for consumers. In addition, DOE proposed to clarify that for variable-speed air circulating fans with a minimum speed that is greater than 20 percent of the maximum speed, the performance data would be captured and reported in five speeds evenly spaced throughout the speed range, including at minimum and maximum speeds.[87] 87 FR 44194, 44227.

In the July 2022 NOPR, DOE added that it was considering several alternative options for specifying the test speeds at which fans with multiple or variable speeds should be tested, including testing a high speed only, or testing in accordance with the speed requirements for large diameter ceiling fans in section 3.5 of 10 CFR part 430, appendix U, which specifies that testing must be conducted at maximum speed and at 40-percent speed or the nearest

[87] If the fan's maximum speed is 1000 RPM and the fan's minimum speed is 400 RPM, then the following speeds should be reported: 400, 550, 700, 850, and 1000 where each speed is equally spaced of 150 RPM or (1000–400)/4.

speed that is not less than 40-percent speed. DOE noted that regardless of the proposed tested speeds, performance data at additional speeds may be captured and reported to better define the shape of the fan performance curve (for example, additional measurements at 20, 60, and 80 percent of maximum speed). *Id.*

AMCA commented that AMCA currently does not have usage data for air circulating fans in the United States. AMCA noted that the AMCA 230 committee recommends rating air circulating fans at only maximum speed. AMCA commented that some small air circulating fans are supplied with solid-state controllers (SSC) for fan-speed reduction and recently, direct-drive air circulating fans with variable-speed EC motors have entered the market. However, AMCA commented that the current market for air circulating fans is predominantly single speed fans. AMCA added that there is no common number of available speeds (2, 3, 4, etc. speed fans) and the discrete speeds vary greatly (~95 to 60 percent of maximum speed). AMCA recommended that only the highest speed be used for the air circulating fan metric because consumers will benefit from comparing fans at a standardized condition and that using the highest speed is the only equitable way to do this for air circulating fans. AMCA stated that rating fans at different non-maximum speeds will cause consumers to be confused and potentially purchase significantly less efficient fans. AMCA provided an example comparison of a single speed fan (Fan 1) and a variable speed model (Fan 2) where both fans are used in agricultural applications and generate the same amount of airflow at maximum speed and Fan 1 consumes half the power of Fan 2 at high speed. AMCA commented that as currently defined in the NOPR, Fan 1 and Fan 2 would have the same proposed ACFEI rating of 1.01. (See Table III–11)

TABLE III–11—AIR CIRCULATING FAN PERFORMANCE COMPARISON

% Max RPM	36%	52%	68%	84%	100%
Airflow (CFM)	2,440	3,145	3,851	4,556	5,262
Fan 1 Power (W)					297.6
Fan 2 Power (W)	38.8	107.6	220	381.4	595.2
Fan 1 ACFEI (proposed)	*	*	*	*	1.01
Fan 2 ACFEI (proposed)	2.15	1.07	0.74	0.59	0.51
Fan 1 (CFM/W)**					17.68
Fan 2 (CFM/W)**	62.89	29.23	17.50	11.95	8.84

* **Note:** the AMCA comment included values at different speeds. However, for a single speed fan, only one speed is applicable.
** DOE added the CFM/W row for additional comparison.

AMCA commented that since air circulating fan heads in agricultural applications are often purchased to generate relatively high air speeds to cool large mammals (cows require 200–400+ fpm of air speed for cooling), the air circulating fans are very likely to run at higher speeds for the majority of their operating hours. In this instance, according to AMCA, the efficiency metric would mislead the consumer to believe that the single speed fan would consume the same amount of electricity as the highly inefficient variable speed fan. (AMCA, No. 41 at p. 26) AMCA added that similar to high-speed small diameter (HSSD) ceiling fans, air circulating fan heads are typically either single speed or do not have common discrete speeds, so speeds other than high speed may not be well defined. Additionally, stated AMCA, there are no data available to estimate a distribution of time spent at speeds other than high speed for use in an efficiency metric. AMCA commented that the operating speed(s) and time spent at each speed will vary greatly based on the application and potentially on the local weather conditions. Finally, commented AMCA, unlike ceiling fans where low speed operation can be used for destratification, the only utility of an air circulating fan is generating elevated air speed, which takes place at higher fan speeds. Therefore, AMCA recommended that similar to HSSD fans, DOE only rate air circulating fans at maximum speed. (AMCA, No. 41 at pp. 25–26)

Big Ass Fan commented that an [air circulating] fan with an ACFEI of 1 at full speed could have a ACFEI of 10 to 20 when the speed is reduced to the 20 to 30 percent range. Big Ass Fan commented that such approach would inflate the ACFEI metric such that a fan could have a ACFEI of 1 at full speed and a weighted average ACFEI of 7. In addition, Big Ass Fan commented that operating at 20 percent speed does not provide any utility as these fans are primarily designed to create air speed to increase the rate of heat loss off the human body, or off of an animal. As such Big Ass fan stated that the ACFEI metric as proposed would be rewarding to speeds that provide no utility and would not represent how the product is used. (Public Meeting Transcript, No. 18 at p. 55)

DOE collected additional speed data on air circulating fan performance data from the BESS certification database[88] and observed that over 80 percent of models are rated at high speed only. While DOE cannot confirm if these fans are single speed, the data seems to indicate that the market is predominantly single speed as stated by AMCA. In addition, as noted by AMCA and Big Ass Fans, a weighted average metric across different speeds may have unintended consequences, inflate the ACFEI metric, and disproportionally favor multi-and variable-speed fans, which would show significantly better ratings even when performing relatively worse than a similar single speed fan at the same airflow and maximum speed. In addition, the latest version of AMCA 230–23 (section 7.2.4.1 of AMCA 230–23) was revised to require testing at the highest speed only (maximum speed). Therefore, at this time, DOE is requiring testing at maximum speed only, which DOE believes is most representative of an average use cycle and would not be unduly burdensome for manufacturers to conduct. DOE notes that for multi- and variable-speed air circulating fans, section 7.2.4.1 of AMCA 230–23 provides that performance data at additional speeds may be captured to better define the shape of the fan performance curve (for example, additional measurements at 20, 60, and 80 percent of maximum speed). DOE adopts to reference these provisions and allows optional representations at lower speeds as allowed in AMCA 230–23.

In the July 2022 NOPR, DOE noted that AMCA 214–21 has provisions to

[88] Additional speed data collected in September 2022 included 435 models of air circulating fans with the following information: Manufacturer, Power Supply, Model Number, Style (*i.e.,* basket, box, panel, or tube), Size (in) (*i.e.,* impeller diameter), Guard configuration, Airflow (CFM), efficacy (CFM/W), Thrust (lbf), Input power (kW), Thrust Efficiency ratio (lbf/kW), 5D Centerline Velocity (fpm), and Speed (high, med, low, % of max). *See bess.illinois.edu.*

calculate performance data at non-tested speeds based on wire-to-air test results at different speeds. *See* section 6.2 of AMCA 214–21, ''Calculated Ratings Based on Wire to Air Testing,'' which references section 8.2.3, ''Calculation to other speeds and densities for wire-to-air testing'' and Annex G, ''Wire-to-Air Measurement—Calculation to Other Speeds and Densities (Normative).'' For air circulating fans, DOE tentatively determined that these sections do not apply because air circulating fans have a more limited range of operating speeds and DOE proposed to test at each speed where performance data is required. In the July 2022 NOPR, DOE noted that AMCA 214–21 also includes an annex that only applies to shaft-to-air tests and allows interpolating performance between tested speeds (Annex E of AMCA 214–21). For air circulating fans, DOE tentatively determined that these sections do not apply because air circulating fans are tested wire-to-air. 87 FR 44194, 44227.

In response to the July 2022 NOPR, AMCA commented that for ACF, only G.2.3 airflow and G.2.5.2 electrical power at zero static pressure apply. (AMCA, No. 41 at p. 27) AMCA commented that Annex E is not needed for air circulating fans because air circulating fans are tested and sold inclusive of motors. *Id.*

As previously stated, DOE is no longer referencing AMCA 214–21 for air circulating fans and DOE is not opting to reference sections 6.2 of AMCA 214–21, which references section 8.2.3 and Annex G; or Annex E of AMCA 214–21.

14. Run-In Requirements

In the July 2022 NOPR, DOE stated that section 7.4 of AMCA 214–21 specifies that all fans shall be run-in for not less than 15 minutes prior to the commencement of data collection and that the AMCA 230 committee was considering similar provisions for air circulating fans. DOE proposed that the minimum run-in requirement of 15 minutes for fans and blowers be applied to air circulating fans. 87 FR 44194, 44235.

Since then, AMCA 230–23 became available and sections 7.1.3 and 7.3 of AMCA 230–23 include a minimum run-in requirement of 15 minutes.

New York Blower commented that the proposed run-in requirements seem appropriate and are similar to current procedures and practices. (New York Blower, No. 33 at p. 17)AMCA and Morrison recommended that the minimum run-in time for any fan should be at least 15 minutes, which is consistent with DOE's proposal. (AMCA, No. 41 at pp. 28–30; Morrison, No. 42 at p. 7)

In this final rule, DOE is requiring that all fans shall be run-in for no less than 15 minutes prior to the commencement of data collection.

15. Determination of Equilibrium and Test Stability

As discussed in the July 2022 NOPR, both AMCA 210–16 and AMCA 230–15 require that steady readings must be obtained prior to the start of test; however, neither test standard provides specific variables with associated tolerances within which equilibrium can be quantified. To ensure repeatable and reproducible results from a test method, it is necessary to specify consistent requirements for determining when a fan is and is not at equilibrium before the commencement of testing. It is also necessary to specify a duration over which equilibrium must be established. 87 FR 44194, 44227–44228.

a. Fans and Blowers Other Than Air Circulating Fans

As discussed in the July 2022 NOPR, DOE reviewed the test chamber and test equipment accuracy requirements listed in section 6 of AMCA 210–16 to determine equilibrium requirements for fans and blowers other than air circulating fans. 87 FR 44194, 44229. DOE proposed that calculations of ambient air density, and measurements of input power (as measured by a reaction dynamometer, torque meter, calibrated motor, or electrical meter), and fan speed would need to fall within the tolerance window listed in Table III–12 prior to initiating the test. *Id.* In DOE's proposal, input power stability would be required on a single input power device. DOE proposed that fan system equilibrium would need to be verified over at least 5 minutes, with measurements for each variable recorded at a maximum of 5 seconds. *Id.*

TABLE III–12—TOLERANCE REQUIREMENTS FOR MEASURED VARIABLES TO ESTABLISH STABILITY FOR FANS AND BLOWERS THAT ARE NOT AIR CIRCULATING FANS AS PROPOSED IN THE JULY 2022 NOPR

Variable	Equilibrium tolerance
Ambient air density	±1 percent of mean.
Input power by reaction dynamometer.	±4 percent of mean.
Input power by torque meter.	±4 percent of mean.
Input power by calibrated motor.	±4 percent of mean.
Input power by electrical meter.	±2 percent of mean or 1 W, whichever is greater.
Fan speed	±1 percent of mean or 1 rpm, whichever is greater.

In the July 2022 NOPR, DOE discussed that ISO 5801 includes more stringent stability tolerance requirements for fan speed; however, DOE stated that since it was proposing requirements for both fan speed and input power, it was suggesting a less stringent tolerance on fan speed. *Id.* DOE requested comment on its proposal for determining if a fan that is not an air circulating fan has reached equilibrium prior to initiating testing, on the minimum duration and maximum interval over which equilibrium would need to be verified, and on which variables proposed in Table III–12 that, if not stable prior to test, would have the greatest impact on measured fan performance. 87 FR 44194, 44229.

During the public meeting associated with the July 2022 NOPR, Nidec commented that motor test methods require [motor] temperature stabilization and that the July 2022 NOPR did not discuss temperature stabilization. (Public Meeting Transcript, No. 18, p. 57) In the July 2022 NOPR, DOE stated that section 7.4 of AMCA 214–21 specifies that all fans shall be run-in for not less than 15 minutes prior to the commencement of data collection. 87 FR 44194, 44235. As discussed in section III.E.15, DOE is requiring that all fans shall be run-in for no less than 15 minutes prior to the commencement of data collection. The purpose of this requirement is to ensure the motor tested with the fan is appropriately warmed up and stable. While DOE has not provided specific temperature stabilization requirements for the motor, DOE expects that laboratories will sufficiently run-in the motor to avoid lengthy testing to demonstrate fan stability. ebm-papst commented that AMCA 210 and ISO 5801 testing has not caused them concerns about equilibrium. (ebm-papst, No. 31 at p. 11)

New York Blower commented that the signals being measured for larger fans have inherent instability. (New York Blower, No. 33 at p. 12) New York Blower also commented that a 5-minute interval between each test determination seems excessive, particularly based on their experience of testing industrial fans; however, they understand if this is necessary for air circulating fans. (New York Blower, No. 33 at p. 16) In response, DOE notes that its intent in the July 2022 NOPR was that a fan would be considered stable if it met the proposed tolerance requirements over a 5-minute ''stability test'', not that each test would be 5 minutes in duration.

Robinson stated that the equilibrium requirements are reasonable; however, they added that not all laboratories are temperature controlled and therefore the density requirement may not be attainable for the duration of the test. Robinson commented that specifying equilibrium for density as it applies to centrifugal housed or radial housed fans would create a need for laboratories to add climate control systems or increase the sizes of their existing laboratories to maintain a density equilibrium. If this is only meant as a measure of starting a test that may be acceptable, but for the duration of a test a 1 percent change in density is unlikely to be maintained particularly as testing a fan will take several hours or span over more than one day. (Robinson, No. 43 at p. 7) Additionally, Robinson commented that they do not see a need for a tight restriction on speed variation if the data can be corrected to a common condition. (Robinson, No. 43 at p. 10) In response, DOE notes that the purpose of setting a tolerance on fan speed is to ensure stability prior to testing, and prior to correcting to a common condition.

Of the variables listed in Table III–12, calculated ambient air density, which is a function of dry bulb temperature, wet bulb temperature and barometric pressure, impacts the fan's test environment. It is important to ensure that the lab environment is stable, while fan stability is being assessed. Calculated air density for fans and blowers that are not air circulating fans is determined from the dry bulb temperature at plane 0 (T_{d0}), the wet bulb temperature at plane 0 (T_{w0}), and the barometric pressure, where plane 0 is defined in Table 2 of AMCA 210–16 as the general test area. Regarding Robinson's comment that it may be difficult to maintain calculated air density within ±1 percent of the mean over the duration of the test, DOE clarifies that the air density tolerance proposed in the July 2022 NOPR applies only to the determination of fan stability and that section 6.2.4.1 of AMCA 210–16 includes temperature and pressure measurement requirements when environmental conditions are varying. DOE would not expect temperature, relative humidity, and barometric pressure to vary outside of the ranges listed above over the timeframe necessary to determine stability, even in a building without climate control. However, DOE notes that since air density is used to determine fan performance, air density must be captured during each test run.

Greenheck recommended not including additional equilibrium or stabilization procedures because once the dynamometer or calibrated motor is initially warmed up, no additional benefit is gained by waiting to stabilize. (Greenheck, No. 39 at . 6) To substantiate its position, Greenheck provided example test data for housed centrifugal fans at a constant rpm that showed no difference in brake horsepower versus airflow when the test was completed with cold bearings, warmed bearing or running each duty point for 5 minutes before taking the test measurement. (Greenheck, No. 39 at p. 7, Figure 2) Greenheck also provided a plot of energy use as a function of airflow for an axial fan using a calibrated motor. (Greenheck, No. 39 at p. 8, Figure 3) Although data values were not provided, Greenheck stated that all power readings within the usable portion of the fan curve are within 1 percent whether the motor was warmed up and data collected, the motor was warmed up and data was corrected to 1200 rpm, or the motor was warmed up and data was taken after running for 5 minutes. (Greenheck, No. 39 at p. 7, Figure 2)

Section 6.1.2 of AMCA 210–16 states that ''statistically stable conditions shall be established before each determination'' and that ''trial observations shall be made until steady readings are obtained.'' This section of AMCA 210–16 provides no provisions for determining stable readings and provides no requirements for evaluating if conditions are statistically stable. Comments from AMCA and fan and blower manufacturers suggest that there are multiple ways a manufacturer may verify that a fan under test is considered stable prior to testing. Based on the data provided by Greenheck, ensuring that the dynamometer or calibrated motor is warmed up may be sufficient to ensure fan stability during test. However, DOE notes that it is required to ensure that its test procedures are repeatable—ensuring repeatability becomes especially important if enforcement testing is warranted to evaluate compliance with any potential energy efficiency standards.

AMCA and Morrison stated that there is a need to ensure both equilibrium prior to testing and stability during testing, and that DOE did not sufficiently differentiate between the two. (AMCA No. 41 at pp. 28–30; Morrison, No. 42 at p. 7) In the following sections, DOE discusses the test stability requirements that it is adopting for fans and blowers that are not air circulating fans. DOE notes that the purpose of these stability provisions is to clarify section 6 of AMCA 210–16 to improve overall repeatability and reproducibility of the test procedure. DOE does not expect these requirements to obsolete historical testing completed by the industry.

In its comments, AMCA recommended using the same approach for determining stability of air circulating fans and fans and blowers that are not air circulating fans. Specifically, AMCA stated that all measured values will fluctuate over time, and recommended averaging these values over a 120-second duration to ensure test repeatability. (AMCA, No. 41 at p. 28) AMCA also commented that these fluctuations may trend upward or downward, or may fluctuate around an average value, and provided two examples, one where measured power increases with time over a measurement interval of 300 seconds, and the second where measured power varies, but does not increase over the same measurement interval. (AMCA, No. 41 at pp. 28–29) AMCA further recommended that instrument filtering should be used to minimize measurement fluctuations and provided examples of how a measurement instrument could be set up to do this. (AMCA, No. 41 at p. 29) AMCA also suggested that fan speed stability would be established when the averaged results from two successive readings differ by no more than 1 percent or 1 rpm, whichever is greater, and that electrical input power stability would be established when the averaged results from two successive readings differ by no more than 1 percent or 1 watt, whichever is greater. *Id.* DOE interprets AMCA's comments to suggest that filtered fan speed and input power or torque measurements should be averaged over 120-second intervals and that the average over this interval should be compared to previous 120-second intervals to determine whether these variables meet the tolerance requirements discussed above. (*See* AMCA, No. 41 at p. 29, recommendation 3) But AMCA also stated that fan stability occurs much more quickly for fans and blowers that are not air circulating fans since they are tested against pressure and in a duct or in a chamber. (AMCA, No. 41 at p. 29) Additionally, for fans and blowers that are not air circulating fans, AMCA suggested a different time interval for determining the test measurement value, specifically taking the average over a 15 second interval, but increasing the averaging duration to 60 seconds if individual measurements fluctuate by more than ±2 percent of the average over the 15-second interval. (AMCA, No. 41 at p. 30) For testing, Morrison Products suggested a similar approach, but with shorter time intervals, specifically, test measurement values would be determined by averaging over 10 seconds; however, if individual measurements fluctuate by more than ±2 percent of the mean, the duration over which the average should be taken would increase to 30 seconds. (Morrison Products, No. 47 at p. 7)

DOE agrees with AMCA that determination of fan stability should be a comparison of averages over successive time durations. However, because DOE expects that fans and blowers that are not air circulating fans will reach stability more quickly than air circulating fans, it believes determining average input power and fan speed over 120-second intervals may filter the data too much and may unnecessarily increase the time to confirm equilibrium. Instead, DOE has determined that ensuring the average fan speed and average input power over successive 60-second data intervals (*i.e.,* average of data points collected at least every 5 seconds over 60 seconds) are within the tolerances listed in Table III–12 is appropriate for determining fan speed and input power equilibrium. The 60-second data interval is consistent with the interval recommended by AMCA as a secondary option if filtered measurements fluctuate by more than ±2 percent over a 15-second test interval. (AMCA, No. 41 at p. 30) While AMCA's suggestion was specific for testing, DOE believes that a consistent data collection interval for both equilibrium determination and testing reduces the complexity of the test procedure and reduces test procedure burden since the last sampling interval for determining equilibrium interval may be used as a test measurement.

In its comments, AMCA provided a figure showing input power trending upward over a 300-second measurement interval. (AMCA, No. 41 at p. 29, Figure 7) DOE understands this figure to suggest that comparing average values between successive data collection intervals may not capture instances where fan speed or input power are consistently trending upward or downward over time. Upward or downward trends in fan speed or input power over successive test intervals indicate that the fan system has not reached stability and that stability data must be collected over additional 60-second time intervals until data within the measured time intervals are no longer consistently increasing or decreasing. Comparing the slope of the individual data within each time interval, in addition to ensuring required tolerances are met, provides information on whether the measured value is stable, or consistently increasing or decreasing over time. For example, a positive slope calculated for three consecutive time intervals indicates a consistent upward trend in the measured variable suggesting that the fan has not reached stability and additional intervals must be run until a negative slope is achieved. As a second example, if a positive, negative, and positive slope are determined for fan speed and input power over three consecutive intervals, these variables are likely stable.

As such, DOE has determined to add further specificity to the stability requirements outlined in section 6.1.2 of AMCA 210–16. Specifically, stability will be evaluated and confirmed over at least three 60-second data collection intervals. DOE believes that at least three data collection intervals are necessary to ensure that slope is not consistently increasing or decreasing for each successive test duration. Fan speed and input power shall be monitored at least every 5 seconds over each 60-second data collection interval. The following two requirements must be met for a fan to be considered stable and for testing to commence:

(1) The average of fan speed from one data collection interval to the next must be within ±1 percent or 1 rpm, whichever is greater; and the average input power by reaction dynamometer, torque meter or calibrated motor must be ±4 percent, or the average input power by electrical meter must be ±2 percent of the mean or 1 watt, whichever is greater. These values are consistent with those proposed in the July 2022 NOPR; however, the interval over which average speed and average input power is determined, and the comparison between these intervals has been further clarified.

(2) The slope of fan speed and the slope of fan input power over 60 seconds from one data collection interval to the next shall not be trending upward or trending downward. Specifically, if the slope of 3 or more successive data collection intervals are all positive or all negative, additional data collection intervals must be run until a negative or positive slope, respectively, is achieved.

For testing (*i.e.,* after equilibrium has been verified), Morrison recommended sampling and statistically averaging test measurements over 10 seconds and that if filtered measurements fluctuate by more than 2 percent of the average value, the averaging time shall be increased to 30 seconds. (Morrison, No. 42 at p. 7) AMCA, as discussed previously, recommended statistically averaging test measurements over 15 seconds and if filtered measurements fluctuate by more than 2 percent of the average value, the averaging time would be increased to 60 seconds. (AMCA, No. 41 at p. 29–30)

First, DOE clarifies that the tolerances specified in Table III–12, excluding the air density tolerance, should be maintained throughout the test. Second, average values from two successive 60-second sampling intervals meet the tolerance requirements specified in Table III–12 (excluding air density). DOE expects that maintaining the same data collection requirements for equilibrium determination and testing (*i.e.,* 60 seconds) will simplify the test and ultimately reduce test burden, since the last equilibrium measurement could be used as a valid test point. However, DOE also recognizes that laboratories may be able to achieve the specified tolerance on fan speed and input power over a shorter time interval, as suggested by Morrison. Therefore, in this final rule, DOE is specifying only that the sampling interval to determine average test values should not exceed 60 seconds, consistent with the sampling interval used to determine equilibrium.

Regarding AMCA's comment on data filtering, or damping, DOE recognizes that data filtering helps reduce noise or measurement fluctuation. DOE's requirement that data taken every 5 seconds must be averaged over a 60-second duration effectively filters the data with a time constant of 5 seconds.

b. Air Circulating Fans

In the July 2022 NOPR, DOE discussed the equilibrium options considered by the AMCA 230 committee. At the time, the committee was considering choosing three or four of the following values to determine equilibrium: fan speed, system input power, barometric pressure, and load differential. The committee was also considering that these variables would need to meet a specified tolerance after at least 5 minutes of the fan running, with measurements taken at least every 5 seconds. 87 FR 44194, 44228.

Furthermore, DOE had tentatively determined that the ambient air density, extraneous airflow (*i.e.,* test room ventilation), system input voltage, system input current, system input power, fan speed, load, and load differential would impact test results. *Id.* Therefore, DOE proposed that measurements of these values would need to fall within a specified tolerance window listed in Table III–13 prior to initiating a test for air circulating fans. *Id.* DOE also proposed that measurements for each of the variables would be taken at least every 5 seconds over at least 5 minutes, providing a minimum of 60 data points from which equilibrium can be verified. *Id.*

TABLE III–13—TOLERANCE REQUIREMENTS FOR MEASURED VARIABLES TO ESTABLISH STABILITY FOR AIR CIRCULATING FANS AS PROPOSED IN THE JULY 2022 NOPR

Variable	Equilibrium tolerance
Calculated air density	±1 percent of mean.
System input voltage	±2 percent of mean.
System input current	±2 percent of mean.
System input power	±2 percent of mean or 1 W, whichever is greater.
Fan speed	±1 percent of mean or 1 rpm, whichever is greater.
Load	±1 percent of mean.
Load differential	±1 percent of mean.

DOE proposed that air density, as determined from dry bulb temperature, dew point, and barometric pressure measured over at least 5 minutes, would remain within one percent of the mean air density to establish equilibrium prior to fan testing. *Id.* The system input voltage, system input current, system input power, load, and load differential tolerances for evaluating equilibrium that DOE proposed were two times the equipment accuracy tolerances specified in AMCA 230–15 and identical to those discussed by the AMCA 230 committee working group at the time. *Id.* Additionally, DOE proposed that fan speed would be within ±1 percent of the mean rpm or 1 rpm, whichever is highest over at least a 5-minute duration to establish equilibrium prior to testing. *Id.*

Furthermore, in the July 2022 NOPR, DOE discussed possibly prioritizing the variables such that equilibrium must always be demonstrated for a specific number of the highest priority variables. *Id.* Alternately, DOE discussed possibly specifying a subset of the variables proposed, similar to what had been discussed by the AMCA 230 committee at the time. *Id.*

DOE requested comment on its proposal for determining that an air circulating fan has reached equilibrium prior to initiating testing, on the minimum duration and maximum interval over which equilibrium would need to be verified, and on the variables it proposed. 87 FR 44194, 44228–44229.

As discussed, AMCA recommended using the same approach for determining stability of air circulating fans and fans and blowers that are not air circulating fans and AMCA's comments are summarized in the previous section. For air circulating fans, AMCA stated that the AMCA 230 committee proposed the following requirements for equilibrium that will be included in the next edition of AMCA 230: readings shall be recorded when both speed and electrical power have stabilized; readings shall be recorded at least 15 minutes after start-up; the averaged results from two successive readings of electrical input power shall differ by not more than 1 percent or 1 watt, whichever is greater; and the averaged results from two successive readings of fan speed shall differ by not more than 1 percent or 1 rpm, whichever is greater. (AMCA, No. 41 at p. 28, 30)

Greenheck recommended that DOE adopt the run-in period and filtering methodology in the latest revision of AMCA 230 and that DOE handle air circulating fans in a separate rulemaking. (Greenheck, No. 39 at p. 8)

In the July 2022 NOPR, DOE stated that should the revised version of AMCA 230 publish prior to the publication of any DOE test procedure final rule, DOE intends to revise its test procedure provisions in line with the latest AMCA 230 standard, provided the updates to the AMCA 230 standard are related to topics that DOE has discussed and for which DOE solicited comments. 87 FR 44194, 44228. Sections 7.1 and 7.3 of AMCA 230–23 include provisions for run-in and determination of fan stability prior to test, specifically:

(1) Run-in shall be conducted for no less than 15 minutes prior to the commencement of data collection;

(2) Ambient conditions shall be measured prior to startup and throughout the test, as specified;

(3) Load differential, measured electrical input power and fan speed measurements shall be averaged for a minimum of 120 seconds;

(4) Measured electrical input power stability is established when the averaged results from two successive readings differ by not more than 1 percent or 1 watt, whichever is greater; and

(5) Fan speed stability is established when the averaged results from two successive readings differ by not more than 1 percent or 1 rpm, whichever is greater.

Based on its review of AMCA 230–23, review of the comments received to the July 2022 NOPR, and additional evaluation of DOE test data for air circulating fans, DOE is generally adopting the fan stability provisions in AMCA 230–23, with additional clarification, as discussed below.

Regarding the determination of ambient conditions, DOE notes that AMCA 230–23 does not provide additional specifications for determining ambient conditions. Of the variables listed in Table III–13, input voltage and room air density, which is a function of dry bulb temperature, wet bulb temperature and barometric pressure, impact the fan's test environment. It is important to ensure that environmental stability is achieved to minimize changes that impact fan performance, and that stability is maintained during the test to ensure test repeatability. DOE proposed in the July 2022 NOPR that calculated air density must remain within ±1 percent of the mean and input voltage must remain within ±2 percent of the mean over a period of 5 minutes with data collected at least every 5 seconds. 87 FR 44194, 44228. DOE received no comments from stakeholders regarding stability determination or proposed tolerance criteria for either input voltage or room air density. Therefore, DOE is adopting the equilibrium tolerance criteria for input voltage and calculated air density as proposed in the July 2022 NOPR. However, based on comments received regarding determining fan stability (*i.e.,* fan speed and load differential) and the language in AMCA 230–23, DOE is instead requiring that input voltage and room air density must meet the specified tolerance requirements over the full duration of a test, including the time it takes to demonstrate fan stability. While DOE proposed that determining equilibrium over at least 5 minutes, DOE recognizes that achieving equilibrium and capturing test data will vary depending on the fan, and has therefore opted to not specify a minimum time requirement for data capture. Finally, as discussed for fans and blowers that are not air circulating fans, since air circulating fans may be tested in facilities without climate control, ambient condition data collection may start after the run-in period has been completed, but before commencement of stability testing. In summary, this final rule specifies that input voltage shall be captured at least every 5 seconds and shall not vary by more than ±2 percent over the duration of each test (including stability determination) and calculated air density shall not vary by more than ±1 percent over the duration of each test (including stability determination).

AMCA 230–23 specifies that stability must be established for electrical input power and fan speed; however, DOE notes that section 7.2 of AMCA 230–23 requires reporting of load differential. Since measurement of load differential is a required value, and used in later calculations, DOE has determined that stability must also be demonstrated for load differential, in addition to electrical input power and fan speed. DOE notes that it proposed a tolerance of ±1 percent of the mean for load differential in the July 2022 NOPR. 87 FR 44194, 44228.

While AMCA's comments to the July 2022 NOPR are consistent with the language in AMCA 230–23, AMCA's comments additionally suggest that comparing average values between successive data collection intervals may not capture an upward or downward trend in fan speed, input power, or load differential. (AMCA, No. 41 at p. 29, Figure 7) A lab may observe an upward or downward trend in these variables over successive data collection intervals if the fan has not been run-in for enough time and/or is not at equilibrium.

To account for continuous upward or downward trends in slope over multiple 120-second measurement intervals, and to address AMCA's comment, DOE is adding further specificity to the stability requirements outlined in section 7.3 of AMCA 230–23. Specifically, stability will be evaluated and confirmed over at least three 120-second data collection intervals. The 120-second data collection interval is consistent with the provisions in section 7.3 of AMCA 230–23 for determining fan stability. However, AMCA 230–23 and AMCA's comments to the July 2022 NOPR do not recommend a minimum number of data collection intervals for determining stability. DOE believes that at least three data collection intervals are necessary to ensure a mix of positive and negative slopes calculated for the data collected over successive 120-second intervals. If the slope for each of three intervals either all increase or all decrease, the variable being measured is trending up or trending down, respectively, and the fan is not at equilibrium (see similar discussion in the previous section for fans and blowers that are not air circulating fans). While more than a minimum of three data collection intervals would provide greater assurance that fan speed, input power, and load are stable, DOE selected a minimum of three test intervals to minimize test burden, while still ensuring that a laboratory can validate that slopes are not consistently positive or negative. Additionally, DOE expects that if a fan is appropriately run-in prior to testing, laboratories should be able to demonstrate speed, input power and load stability with the minimum of three test intervals. Fan speed, input power, and load differential shall be monitored at least every 5 seconds over each 120-second data collection interval. The following two requirements must be met for a fan to be considered stable and for testing to commence:

(1) The average of fan speed from one data collection interval to the next must be within ±1 percent or 1 rpm, whichever is greater; the average fan input power from one data collection interval to the next must be ±1 percent or 1 watt, whichever is greater; and the average load differential from one data collection interval to the next must be ±1 percent. The tolerance requirements for fan speed and load differential are the same as those proposed in the July 2022 NOPR (see Table III–13); however, DOE has tightened its tolerance criteria for fan input power from ±2 percent of the mean or 1 W, whichever is greater, to ±1 percent of the mean or 1 W, whichever is greater, to be consistent with section 7.3 of AMCA 230–23.

(2) The slope of fan speed, input power, and load differential over 120 seconds from one data collection interval to the next shall not be monotonic. Specifically, if the slope of 3 or more successive data collection intervals are all positive or all negative, additional data collection intervals must be run until a negative or positive slope, respectively, is achieved.

16. Test Figures for Air Circulating Fans

In the July 2022 NOPR, DOE noted that AMCA 230–15 (with errata) describes the test set-up that can be used to test various categories of air circulating fans and specifies that air circulating fan heads and table fans, which correspond to unhoused ACFHs, must be tested according to test figures 2A, 2B1, and 2B2. AMCA 230–15 (with errata) and also specifies that box fans and personnel coolers, which are both housed ACFHs, must be tested using test figures 3A and 3B. DOE noted that the AMCA 230 committee reviewed the existing text figures and was considering revising the allowable test figures to reflect that housed air circulating fans could also be tested using test figures 2A, 2B1, and 2B2, and unhoused air circulating fans would be tested using figures 3A and 3B. 87 FR 44194, 44229.

In the July 2022 NOPR, DOE tentatively determined that test figures 2A, 2B1, 2B2, 3A and 3B are appropriate for all air circulating fans. As such, DOE proposed to specify that any test figures that are specified in AMCA 230–15 (with errata) can be used for testing air circulating fans. *Id.*

Since then, AMCA 230–23 became available and specifies that test figures 2A, 2B1, 2B2, 3A and 3B [89] are appropriate for all air circulating fan in section 6.1 of AMCA 230–23.

AMCA commented that AMCA 230–23 will include slight refinement of the test figures from the 2015 version. Nevertheless, stated AMCA, each test figure is applicable to the fans in the scope of AMCA 230, which means that figures 2A, 2B1, 2B2, 3A, and 3B are applicable to all air circulating fans. (AMCA, No. 41 at p. 27)

As proposed, DOE specifies that any test figures specified in AMCA 230–23 can be used for testing air circulating fans.

17. Location of External Airflow Measurement

In the July 2022 NOPR, DOE noted that section 8.1.2 of AMCA 230–15 (with errata) specifies that the air velocity in the test room, not generated by the test air circulating fan, shall not exceed 0.25 m/s (50 fpm) prior to, during, and after the test. Velocity measurements shall be taken immediately before and immediately after the test to ensure that this condition is met. In addition, AMCA 230–15 (with errata) specifies the location of the extraneous airflow measurement shall be directly under the center of the fan at an elevation of 1701.8 mm (67 in.) above the floor. DOE noted that this provision is only applicable to fans tested according to Figure 1 of AMCA 230–15 (with errata) and that there is no location specified for extraneous airflow measurement for fans tested according to Figures 2A, 2B1, 2B2, 3A and 3B. 87 FR 44194, 44234–44235.

In the July 2022 NOPR, DOE noted that the AMCA committee was considering adding the following provisions to specify the location of the extraneous airflow measurement and to move these provisions from section 8.1.2 of AMCA 230–15 (with errata) into each of the figures. For Figure 1 of AMCA 230–15, the location of extraneous airflow measurement would be directly under the center of the fan at an elevation of 1.7m (67 in.) above the floor. For figures 2A, 2B1, 2B2, 3A and 3B, the location of extraneous airflow measurement should be at the center of

[89] In AMCA 230–23. These figures were re-numbered 10.2A, 20.2B1, 10.2B2, 10.3A and 10.3B

the fan at a distance of 1.5m (5 ft) downstream of the fan impeller. DOE agreed that these additional specifications were necessary to ensure test procedure repeatability, and therefore proposed to add these additional provisions as considered by the AMCA 230 committee. 87 FR 44194, 44235.

AMCA commented that it supports the proposed location, adding that positions to measure extraneous airflow were added to AMCA 230 toward its revision. AMCA commented that the positions are the same as noted in the NOPR. (AMCA, No. 41 at p. 28)

Since publication of the July 2022 NOPR, the test figures of AMCA 230–23 have been updated to specify the positions to measure extraneous airflow as proposed. In this final rule, DOE is directly referencing the test figures in AMCA 230–23 which include the location of the extraneous airflow measurement as proposed.

18. Transducer Type Barometer

In the July 2022 NOPR, DOE noted that section 6.5.2.1 of AMCA 230–15 (with errata) specifies that transducer type barometers shall be calibrated for each test. DOE stated that the AMCA 230 committee was considering removing this requirement from the revised version. DOE noted that it was also considering not including this requirement as it may be sufficient to require that the barometer be calibrated against a mercury column barometer with a calibration that is traceable to National Institute of Standards and Technology (''NIST'') or other national physical measures recognized as equivalent by NIST, without having to repeat calibration before each test. 87 FR 44194, 44235.

AMCA commented that calibration of transducer-type barometers for each test should be removed. AMCA commented that mercury-column barometers are discouraged and have often been removed from labs for safety reasons, but that transducers are very stable and are calibrated annually. AMCA commented that the AMCA 230 technical committee proposed the following change to barometer calibration, which will be included in section 6.5.2.1 ''Calibration'' of the 2022 edition of AMCA 230: ''barometers shall be calibrated and calibration traceable to NIST or other national physical measures recognized as equivalent by NIST. Barometers shall be maintained in good condition. All equipment used to measure psychometric data shall be calibrated with uncertainties by an ISO 17025 accredited calibration laboratory.'' (AMCA, No. 41 at p. 30)

Robinson commented that it does not recommend adding a requirement to calibrate transducer-type barometers for each test. (Robinson, No. 43 at p. 10)

Since publication of the July 2022 NOPR, section 5.5.2.1 of AMCA 230–23 removed the requirement for calibration of transducer-type barometers for each test. As noted by AMCA, it is sufficient to require that the barometer be calibrated with a calibration that is traceable to National Institute of Standards and Technology (''NIST'') or other national physical measures recognized as equivalent by NIST, without having to repeat calibration before each test. DOE adopts to reference the provisions in section 5.5.2.1 of AMCA 230–23, and to not require calibration of transducer-type barometers for each test as recommended by Robinson.

19. Reference Fan Electric Input Power Calculation for Air Circulating Fans

In the July 2022 NOPR, DOE proposed to rely on an FEI metric for air circulating fans. 87 FR 44194, 44237–44238. Section 4 of AMCA 214–21defines the FEI as the fan electrical input power of a reference fan (FEP_{ref}) divided by the fan electrical input power of the fan being rated at the same flow and total pressure conditions (FEP_{act}). Similar to how the FEP_{ref} of fans and blowers other than air circulating fans is calculated, DOE proposed to calculate the FEP_{ref} for air circulating fans based on:

- A reference fan shaft input power equation, used to calculate the reference fan shaft input power at a given duty point. This equation relies on a flow constant (Q_0) and a pressure constant (P_0), which represent how efficiency varies as a function of flow and pressure and an efficiency target, which was set to represent a market reference efficiency fan;
- A reference fan transmission efficiency equation, which calculates the reference fan transmission as a function of the reference shaft input power and represents a typical belt drive. *See* section 5.2 of AMCA 214–21; and
- A reference motor equation as described in section III.E.1 of this document.

DOE collected air circulating fan performance data from the BESS certification database[90] and performed regression analyses to determine the appropriate flow, pressure, and efficiency target constants for air circulating fans. DOE proposed to rely on the following constants: Q_0 = 3,210 CFM (rounded to the nearest 10); P_0 = 0 in.wg; and an efficiency target of 0.38 (38 percent). 87 FR 44194, 44231–44234.

In addition, DOE noted that it was considering using the term ''Air Circulating Fan FEI'' or ''ACFEI'' to differentiate the proposed FEI for air circulating fans from the FEI as it applies to fans and blowers that are not air circulating fans and from the CFEI as it applies to ceiling fans. 87 FR 44194, 44238

As noted in Section III.G of this document, DOE is not adopting the FEI or ACFEI as the metric for air circulating fans. Therefore, DOE is not opting to specify a calculation of FEP_{ref} for air circulating fans. Comments received on the air circulating fan FEI also relate to the metrics and are discussed in Section III.G of this document.

20. Rounding

As discussed in the July 2022 NOPR, AMCA 214–21 provides a method for calculating fan performance using the FEI metric; however, AMCA 214–21 does not provide normative rounding requirements for FEI. 87 FR 44194, 44234. DOE also discussed that it would consider referencing any rounding requirements in the updated version of AMCA 230, if those requirements were consistent with the rounding provisions that DOE proposed and solicited comments on in the July 2022 NOPR.[91] *Id.* DOE received no comments regarding standardization of rounding with the newest version of AMCA 230. DOE notes that AMCA 230–23 provides rounding provisions for blade span and tip speed but does not include rounding provisions in Section 8, calculations. While not discussed in the July 2022 NOPR, DOE notes that AMCA 230–15

[90] Data collected on March 22, 2022, included 507 models of air circulating fans with the following information: Manufacturer, Power Supply, Model Number, Style (*i.e.,* basket, box, panel, or tube), Size (in) (*i.e.,* impeller diameter), Guard configuration, Airflow (CFM), efficacy (CFM/W), Thrust (lbf), Input power (kW), Thrust Efficiency ratio (lbf/kW), 5D Centerline Velocity (fpm). *See bess.illinois.edu.*

[91] There is an error in section III.D.18 (Rounding) in the July 2022 NOPR. In the following sentence, it should have stated ''reporting'' instead of appurtenances, ''Should the revised version of AMCA 230 publish prior to the publication of any DOE test procedure final rule, DOE intends, after considering stakeholder feedback received in response to the proposals in this document, to revise the provisions related to appurtenances in line with the latest AMCA 230 standard, provided the updates in this standard are consistent with the provisions DOE is proposing in this NOPR, or the updates are related to topics that DOE has discussed and for which DOE has solicited comments to in this NOPR. Since the section title is ''rounding'', DOE has determined that, despite the error, and given that DOE received no comments the context of this sentence is clear.

also does not provide rounding requirements.

FEI is specified to the hundredths place in section 6.5.3.1.3 of ASHRAE 90.1–2019 (Fan Efficiency). Additionally, the DOE energy conservation standard for large diameter ceiling fans is the Ceiling Fan Energy Index (''CFEI''), where the CFEI metric is calculated according to AMCA 208–18, is specified to the hundredths place (*i.e.,* CFEI must be greater than or equal to 1.00 at high speed and 1.31 at 40 percent speed, or the nearest speed that is not less than 40 percent speed). 10 CFR 430.32.(s)(2)(ii). Additionally, Annex I of AMCA 214–21 (informative) specifies rounding the FEI to the hundredth place.

Therefore, in the July 2022 NOPR, DOE proposed rounding represented values of FEI to the hundredths place. *Id.* For consistency, DOE also proposed that represented values for FEP would be rounded to the hundredths place. *Id.*

How inputs to the calculation of FEI are rounded can impact the represented FEI (or FEP value). DOE reviewed the provisions related to rounding in the ceiling fans test procedure, which states that all measurements should be recorded at the resolution of the test instrumentation and that calculations shall be rounded to the number of significant digits present at the resolution of the test instrumentation. Section 3.1.1 of 10 CFR part 430, appendix U; 87 FR 44194, 44234.

In the July 2022 NOPR, DOE tentatively concluded that the rounding provisions in section 3.1.1 of 10 CFR part 430, appendix U are reasonable and that recording measurements at the resolution of the test instrumentation would provide sufficient significant digits for accurately calculating representative values of FEI and FEP. *Id.* Therefore, DOE proposed that all measurements would be recorded at the resolution of the test instrumentation and that calculations would be rounded to the number of significant digits present at the resolution of the test instrumentation. *Id.*

ebm-papst, New York Blower, AMCA, and Morrison agreed that rounding FEI to the hundredths place is reasonable. (ebm-papst, No. 31 at p. 11; New York Blower, No. 33 at p. 17, AMCA, No. 41 at p. 28; Morrison, No. 42 at p. 6). Additionally, New York Blower, AMCA and Morrison supported DOE's to round FEP to the nearest hundredth of a kW. (New York Blower, No. 33 at p. 17, AMCA, No. 41 at p. 28; Morrison, No. 42 at p. 6) AMCA and Morrison did, however, suggest that if the FEP is less than 1 kW, the value should be rounded to the nearest thousandth of a kW. (AMCA, No. 41 at p. 28; Morrison, No. 42 at p. 6) DOE received no comment on measurements being recorded at the resolution of the test instrument and calculations being rounded to the number of significant digits present at the resolution of the test instrument.

DOE is adopting the requirement to round the FEI to the nearest hundredths place. DOE considered stakeholder feedback on the rounding requirements for FEP and is specifying that FEP should be rounded to three significant digits. Therefore, if FEP is greater than 1 kW, the value would be rounded to the nearest hundredth of a kW and if the FEP is less than 1 kW, the value would be rounded to the nearest thousandth of a kW. DOE is additionally specifying that all measurements shall be recorded at the resolution of the test instrument and that calculations shall be rounded to the number of significant digits present at the resolution of the test instrument, consistent with its proposal in the July 2022 NOPR.

As discussed in detail in section III.G of this document, DOE is adopting an efficacy metric, reported in CFM/W, for air circulating fans. Although DOE discussed the possibility of adopting a CFM/W metric for air circulating fans in the July 2022 NOPR (87 FR 44194, 44234), DOE did not discuss or propose any rounding requirements for this metric. As such, DOE expects to propose rounding provisions for air circulating fans in a future certification rule.

F. Distinguishing Between Fans and Blowers and Air Circulating Fans

In the July 2022 NOPR, DOE noted that some manufacturers offer the same fan model with different mounting configurations. Depending on the mounting configuration, the same fan could either meet the definition of a fan tested per AMCA 210–15 or meet the definition of an air circulating fan and be tested per AMCA 230–15. DOE identified that air circulating fans with housing (*i.e.,* axial panel air circulating fans and box fans) can also be distributed in commerce as with brackets for mounting through a wall, ceiling, or other structure that separates the fan's inlet from its outlet and marketed as ''exhaust fans.'' In this case, DOE tentatively concluded these fans would be tested per AMCA 210–16 as they would meet the definition of an axial panel fan. DOE added that manufacturers who distribute these fans in commerce in both configurations and market the fans both for air circulation and exhaust applications typically test the fan using both AMCA 230–15 (with errata) and AMCA 210–16. DOE proposed that fan models that meet both the definition of an axial panel fan and the definition of an air circulating fan depending on the presence or absence of brackets for mounting through a wall, ceiling, or other structure that separates the fan's inlet from its outlet be tested according to both the test procedures for fans and blowers, excluding air circulating fans, and the test procedure for air circulating fans. 87 FR 44194, 44235.

AMCA commented that fan owners often apply fans differently from how manufacturers intended them to be used and that fan manufacturers did not have control over how panel fans are employed. AMCA noted that the presence or absence of brackets may not deter the use of a fan for the user's desired application. AMCA recommended that the criterion for the DOE-relevant test method is the fan nameplate information and coinciding technical marketing material and installation instructions. AMCA commented that if a fan is presented both as an air circulating fan and a fan and blower other than an air circulating fan by the manufacturer, then it shall be rated both ways, supported by both type of test reports. AMCA added that if a fan is a circulating panel fan, it should be required to be tested only as a circulating panel fan; if it is a panel fan, it should be required to be tested only as a panel fan; and if the fan can be used as either a circulating panel fan or a panel fan, it should be tested as both. (AMCA, No. 41 at pp. 30–31)

ebm-papst commented that the NOPR does not provide sufficient clarification of the distinguishing mounting features. Therefore, ebm-papst stated that an axial panel fan should be rated at least either as a ventilation fan or as a circulation fan. ebm-papst commented that rating of the same fan as per a second category should remain the choice of the fan suppliers, because they have to serve a diverse market with many unique fan selection criteria. (ebm-papst, No. 31 at p. 12)

The Efficiency Advocates commented in support of DOE's proposal that fans meeting the definition of both axial panel fans and air circulating fans be tested as both. The Efficiency Advocates commented that some manufacturers offer the same fan model with different mounting configurations. For example, stated the Efficiency Advocates, housed air circulating fans may also be sold with brackets for mounting through a wall or ceiling for use as an exhaust fan. The Efficiency Advocates added that this would reduce the potential for a loophole wherein a less efficient fan could be sold with different mounting configurations as a means of being subject to a less stringent standard. (Efficiency Advocates, No. 32 at pp. 2–3)

DOE recognizes that manufacturers do not have control over how users ultimately decide to install their equipment. As a general matter, DOE's authority applies to products as manufactured and not at point of installation. (*See* generally 42 U.S.C. 6302.) DOE considers whether a fan is distributed in commerce with or without the presence or absence of brackets for mounting through a wall, ceiling, or other structure that separates the fan's inlet from its outlet. DOE requires that a fan that meets the definition of an axial panel fan and is distributed in commerce with components that enable it to be mounted through a wall, ceiling, or other structure that separates the fan's inlet from its outlet be tested in accordance with the test procedure for fans and blowers, excluding air circulating fans. DOE requires that a fan that meets the definition of an axial panel air circulating fan or box fan and is not distributed in commerce with components that enable it to be mounted through a wall, ceiling, or other structure that separates the fan's inlet from its outlet, be tested in accordance with the test procedure for air circulating fans. DOE requires that a fan that meets the definitions of both an axial panel fan and an air circulating fan (*i.e.,* axial panel air circulating fans and box fans) and is distributed in commerce with and without components that enable it to be mounted through a wall, ceiling, or other structure that separates the fan's inlet from its outlet be tested according to both the test procedures for fans and blowers, excluding air circulating fans, and the test procedure for air circulating fans.

In addition, AMCA commented that the current definitions used for certain air circulating fans, including axial panel fans, will lead to market confusion and the potential elimination of a significant number of products from the marketplace due to the product class assigned by DOE to the fan. AMCA provided an example of two essentially identical fans, except for the size of the fan. AMCA stated that per the current definitions, the first fan would be classified as an axial panel fan/air circulating axial panel fan and will likely remain available to consumers. However, AMCA commented that per the current DOE definitions, the second fan is a belt-driven ceiling fan, which requires the fan to meet the design requirements, including the capability of reverse operation and energy conservation standard, for ceiling fans. AMCA added that as Fan 2 is commonly applied, reversing the fan provides no benefit and the addition of the capability to reverse would reduce the efficiency of the fan at an added first cost to the consumer. In addition, stated AMCA, the second fan (assuming a common method of test) uses less energy to move the same volume of air, hence has a higher efficiency than Fan 1. AMCA finds it difficult to believe that consumers, retailers, and customs officials will be able to differentiate between DOE's axial panel Fan 1 and ceiling Fan 2. (AMCA, No. 41, p.31)

DOE notes that the requirement to include the capability of reversible action is not required for all ceiling fans s manufactured on or after January 1, 2007, and DOE included three exceptions for fans sold for industrial applications, fans sold for outdoor applications, and cases in which safety standards would be violated by the use of the reversible mode. 42 U.S.C. 6295(ff)(1)(A)(iii)) Further, as previously stated, the definition of ''fan and blower'' includes air circulating fans and excludes ceiling fans. Therefore, equipment that meets the definition of a ceiling fan would be excluded from the scope of equipment included under ''fan and blower.'' Any fan that is distributed in commerce with components that enable it to be suspended from a ceiling, and that meets the ceiling fan definition (*see* 10 CFR 430.2) in terms of being a non-portable device and for circulating air via the rotation of fan blades, is a ceiling fan. 87 FR 50396, 50402 (August 16, 2022). DOE will address any comments and concerns regarding the energy conservation standards for ceiling fans under a separate ceiling fan rulemaking.[92]

G. Metric

This section discusses the metrics adopted for fans and blowers other than air circulating fans and for air circulating fans.

1. Metric for Fans and Blowers Other Than Air Circulating Fans

AMCA 214–21 provides uniform methods to determine the FEP and FEI of a fan at a given duty point.[93] As explained, FEP describes the electrical input power of a fan in kW. AMCA 214–21 defines FEI as the ratio of the electrical input power of a reference fan to the electrical input power of the actual fan for which the FEI is calculated, both established at the same duty point. As stated, FEI is a dimensionless index for evaluating a fan's performance against a reference fan. Section 5 of AMCA 214–21 provides the equations to calculate the reference fan electrical input power as a function of airflow and pressure.

For fans other than circulating fans, the Working Group recommended using FEP as the primary fan metric and to allow using FEI for additional representation of energy use. The Working Group also recommended calculating FEI using the FEP of a fan that is exactly compliant with any future fan energy conservation standards. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #6 at p. 5). The Working Group further recommended that the metric be evaluated at each operating point as specified by the manufacturer. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendations #18 and #27 at pp. 10–11, 13–14). DOE explained that under this approach, for each basic model of fan, a manufacturer would have to determine the FEP of the fan at each operating point.

In the July 2022 NOPR, DOE also noted another metric called ''Fan Efficiency Grade'' or FEG, which is a numerical rating that represents the ratio of air power produced by the fan divided by the fan shaft power and is defined as a function of fan impeller diameter. FEG ratings are defined in discrete ''bands'' (*e.g.,* FEG 85, FEG 80, FEG 75, etc.) and are established in accordance with AMCA 205–12, ''Energy Efficiency Classification for Fans.''[94] DOE noted that as defined in AMCA 205–12, the FEG rating is representative of only the maximum efficiency of the fan. As a result, depending on the actual operating conditions, a fan with a higher peak efficiency and FEG rating could consume more energy in a particular application than a fan with a lower peak efficiency and FEG rating. In addition, the FEG metric does not capture the performance of the motor, transmission, or motor controllers and does not differentiate among fans with motors, transmissions, and motor controllers with differing efficiency levels. DOE further noted that in its proposed regulation, the CEC is proposing to use

[92] *See* Docket No. EERE–2021–BT–STD–0011.

[93] As previously described, a duty point is characterized by a given airflow and pressure and has a corresponding operating speed. The collection of all duty points associated with a given speed is referred to as a ''fan curve.'' AMCA 214–21 provides methods to establish the FEP and FEI at any point within the operating range of the fan.

[94] *See* AMCA white paper available at: *www.amca.org/assets/resources/public/userfiles/file/Nospreads_FanEfficGrades.pdf.*

the FEI metric for fans and blowers.[95] Since the publication of the term sheet and of AMCA 214–21, a number of incentive programs and model energy codes and standards used in State energy codes rely on the FEI metric.[96] 87 FR 44194, 44237.

In the July 2022 NOPR, DOE proposed to apply FEI as the efficiency metric for fans and blowers. DOE stated that FEI would provide for evaluation of the efficiency of a fan or blower across a range of operating conditions, would capture the performance of the motor, transmission, or motor controllers (if any), and would allow for the differentiation of fans with motors, transmissions, and motor controllers with differing efficiency levels. In addition, the use of FEI would align with the industry test standard (AMCA 214–21) and drive better fan selections. 87 FR 44194, 44237.

In addition, DOE proposed that fan FEI would be evaluated in accordance with the DOE proposed test procedure at each of the fan's operating points within the range of air power and shaft input power proposed in scope (*i.e.,* at each duty point, as specified by the manufacturer within the range of air power and shaft input power in scope, *see* Section III.B.1 of this document). This approach is consistent with the term sheet recommendations and would require the determination of the FEI at each duty point as specified by the manufacturer. With this approach, the test procedure would not prescribe particular operating conditions at which the FEI is to be evaluated in order to calculate the FEI metric; instead, the FEI is determined at each duty point. Further, if DOE were to establish any potential energy conservation standards, compliance with that standard would be required at each duty point specified by the manufacturer within the range of air power and shaft input power proposed in scope (*i.e.,* operating range or ''bubble''), and for which the manufacturer publishes performance data. Manufacturers would not be allowed to publish performance data at non-compliant operating points. 87 FR 44194, 44237.

DOE further explained that in order to allow manufacturers to continue to publish performance data at any duty point, DOE also considered an alternative metric approach where the metric would be evaluated at set duty point(s) specified in the test procedure instead of having the FEI metric evaluated at each duty point as proposed. As a potential consideration, DOE provided an example of three duty points identified relative to the fan's BEP[97] at maximum speed and provided an example of a weighted average FEI metric (''WFEI'') established as the average FEI across all three duty points (*i.e.,* duty points of 100, 75, and 50 percent flow relative to BEP) and using a reference system curve in the case of multi- and variable-speed fans. DOE did not propose use of the WFEI metric in the July 2022 NOPR but requested comment on this alternative approach. 87 FR 44194, 44237–44238.

In response to the July 2022 NOPR, the CA IOUs commented in support of the proposed publication of the FEI and FEP at each duty point. (CA IOUs, No. 37 at p. 1)

ebm-papst stated support for the use of FEI for fans in the scope of this NOPR, other than air circulating fans. (ebm-papst, No. 31 at p. 12)

Greenheck commented that DOE should follow the recommendations of the term sheet, specifically in terms of the metric. (Greenheck, No. 39 at p. 2) Greenheck further recommended DOE utilize FEI as its efficiency metric as defined in AMCA 214–21 and required by ASHRAE 90. (Greenheck, No. 39 at p. 3)

Morrison commented that FEI is an appropriate metric to use in this proposed regulation for fans (that are not circulating fans). Morrison noted that ASHRAE and ICC energy codes, and States such as California, Oregon, and Florida, have adopted FEI in their State energy codes. The CEC is using FEI in its Title 20 regulation and that FEI is consistent with the term sheet. (Morrison, No. 42 at p. 7)

AMCA commented that FEI at maximum fan speed is the regulated metric for fans and blowers. AMCA commented that fan manufacturers and many other stakeholders have invested in determining and publishing FEI in lieu of FEG, FMEG,[98] and other efficiency metrics. (AMCA, No. 41 at p. 16) Further, AMCA commented that FEI is the most appropriate metric to use for a regulation for fans that are not air circulating fans. AMCA commented that FEI has been the metric used in ASHRAE and ICC energy codes since 2019, and States such as California, Oregon, and Florida have FEI in their State energy codes. AMCA further stated that the CEC is using FEI in its Title 20 regulation, which underwent extensive internal and public review—Title 20 is slated to take effect on Nov. 1, 2023.[99] AMCA further noted that the 2015 ASRAC term sheet has FEP as the regulatory metric and allowed for FEI to be used for marketing and other purposes. AMCA commented that since ASRAC, while code-change processes for ASHRAE 90.1, IECC, Title 20, and Title 24 were under way, industry and regulators agreed that FEI was a superior metric for regulating fans; hence these code/regulatory bodies settled on FEI and the AMCA 214 standard was developed around FEI as the regulatory metric. AMCA commented that the AMCA Certified Ratings Program evolved to certify manufacturer selection software ratings for FEI.[100] Also, stated AMCA, electric utility incentive programs have been developed around FEI for fans and blowers other than air circulating fans. AMCA also noted that for large-diameter ceiling fans, a derivative of FEI, Ceiling Fan Energy Index (CFEI), was developed to replace the average CFM/W metric DOE had previously used to regulate these products. (AMCA, No. 41 at pp. 31–32)

NEEA recommended that DOE establish the design point metric FEI as the regulatory metric for fans and blowers other than air circulating fans as it is an easy-to-understand rating (the higher the FEI value is, the better that fan is for a customer's specific application), accounts for one of the

[95] *See* Proposed regulatory language for Commercial and Industrial Fans and Blowers available in the following Docket: 22–AAER–01 at: *efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=22-AAER-01.*

[96] ANSI/ASHRAE/IES 90.1–2019, Energy Standard for Buildings Except Low-Rise Residential Buildings; ANSI/ASHRAE/ICC/USGBC/IES 189.1–2020, Standard for the Design of High-Performance; Green Buildings Except Low-Rise Residential Buildings; 2021 International Energy Conservation Code; 2021 International Green Construction Code; 2020 Florida Building Code: Energy Conservation; 2021 Oregon Energy Efficiency Specialty Code; 2022 California Building Energy Efficiency Standards (Title 24); incentive programs presently offered or under development by Seattle City Light, ComEd, and Xcel Energy *See* AMCA FEI Advocacy Brief available at: *www.amca.org/assets/resources/public/assets/uploads/0621-FEI_Advocacy_Brief_V3-20210715.pdf.*

[97] The BEP represents the flow and pressure values at which the fan total efficiency (ratio of total air power to fan shaft input power) is maximized when operating a given speed. Prior to the use of FEI, energy codes required selecting a fan with an efficiency within 10–15 percentage points of the BEP efficiency. *See* International Green Construction Code (2012); ANSI/ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (2013); ANSI/ASHRAE/USGBC/IES 189.1, Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings (2014); International Energy Conservation Code (2015).

[98] DOE notes that FMEG refers to the Fan Motor Efficiency Grade metric used in Europe and determined in accordance with ISO 12759:2010, ''Fans—Efficiency classification for fans.''

[99] DOE notes that the CEC has since finalized its rulemaking. *See www.energy.ca.gov/rules-and-regulations/appliance-efficiency-regulations-title-20/appliance-efficiency-proceedings-11.*

[100] AMCA noted that a complete list of manufacturers with AMCA-certified ratings, is available at *www.amca.org/find-FEI.*

major drivers of fan energy use (fan sizing and specification) and will result in significant energy savings and better-sized fans for the end user. NEEA added that although FEI is a new metric, the fan market is ready and willing to adopt this metric for regulation as demonstrated by the development of an industry standard for FEI (AMCA 214–21), by manufacturers beginning to rate their fans using FEI, and by energy codes and utility incentive programs establishing requirements based on FEI. (NEEA, No. 36 at p. 2)

New York Blower stated support for AMCA's recommendations regarding the FEI metric. (New York Blower, No. 33 at p. 20) New York Blower added that FEI, as proposed in AMCA 214–21 provides a variety of utility, accurately represents efficiency, and provides energy consumption comparison between fans operating at the same duty point and that New York Blower is not aware of a better metric that represents energy consumption or the opportunity for energy savings. (*Id.* at p. 18)

In this final rule, DOE is applying FEI as the efficiency metric for fans and blowers other than air circulating fans. In addition, consistent with the term sheet recommendations, DOE is requiring that the FEI be evaluated in accordance with the DOE test procedure at each of the fan's operating points within the range of air power and shaft input power with thein scope (*i.e.,* at each duty point, as specified by the manufacturer within the range of air power and shaft input power in scope; *see* Section III.B.1 of this document). This approach requires the determination of the FEI at each duty point as specified by the manufacturer.

In response to the July 2022 NOPR, several stakeholders commented on the consideration of a WFEI metric for fans and blowers other than air circulating fans. The CA IOUs commented that while they support the proposed FEI metric, they equally support the concept of an alternate WFEI metric. However, the CA IOUs recommended revising the recommended alternative test points for fans without motor controllers because two of the points would fall in the unstable or stall operating region of the fan curve and provided illustrative examples (*i.e.,* the 75 percent and 50 percent of BEP airflow). Instead, the CA IOUS suggested a WFEI calculation using operating points based on pressure (*e.g.,* 80 and 60 percent of the BEP pressure). In addition, the CA IOUs suggested refining the definition of ''maximum speed.'' The CA IOUs commented that maximum speed is ambiguous and could refer to: (1) the maximum structural speed; (2) the maximum speed for which the manufacturer provides ratings; (3) the maximum speed the motor can sustain; (4) the maximum speed at which the motor controller allows the fan to operate; or (5) the maximum speed at which the fan can operate with a particular belt-drive transmission. The CA IOUs noted that interpreting maximum speed according to the last definition could provide an opportunity to evade any future standard as a manufacturer could certify performance at the speed resulting from operation with the fixed pulleys, which may incentivize some manufacturers to use a pulley set that results in a low speed or an adjustable pulley set to the lowest speed. The CA IOUs recommended the following framework to create a definition of maximum speed: (1) for bare shaft fans, the maximum speed shall be the maximum permitted speed of the fan as published by the manufacturer; (2) for fans sold with single-speed motors and direct-drive or flexible coupling transmissions, the certified speed shall be the speed achieved at each test point;[101] (3) for fans sold with single-speed motors and belt-drive transmissions, the fan shall be tested with a configuration that provides a speed the lesser of (a) the maximum speed that can be sustained by the motor or (b) the maximum structural speed published by the manufacturer; (4) for fans sold with a motor, speed controller, and direct-drive or flexible coupling transmissions, the tested point shall be the lesser of: (a) the maximum permitted speed of the fan as published by the manufacturer, (b) the maximum speed that can be sustained by the motor along the best efficiency curve, or (c) the maximum speed allowed by the controller and cannot be increased by a consumer; (5) for fans sold with a motor, speed controller, and belt-drive transmissions, the tested point shall be the lesser of: (a) the maximum permitted speed of the fan as published by the manufacturer, or (b) the maximum speed that can be sustained by the motor at its rated output along the best efficiency curve, using a transmission configuration that allows the motor to operate at its rated output. (CA IOUs, No. 37 at pp. 3–7)

ebm-papst commented that WFEI has no benefit over any of the other, much more deeply evaluated, fan efficiency metrics. In addition, ebm-papst stated opposition to the establishment of a reference system curve. ebm-papst commented that the fans it manufactures serve vastly different applications and this prevents usage of one or a few reference system curves for developing valid kWh predictions. (ebm-papst, No. 31 at p. 12)

Greenheck commented that the alternative WFEI metric would allow fan selections that use additional energy compared to a more energy-efficient fan for a given duty point and provided an illustrative example. (Greenheck, No. 39 at p. 4)

The CEC commented that a WFEI could result in an invalid representation of the efficiency range of the fan because it may reside in an area of operation where the fan stalls and is therefore not tested by manufacturers nor operated once installed. The CEC commented that when comparing the WFEI of two fans and assuming all three points to be used for the analysis reside in an area of operation where the fan will not stall, the WFEI generated will be heavily dependent on non-efficient operating conditions. Instead, the CEC recommended maintaining the FEI metric. (CEC, No. 30 at pp. 4–6)

NEEA commented against the use of WFEI as the regulatory metric as it does not align with the term sheet recommendation and would be an abrupt change to the current momentum behind FEI in the fan industry and energy codes. NEEA further noted some issues with the duty points considered for calculating the WFEI, which may be in the stall or surge region of the fan. NEEA also noted a lack of market information on the expected WFEI rating. NEEA further commented on the similarities between PEI (Pump Energy Index) and the WFEI metric and commented that while pump performance curves, which are used to calculate PEI, are readily available and did not represent an increase in burden for the industry to provide, fan manufacturers do not commonly publish performance data in this way, so there would be increased burden to produce these data, in addition to the testing required for certification. (NEEA, No. 36 at pp. 4–6)

Morrison commented that a WFEI metric would change the intent of the discussions and spirit of the ASRAC agreement and noted the following issues with such a metric: (1) WFEI is another version of FEG, which the Working Group rejected as a less than ideal metric for fans; (2) WFEI in most circumstances cannot be calculated using the points specified in the NOPR because some duty points may fall in the stall or surge region; (3) the WFEI for fixed-speed fans and variable-speed fans would have vastly differing values for the same fan and nothing related to their

[101] The CA IOUs noted that for many single-speed induction motor fans, the speed will change along the flow-pressure curve.

effect on energy use. Morrison further added that a FEG-style rating was considered by all involved in the ASRAC as inferior to the FEI rating method. Morrison added that the WFEI is an adjusted FEG and not at all like the FEI/FEP metrics proposed and agreed to in the term sheet. (Morrison, No. 42 at pp. 7–8)

Robinson commented on the unlikelihood that using a weighted average measure will result in the intended energy conservation sought by the proposed rule. Robinson added that the heavy industrial fan selection process includes several realities that may not be part of selection of a commercial fan. Robinson stated that heavy industrial process fans often operate on several data points and often require their own permitting process prior to installation. Robinson commented that heavy industrial process fans are subject to unique challenges in operation: they may have acid in the air stream; they may have rock product in the air stream; they may be subjected to high heat, etc. Robinson commented that the unique challenges of the operation of the HIP fan often drive fan selection more than the efficiency of the fan. Robinson commented that the understood, desired end result of implementing a weighted average measure is to force consumers to purchase more efficient fans. However, Robinson concluded, because of the factors described above (and others) it's unlikely that heavy industrial process operators will choose a specific fan type because of its efficiency rating alone. (Robinson, No. 43 at p. 4)

AHRI commented that DOE's consideration of an alternative metric, WFEI to replace Fan Energy Index (FEI)—the metric derived by industry test procedure AMCA 214–21—could constitute a proposal that is contradictory to the National Technology Transfer and Advancement Act of 1995 (NTTA), Public Law 104–113, and the Office of Management and Budget (OMB) Circular A–119, Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities. AHRI commented that both documents direct Federal agencies to adopt voluntary consensus standards unless they are inconsistent with applicable law or otherwise impracticable, as noted by DOE. (86 FR 70892, 70910, at fn 15 (Dec. 13, 2021)) AHRI commented that WFEI is a separate metric with a distinct calculation procedure that has not been evaluated by either fan manufacturers or their customers. (AHRI, No. 40 at p. 4) AHRI added that DOE has not presented supporting documentation that WFEI achieves the differentiation sought. (AHRI, No. 40 at p. 4) AHRI expressed its concern that the introduction of a WFEI metric did not undergo public comment in the October 2021 RFI. AHRI added that due to the lengthy history and complexity of commercial and industrial fans and the introduction of WFEI, stakeholders should be given additional time to review and ask DOE questions in order to provide meaningful comments that will assist DOE in this rulemaking process. (AHRI, No. 40 at p. 5) AHRI further commented that the proposed WFEI metric does not align with the term sheet and is not an appropriate metric. (*Id.* at p. 6)

AMCA commented that the WFEI was a deviation from the ASRAC term sheet which required the industry and advocates to expend time and resources to research and analyze a whole new metric (AMCA, No. 41 at p.2) AMCA added that there were numerous problems with using a WFEI metric. First, AMCA noted that the duty points considered in the NOPR to evaluate the WFEI would fall in regions where many fans would operate in stall or surge. Therefore, AMCA commented that if a weighted average value of BEP flow were used, different duty points would need to be chosen and noted that an optimal selection point for a backward-inclined fan typically is at 95 percent of peak pressure. In addition, AMCA commented that the considered WFEI metric would encourage fan designers to target higher efficiency at lower airflow, which would not result in energy savings. AMCA commented that fans are more often selected for operation at airflows greater than the BEP airflow and fan designers should be encouraged to improve efficiency at these greater airflows where fans are often applied. AMCA also included an example in Table 5 to illustrate how WFEI values for different sizes of the same fan model will remain approximately the same, which would drive fan selections toward the smaller, less-efficient sizes, which are less expensive. AMCA further identified additional issues with the potential consideration of a WFEI metric for fixed-speed fans and variable-speed fans related to the risk of having the duty points located in the stall/surge regions, as well as system effects and the noted that air-system curves are not necessarily quadratic parabolas through the origin due to filters, coils, and other devices which tend to introduce a linear component to the system resistance curve. Further, AMCA commented that it does not believe a WFEI would result in any net energy savings based on rating calculation. AMCA noted that the WFEI metric would assume the fan with a VFD will be selected because it has a higher rating than a fan without a VFD. However, AMCA commented, that would not guarantee the fan will be operated at varying speeds and if the fan is run at constant speed, the fan with the VFD will consume more energy because of additional drive losses in the VFD. Therefore, AMCA commented that the WFEI approach does not accurately reflect the presumed energy savings in application. In addition, AMCA commented that using a WFEI metric would change FEI from a duty-point metric to a product-based metric similar to FEG. AMCA noted the significant history revolving around the shortcomings of the FEG metric and how fans of similar FEG ratings can consume vastly different amounts of energy at specific duty points while a FEI metric would accommodate and identify these differences in energy consumption. (AMCA, No. 41 at pp. 32–34)

JCI stated that it shares AMCA's comments regarding the use of a new metric, weighted average (WFEI), versus the established FEP/FEI metrics which is also not in alignment with the 2015 term sheet. (JCI, No. 34 at p. 2)

New York Blower commented that the challenges of applying a product-based efficiency metric for fans (such as WFEI) because fans adapt to the system in which it is installed and the same fan can operate at high efficiency in one system and perform poorly in a different system. New York Blower commented that the FEI metric was developed to drive fan selections to peak efficiency and yield the greatest energy savings. (New York Blower, No. 33 at p. 2) New York Blower commented that the calculation of the WFEI would select duty points in the stall region for many fans. New York Blower added that they examined different ways to select duty points that could be combined into a WFEI metric and were unable to find an algorithm that could be employed across all fan categories without forcing selection of unacceptable duty points. Instead, New York Blower suggests that the BEP at maximum operating speed should be chosen as a single value to compute the WFEI. In addition, New York Blower commented that fans with variable speed drives would have an artificially high WFEI rating even if that fan is never operated away from a single speed and would allow less efficient fans marketed with a controller to remain in the market. New York Blower added that in the industrial market, a majority of applications are not operated at or applied in a variable speed solution. Instead, there have seen an increase in cyclic activity in fans over the recent years (*i.e.,* the fans are being turned off when not operated). (New York Blower, No. 33 at p. 3) If DOE's intent is to promote variable speed drive installation, New York Blower commented that then either a direct credit to the required FEI performance requirement, or an installation credit at the time of calculations to overcome the insertion loss of the variable speed drive is appropriate. (New York Blower, No. 33 at p. 19) Finally, New York Blower commented that a product-based metric will, ultimately, result in product elimination from the market if efficiency requirements are raised high enough. Because of the vast performance range of a fan, New York Blower stated that it is unlikely the energy savings would be realized in proportion to the products eliminated from the market. Instead, New York Blower commented customers would lose utility from the loss of product availability. New York Blower commented on the complexity of implementing an application-based metric (such as FEI), acknowledging that a product-based metric (such as WFEI) is clearly an easier path to declaring an industry regulated. However, New York Blower recommended that DOE consider the value of saving energy be balanced with the urgency to complete a regulatory effort. (New York Blower, No. 33 at p. 4)

In the July 2022 NOPR, DOE did not propose to adopt the WFEI as the metric for fans and blowers other than air circulating fans. The WFEI metric was considered in the July 2022 NOPR in order to provide a potential alternative metric that would allow manufacturers to publish ratings at operating points with a potentially non-compliant FEI, should DOE establish energy conversation standards for fans and blowers other than air circulating fans. 87 FR 44194, 44237–44238. As noted by the CA IOUs, the CEC, Morrison, New York Blower and AMCA, the determination of such metric is challenging as some the operating points used in the calculation of the WFEI could fall in the stalling operating region of the fan. In addition, as highlighted by NEEA, Morrison, and AHRI such metric would not align with the term sheet recommendations. Further as stated by Greenheck, AMCA, New York Blower and Robinson, a fan with a higher WFEI may not necessarily result in less energy use. As noted previously, DOE establishes the FEI as the metric for fans and blowers other than air circulating fans, consistent with the term sheet recommendations and industry practice. Therefore, DOE is not adopting a definition of maximum speed and is not adopting to specify operating points for the calculation of the WFEI.

In response to the July 2022 NOPR, and regarding the ability to publish performance data for non-compliant duty points, the Efficiency Advocates commented that they continue to support the development of a fan efficiency metric and regulatory framework that drives better fan selections, but they encourage DOE to consider how this goal can be achieved while accommodating the potential need for manufacturers to show certain non-compliant operating points. The Efficiency Advocates commented that the original framework for improving fan selection was to limit the range of operating points, as shown in manufacturer literature and selection software, only to compliant operating points. They added that manufacturers have raised concerns regarding the need to show certain non-compliant operating points for safety reasons. Therefore, they encourage DOE to explore options for a regulatory framework for fans that would drive better fan selections, while accommodating the potential need for additional published information. For example, DOE could consider the feasibility of limiting fan selections returned in manufacturer selection software to those that are compliant at the specified operating point while allowing manufacturers to show certain non-compliant operating points (*e.g.,* in the high pressure, low airflow operating range) for those compliant fan selections. (Efficiency Advocates, No. 32 at p. 1)

Greenheck commented that it remained neutral on the topic of showing noncompliant points on the fan curve after a compliant fan is selected from a list of potential fan options. Greenheck added that this concept was not part of the proposed rulemaking and was suggested as an alternative to the flawed WFEI metric. Greenheck commented that the display of noncompliant points for safety or retrofit applications is an issue for the Energy Regulators, Advocates and built-up equipment manufacturers to discuss and determine the impact upon the industry and the potential value or burden of not showing those values. (Greenheck, No. 39 at p. 5)

NEEA recommended that DOE works together with stakeholders to determine the compliance, certification and enforcement approach for FEI. NEEA stated that NEEA and industry partners are in active collaboration to address DOE's concerns about compliance, certification and enforcement and expect to present additional comments with specific proposals after the comment period has closed. (NEEA, No. 36 at p. 3) NEEA commented in support of allowing manufacturers to publish non-compliant fan information stating that manufacturers need to be able to publish information on non-compliant installations of a fan to inform sizing. If this information is published, NEEA recommended that DOE provide direction on how manufacturers should make it clear that non-compliant fans should not be selected—such as different or grayed-out coloring for visual representations of fan performance. NEEA added that DOE could also require that manufacturer's selection software provide clear warnings and not allow the purchase of fans with FEI less than 1.0. (NEEA, No. 36 at p. 4) NEEA further commented that the process for compliance will be different for FEI compared to other regulated metrics. NEEA suggested two options: (1) Software compliance: Manufacturers could certify compliance of their selection software—the system a user interacts with when selecting a fan for purchase (NEEA noted that this recommendation aligned with Recommendation #26 of the term sheet); and (2) Compliant mapping: For each model, NEEA commented that DOE could require manufacturers to submit the operating conditions that resulted in a compliant FEI. These operating conditions could be organized in a ''compliant window'' or mapping similar to a fan operating curve; DOE could confirm that this window was correct when they review the CCMS submission. (NEEA, No. 36 at pp. 3–4)

In this final rule, DOE is not establishing energy conservation standards for fans and blowers and therefore this final rule would not result in any complaint window or non-complaint operating points as noted in Greenheck and NEEA's comments. DOE will consider issues related to representations and compliance to any potential energy conservation standard in a separate energy conservation standards rulemaking.[102]

2. Metric for Air Circulating Fans

In the July 2022 NOPR, DOE proposed to incorporate by reference AMCA 214–21 for air circulating fans, which relies on the FEP and FEI metrics (''wire-to-air metrics'') for air circulating fans. DOE also presented comments from AHRI,

[102] *See* rulemaking docket: EERE–2022–BT–STD–0002.

AMCA, ASAP, ACEEE, NRDC, and the CA IOUs in support of a FEI metric for air circulating fans.[103] Specifically, ASAP, ACEEE, NRDC cited advantages for FEI such as representativeness of energy use, straightforward interpretation by consumers, ability to account for efficiency differences between fans of the same diameter that deliver the same airflow, consistency with other fan metrics[104] while the CA IOUS mentioned the ability to account for air velocity.[105] [106] 87 FR 44194, 44236–44237.

In addition, to account for variations in fan speeds, DOE proposed the following, depending on the air circulating fan's speed capability: for single speed fans, DOE proposed that the FEI be evaluated at the single available speed and corresponding duty point. For multi-speed fans and variable speed fans, in the absence of data to characterize typical operating speeds, DOE proposed to calculate the FEI based on the weighted average FEI at each of the tested fan speeds, and that each speed be apportioned an equal weight. (*e.g.,* if the FEI is calculated at five speeds, each speed is given 20 percent in the calculation of the weighted average FEI). DOE tentatively determined that while DOE has not found data to characterize the field operating speeds of air circulating fans, a more representative FEI can be calculated by using a weighted average across multiple speeds and weighting all those speeds equally (when compared to calculating the efficiency at only high speed). DOE noted that it would still allow manufacturers to make representations of performance using CFM/W. 87 FR 44194, 44238.

DOE also stated that AMCA 230–15 provides methods to determine FEP of air circulating fans as well as efficacy (*i.e.,* amount of flow per unit of electrical input power produced in CFM/W) and overall efficiency (*i.e.,* amount of thrust per unit of electrical input power produced in lbf/W). *Id.* at 87 FR 44237. In the July 2022 NOPR, DOE indicated that it was aware that the AMCA 230 committee may consider specifying which metric to use in the updated version of AMCA 230 when evaluating the energy performance of air circulating fans. While the NOPR proposed to rely on FEI, DOE stated it was considering alternative metrics such as CFM/W, including weighted average CFM/W for multi- and variable-speed fans, as well as alternative weights for multi- and variable-speed fans. In addition, DOE discussed potentially using the abbreviation ''ACFEI'' (air circulating fan FEI) to distinguish this metric from the FEI specific to fans and blowers other than air circulating fans. 87 FR 44194, 44238–44239.

Since the publication of the July 2022 NOPR, AMCA 230–23 was published and section 7.2.4.1 includes revised provisions regarding test speeds to require testing at maximum speed only, with additional optional tests at lower speeds.

As discussed in section III.E.20 of this document, for the July 2022 NOPR, DOE collected air circulating fan performance data from the BESS certification database and performed regression analysis to determine the appropriate flow, pressure, and efficiency target constants for air circulating fans needed to calculate the FEI metric. DOE proposed to rely on the following constants: Q_0 = 3,210 CFM (rounded to the nearest 10); P_0 = 0 in. wg; and an efficiency target of 0.38 (38 percent). 87 FR 44194, 44230.

In response to the July 2022 NOPR, the Efficiency Advocates commented in support of using FEI as the metric for air circulating fans because it is both representative of energy usage and straightforward for purchasers to interpret (for example, a FEI of 1.1 represents about a 10 percent reduction in energy usage in comparison to an FEI of 1). Importantly, the Efficiency Advocates commented that the FEI accounts for inherent efficiency differences between fans of the same diameter that deliver different airflows. The Efficiency Advocates added that using FEI for air circulating fans would provide consistency with the other non-air circulating fans fan categories included within the scope of the proposed test procedure. In addition, the Efficiency Advocates commented in support of testing variable- and multi-speed air circulating fans at multiple, discrete speeds. They agree with DOE that testing and rating multi-speed fans at a range of speeds will better inform purchasers about fan efficiency across a range of operating speeds. They are also concerned that testing multi-speed air circulating fans only at high speed could result in lower ratings relative to single speed fans due to additional control losses. In other words, while a multi-speed fan may save energy in real-world applications, a rating only at high speed could make it appear less efficient than a comparable single speed fan. Thus, the Efficiency Advocates support DOE's proposal to test variable-/multi-speed fans at multiple speeds. (Efficiency Advocates, No. 32 at p. 2)

ebm-papst commented that FEI provides no benefit with ACFs. Instead, ebm-papst supports making CFM/W the regulated metric because this metric has served users of ACFs well. (ebm-papst, No. 31 at pp. 11, 13)

The CA IOUs commented that BESS Laboratories, an important certifying body for the agricultural fan market, uses a CFM/W metric. The CA IOUs commented that DOE used data from BESS Laboratories to inform its NOPR and similarly, many state utility programs use the BESS Laboratories data to provide rebates incentivizing farmers to use energy-efficient circulating fans. Although a FEI-based metric for circulating fans is likely superior, it would disrupt the market if CFM/W were not allowed to be used 180 days after the final publication of this rule. The CA IOUs recommended that DOE allow the publication of CFM/W and remove it in a future rulemaking (CA IOUs, No. 37 at p. 10) In addition, the CA IOUs commented that DOE should gather additional air circulating fan performance data to develop a new FEI-based metric. The CA IOUs noted that BESS certification database only represents a portion of the air circulating fan market. Specifically, the CA IOUs noted that the air circulating fans tested by BESS Laboratories are among the most efficient in the market and that manufacturers typically will only send their best-performing fans to qualify for utility rebates. The CA IOUs commented that the basis for the new equation should include sampling from the vastly larger air circulating fan market, including commodity fans sold in the retail market. For this reason, the CA IOUs recommended that DOE continue gathering information on the larger market and base the new metric on that data. (CA IOUs, No. 37 at p. 11)

AHRI commented that DOE did not provide data to characterize the field operating speeds of air circulating fans. However, DOE proposed that a more representative FEI can be calculated by using a weighted average across multiple speeds and weighting all those speeds equally (when compared to calculating the efficiency at only high speed) without offering substantiation of this conclusion. Further, AHRI commented that DOE also stated that CFM/W can continue to be used to represent performance of air circulating fan heads; however, this is absent in the proposed regulatory text. (AHRI, No. 40 at p. 4)

AMCA recommended efficacy (in CFM/W) as the regulated efficiency

[103] (AHRI, No. 10 at p. 2; AMCA, No. 6 at p. 9; ASAP, ACEEE, NRDC, No. 7 at p. 2; CA IOUs, No. 9 at p. 2).

[104] (ASAP, ACEEE, NRDC, No. 7 at p. 2).

[105] (CA IOUs, No. 9 at p. 2).

[106] See also (AHRI, No. 10 at p. 2; AMCA, No. 6 at p. 9).

metric for air circulating fans because air circulating fans are rated at only one volumetric flow rate (speed) at zero fan static pressure. AMCA commented that FEI does not add any advantages over simpler metrics for air circulating fans. (AMCA, No. 41 at p. 28) However, AMCA commented that users have for years selected and compared air circulating fans based on CFM/W ratings. AMCA commented that a change of the metric would cause confusion among many stakeholders. In addition, AMCA commented that requiring testing at multiple speeds would negate nearly all historical test data, provide an efficiency metric that confuses consumers, and create an inequitable market that rewards inefficient multiple speed fans that lack consumer utility. (AMCA, No. 41 at pp. 16–17) AMCA added that all considered air circulating-fan metrics (efficacy, thrust efficiency, and single-speed ACFEI) are based on measured fan thrust and fan air density and that legacy data of fully documented tests permit accommodation of future fan ratings as efficacy, thrust efficiency, or single-speed ACFEI these metrics can be calculated from raw test data. AMCA added that there would be little or no impact to the testing cost itself (only recalculation of ratings using the same test data are needed). However, any metric using blended or weighted ratings would invalidate all existing ACF ratings. Most air circulating fans would require new laboratory testing. (AMCA, No. 41 at p. 35) AMCA added that fan manufacturers must accommodate several distinct types of users, including agricultural markets, which generally do not seem to be well-considered in the fan rulemaking. For air circulating fans, the use of the FEI metric may be an issue for agricultural circulating fans (livestock cooling) because BESS labs has been using CFM/W for its certified ratings. These ratings also are used in agricultural electricity-savings incentive programs. However, AMCA commented that a switch to another metric would not be too difficult if historical test results could still be used for calculating new ratings. (AMCA, No. 41 at p. 36) Finally, AMCA commented that the upcoming AMCA 230 will not have an ACFEI metric in the standard. AMCA commented that if DOE ultimately adopts the ACFEI metric, then AMCA recommends using the following constants derived from analyses performed by the AMCA 230 committee: Q_0 = 0.2454 cubic meters per second (1,500 CFM); P_0 = 0.6719 Pa (0.0027 in. wg); and Fan Efficiency target of 38 percent. However, AMCA noted that there was insufficient analytical support for this metric at this time and that the current draft of AMCA 230 does not include ACFEI as a ratings metric. *Id.*

As noted by ebm-papst, the CA IOUs, and AMCA, the fan efficacy in CFM/W is the industry established metric and DOE has concerns over the readiness of an ACFEI metric. In addition, as stated by AMCA, there is insufficient analytical support and DOE acknowledges the uncertainty regarding the values of Q_0 and P_0 that should be used. Therefore, DOE concludes that, at this time, the advantages of the FEI or ACFEI metric identified in the July 2022 NOPR and discussed previously (*i.e.,* representativeness of energy use, straightforward interpretation by consumers, ability to account for efficiency differences between fans of the same diameter that deliver the same airflow, consistency with other fan metrics and ability to account for air velocity) are not significant enough to justify deviating from the established industry efficacy metric (CFM/W) given that the FEI or ACFEI metric have not yet been adopted by industry. In addition, the latest industry test procedure (AMCA 230–23) relies on an efficacy metric and does not rely on the FEI metric. Therefore, at this time, DOE is establishing an efficacy metric in CFM/W for air circulating fans.

In addition, given the uncertainty and lack of data regarding operation at speeds less than the maximum speed, as discussed in section III.E.14 of this document, DOE evaluates the efficacy metric at the highest speed (or ''maximum speed'') only for all air circulating fans regardless of their speed configuration.

H. Control Credit Approach for Fans and Blowers Other Than Air Circulating Fans

For fans and blowers other than air circulating fans, the Working Group recommended that the FEP of a fan with dynamic continuous control be calculated with an additional credit to offset the losses inherent to the control. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #16 at p. 9)

As stated in the July 2022 NOPR, DOE analyzed the control credit in the European Commission Regulation No. EU 327/2011 and observed that the value of the credit is equivalent to about 5 to 10 percent of the fan electrical input power for a fan with controls with an electrical input power less than 5 kW, but that it decreases to 4 percent for fans at or above 5 kW. Since the term sheet publication, AMCA established the FEI calculation method in AMCA 214–21. DOE also reviewed the calculation of FEP for fans with variable speed controls in AMCA 214–21, which does not provide for any control credit (*i.e.,* motor controller credit). (*See* section 6.4.2 of AMCA 214–21.) In its proposed rulemaking for commercial and industrial fans and blowers, the CEC did not propose a credit when establishing the FEI of fans with controllers and did not specify a different minimum FEI level when proposing energy conservation standards for fans with a controller.[107] Instead, the CEC highlighted that fans with a controller will have a larger FEI-compliant performance capability compared to fans that are single speed.[108] 87 FR 44194, 44240.

Consistent with industry practice, DOE proposed to adopt the FEP and FEI calculation as specified in AMCA 214–21 and did not propose to develop a control credit for fans with a controller. As stated, EPCA requires the DOE test procedures be reasonably designed to produce test results, which reflect energy efficiency and energy use during a representative average use cycle and not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2)) To the extent use of a dynamic continuous control impacts the energy use characteristics of a fan or blower, the test procedure should account for such impact and appropriate consideration of any such impact would be part of the evaluation of potential energy conservation standards. *Id.*

AMCA supports DOE's proposal to not include a control credit in the test procedure. AMCA explained that the majority of AMCA members are not in the motor/controller business and frequently do not have influence over the choice of motor control. AMCA commented that should a credit be applied for motor controllers; it should be done at the efficiency-requirement level and not within the FEI calculation. (AMCA, No. 41 at p. 36)

Robinson commented that should DOE not include a credit, as it would cause differentiation from the European calculations and could impact the ability of U.S. manufacturers to compete against European or non-U.S. manufacturers. (Robinson, No. 43 at p. 11)

[107] *See* Proposed regulatory language for Commercial and Industrial Fans and Blowers available in the following Docket: 22-AAER-01 at: *efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=22-AAER-01.*

[108] *See* Staff Report, pp. 36–37 for Commercial and Industrial Fans and Blowers available in the following Docket: 22-AAER-01 at: *efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=22-AAER-01.*

Morrison commented that variable frequency drive (''VFD'') control provides a good method to achieve part load operation dynamically in order to promote energy savings. Morrison stated that since the FEP calculation metric penalizes the use of VFDs, providing at a minimum an equivalent bonus factor is appropriate to gain back the losses in the calculation. Morrison commented that operating at part load saves significantly more energy than any other efficiency change. (Morrison, No. 42 at p. 8)

New York Blower commented against a credit in the FEP and FEI calculation for fans with a motor controller. However, in the context of a WFEI metric which overestimates energy savings obtained merely by selling the fan with a motor controller, New York Blower commented that a credit to cover an insertion loss of the motor controller would be more tolerable and representative of system performance than the energy consumption calculation as currently proposed in the WFEI. While not supported with much data, New York Blower commented that a 5 percent credit would be acceptable. New York Blower commented that based on limited published data, they estimate that motor controllers can operate at roughly 97 percent efficiency at optimal conditions. New York Blower further stated that a 5 percent credit would give the motor controller an additional 2 percent credit above typical insertion loss—which should be included in the FEI calculation—in the overall FEI representation. Again, New York Blower commented that they would accept criticism in their estimates from those more knowledgeable of the subject matter of motor controllers. New York Blower commented that they believe this proposal is reasonable in intent and execution considering the imposition of a WFEI metric. (New York Blower, No. 33 at pp. 20–21)

As stated previously, DOE is not adopting WFEI as the metric for fans and blowers. Consistent with industry practice, for fans and blowers other than air circulating fans, DOE is adopting the FEP and FEI metric as specified in AMCA 214–21 and is not including a control credit for fans with a motor controller. As stated, EPCA requires the DOE test procedures be reasonably designed to produce test results, which reflect energy efficiency and energy use during a representative average use cycle and not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2)) As stated by Morrison, the FEP calculation metric penalizes the use of VFDs, as it incorporates the losses from the VFD and appropriate consideration of any such impact would be part of the evaluation of potential energy conservation standards.

I. Alternative Energy Determination Method (AEDM)

For certain covered equipment, DOE permits the use of an AEDM subject to the requirements at 10 CFR 429.70. An AEDM is a mathematical model based on the covered equipment design, and mitigates the potential cost associated with having to physically test units. AEDMs are permitted in instances in which the model can reasonably predict the equipment's energy efficiency performance.

Although specific requirements vary by product or equipment, use of an AEDM entails development of a mathematical model that estimates energy efficiency or energy consumption characteristics of the basic model, as would be measured by the applicable DOE test procedure. 10 CFR 429.70(c)(1)(i). The AEDM must be based on engineering or statistical analysis, computer simulation or modeling, or other analytic evaluation of performance data. 10 CFR 429.70(c)(1)(ii). A manufacturer must validate an AEDM by demonstrating that its predicted efficiency performance of the evaluated equipment agrees with the performance as measured by actual testing in accordance with the applicable DOE test procedure. 10 CFR 429.70(c)(1)(iii). The validation procedure and requirements, including the statistical tolerance, number of basic models, and number of units tested, vary by product. 10 CFR 429.70.

Once developed, an AEDM may be used for representations of the performance of untested basic models in lieu of physical testing. The manufacturer, by using an AEDM, bears the responsibility and risk of the validity of the ratings, including cases where the manufacturer receives and relies on performance data for certain components from a component manufacturer.

AEDMs, when properly developed, can provide a straightforward and accurate means to predict the energy usage or efficiency characteristics of a basic model of a given covered product or equipment and reduce the burden and cost associated with testing. Where authorized by regulation, AEDMs enable manufacturers to rate and certify the compliance of their basic models by using the projected energy use or energy efficiency results derived from these simulation models in lieu of testing.

The Working Group recommended allowing the use of an AEDM to generate the represented values of FEP and FEI of a fan basic model. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendations #23 through #25 at pp. 12–13)

As proposed in the July 2022 NOPR, DOE allows the use of an AEDM in lieu of testing to determine fan performance, which would mitigate the potential cost associated with having to physically test units. Comments received on this issue are discussed in the remainder of this section. 87 FR 44194, 44241.

1. Validation

Validation is the process by which a manufacturer demonstrates that an AEDM meets DOE's requirements for use as a certification tool by physically testing a certain number of basic models and comparing the test results to the output of the AEDM. Before using an AEDM, a manufacturer must validate the AEDM's accuracy and reliability as follows.

A manufacturer must select a minimum number of basic models from each validation class to which the AEDM applies. To validate an AEDM, the specified number of basic models from each validation class must be tested in accordance with the DOE test procedure and sampling plan in effect at the time those basic models used for validation are distributed in commerce. Testing may be conducted at a manufacturer's testing facility or a third-party testing facility. The resulting rating is directly compared to the result from the AEDM to determine the AEDM's validity. A manufacturer may develop multiple AEDMs per equipment category, and each AEDM may span multiple validation classes; however, the minimum number of basic models must be validated per equipment category for every AEDM that a manufacturer chooses to develop. An AEDM may be applied to any basic model within the applicable equipment category at the manufacturer's discretion. All documentation of testing, the AEDM results, and subsequent comparisons to the AEDM would be required to be maintained as part of both the test data underlying the certified rating and the AEDM validation package pursuant to 10 CFR 429.71.

The Working Group recommended that the AEDM be validated by the testing of at least two basic models, compliant with any potential energy conservation standards for each equipment class.[109] In addition, the

[109] DOE uses validation classes for AEDMs. While validation classes may not directly align with equipment classes, validation classes are consistent

Working Group recommended that if an AEDM was used to simulate a wire-to-air test method, then the basic models used to validate the AEDM had to be tested using the wire-to-air test method. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #24 at p. 13).

In the July 2022 NOPR, DOE proposed to include fan and blower validation classes at 10 CFR 429.70(k) and to require that two basic models per validation class be tested using the relevant proposed test procedure. This number of basic models is consistent with the number of basic models required for most DOE-regulated equipment that utilize AEDMs. In addition, DOE proposed that at least one basic model selected for validation testing would be required to include a motor, or a motor and controller of each topology (*e.g.,* induction, permanent magnet, electronically commutated motor) included in the AEDM. DOE also proposed that if the AEDM is intended to represent the wire-to-air test method, then the testing of the basic models used to validate the AEDM must be performed according to the wire-to-air test method. Similarly, if the AEDM is intended to represent the fan shaft power test method, DOE proposed that the testing of the basic models used to validate the AEDM be performed according to the fan shaft power test method. 87 FR 44194, 44241.

Morrison commented that they continue to support the recommendation 24 of the term sheet and support a plan that has manufacturers using testing results from two units to prove an AEDM but using the sampling plan per Recommendation #23 of the ASRAC term sheet. The sampling plan should be removed from the AEDM validation testing requirements. (Morrison, No. 42 at p. 9)

AMCA commented that they support Working Group Recommendation #24. However, AMCA commented that Recommendation #24 varies from the NOPR in that the NOPR calls for the testing to be done compliant with the test procedure and sampling plan, which currently calls for two units per basic model. AMCA accepts testing two units to prove an AEDM but using the sampling plan per Recommendation #23 of the ASRAC term sheet. (AMCA, No. 41 at p. 37)

New York Blower commented that to require two units to validate an AEDM seems reasonable, but when the tests must be executed in accordance with a sampling requirement attached to it, the AEDM development processed appears overly complicated. (New York Blower, No. 33 at p. 21)

Robinson commented that the AEDM approach for fans and blowers is an imperative as testing costs will be overwhelming in the absence of an AEDM. Robinson commented that the requirement for two samples to validate an AEDM will preclude the term sheet agreement of using historical testing data which is developed from a single fan. (Robinson, No. 43 at p. 11)

DOE includes fan and blower validation classes at 10 CFR 429.70(m) and requires that two basic models per validation class be tested using the relevant proposed test procedure. As stated, the number of basic models is consistent with the number of basic models required for most DOE-regulated equipment that utilize AEDMs. In addition, DOE requires that at least one basic model selected for validation testing would be required to include a motor, or a motor and controller of each topology (*e.g.,* induction, permanent magnet, electronically commutated motor) included in the AEDM. DOE also requires that if the AEDM is intended to represent the wire-to-air test method, then the testing of the basic models used to validate the AEDM must be performed according to the wire-to-air test method. Similarly, if the AEDM is intended to represent the fan shaft power test method, DOE requires that the testing of the basic models used to validate the AEDM be performed according to the fan shaft power test method. In addition, as discussed in section III.J of this document, DOE requires testing at least one unit per basic model in accordance with the sampling plan per Recommendation #23 of the ASRAC term sheet.

DOE's proposed validation classes for fans and blowers are listed as follows: (1) centrifugal housed; (2) radial housed; (3) centrifugal inline; (4) centrifugal unhoused; (5) centrifugal PRV exhaust; (6) centrifugal PRV supply; (7) axial inline; (8) axial panel; (9) axial PRV; (10) unhoused ACFH; (11) air circulating axial panel fan; (12) box fan; (13) cylindrical air circulating fan; and (14) housed centrifugal air circulating fan. 87 FR 44194, 44241. Per the current draft of the revised AMCA 230 standard, AMCA recommends replacing the proposed validation classes (10) through (14) with ''(10) Air circulating fan heads.''[110] Additionally, AMCA recommends an 11th class for laboratory exhaust fans that are not induced flow fans per its recommendation for the definition of safety fans and lab exhaust fans that are not induced flow fans.[111] (AMCA, No. 41 at p. 37)

DOE did not receive any comments related to the proposed validation classes (1) through (9) and is adopting them as proposed. Regarding laboratory exhaust fans, as stated previously (*see* section III.C.2 of this document), DOE is not including laboratory exhaust fans in the scope of the test procedure and therefore is not adding a validation class for this equipment. Regarding validation classes for air circulating fans, AMCA recommended using unique validation classes for all categories of air circulating fans. DOE has concerns that such an approach, keeping with the 2 basic models per validation class, would not allow development of a model that is sufficiently representative of impeller designs and housing configurations. In addition, AMCA did not provide supporting information other than stating consistency with AMCA 230–23 (which does not include AEDM requirements). Therefore, at this time, DOE is reducing the number of validation classes for air circulating fans by grouping all housed ACFHs with axial impellers (*i.e.,* air circulating axial panel fans, box fans, and cylindrical air circulating fans) under the same validation class (''axial housed ACFH'') and to establish the following validation classes: unhoused ACFH, axial housed ACFH, and housed centrifugal air circulating fan.

New York Blower estimated that three fans would need to be tested to support ratings for 12 sizes and that the performance of the remaining sizes could be estimated using an AEDM. New York Blower commented that once the AEDM inventory in the industry is created, maintenance would be

with equipment classes. DOE would propose equipment classes in a future energy conservation standards rulemaking for fans and blowers.

[110] In their comments, AMCA uses the acronym ACFH to designate air circulating fan heads. Air circulating fans includes both housed and unhoused ACFHs and DOE considers the term ACFH equivalent to air circulating fan.

[111] DOE notes that AMCA also noted that their recommended changes would alter the regulatory text as follows: (i) Select basic models. For each fan or blower validation class listed as follows: centrifugal housed fan; radial housed fan; centrifugal inline fan; centrifugal unhoused fan; centrifugal power roof ventilator exhaust fan; centrifugal power roof ventilator supply fan; axial inline fan; axial panel fan; axial centrifugal power roof ventilator fan; unhoused ACFH; air circulating axial panel fan; housed air circulating fan head; lab exhaust fan to which the AEDM is applied. (AMCA, No. 41 at p. 37) DOE notes that the draft regulatory text provided by AMCA and the comment do not align. In their comments, AMCA recommends replacing the proposed validation classes (10) through (14) with ''(10) Air circulating fan heads'' while in the regulatory text they recommend replacing the proposed validation classes (12) through (14) with ''(10) Air circulating fan heads.'' (AMCA, No. 41 at p. 37) DOE interprets that comment as taking precedent over the draft regulatory text provided as the validation classes listed by AMCA in the draft regulatory text provided do not match the comment otherwise.

lessened, but to get started would clearly take extensively longer than any compliance period currently proposed. New York Blower commented that having to document AEDMs and certify every size, on an annual basis, would be an incredible burden to the fan industry and result in added cost paid by consumers. (New York Blower, No. 33 at p. 5)

DOE is not establishing any certification requirements in this final rule; however, DOE notes that beginning 180 days after publication of this final rule, any voluntary representations of FEI for fans that are not air circulating fans or CFM/W for air circulating fans that are within the scope of this test procedure would be required to be based on the DOE test procedure. This requirement is further discussed in section III.L.

The Working Group recommended adding a tolerance of 5 percent to the results of the AEDM for the basic models used for validation of the AEDM. The Working Group recommended that the predicted FEP using the AEDM may not be more than five percent less than the FEP determined from the test according to the DOE test procedure for the basic models used to validate an AEDM. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #25 at p. 13).

The Working Group recommendation would require that the FEP calculated by an AEDM must be greater than or equal to 95 percent of the FEP determined testing the basic models used to validate the AEDM. This is equivalent to requiring that the FEI determined using the FEP calculated by an AEDM must be less than or equal to 100/0.95 percent or approximately 105 percent of the FEI calculated using the FEP determined from testing the basic models used to validate the AEDM.[112]

In the July 2022 NOPR, DOE proposed to apply the 5 percent tolerance to the FEI because FEI is the proposed metric. DOE proposed that the FEI calculated by an AEDM must be less than or equal to 105 percent of the FEI determined from the test of the basic models used to validate the AEDM. 87 FR 44194, 44241.

In response to the July 2022 NOPR, Robinson requested clarification on whether there is a positive margin on the AEDM for predicted FEP. (Robinson, No. 43 at p. 11) DOE notes that there is a positive margin, as stated in the previous paragraph.

DOE did not receive any additional comments on this proposal and therefore is requiring that the FEI calculated by an AEDM must be less than or equal to 105 percent of the FEI determined from the test of the basic models used to validate the AEDM. For air circulating fans, DOE is applying a 5 percent tolerance as proposed, but to the adopted efficacy metric in CFM/W.

2. Additional AEDM Requirements

In the July 2022 NOPR, consistent with provisions for other commercial and industrial equipment, DOE proposed to require that, if requested by DOE, a manufacturer must perform at least one of the following activities: (1) conduct a simulation before a DOE representative to predict the performance of particular basic models of the equipment to which the AEDM was applied; (2) provide analysis of previous simulations conducted by the manufacturer; or (3) conduct certification testing of basic model(s) selected by DOE. 87 FR 44194, 44241–44242.

In addition, DOE proposed that when making representations of values other than FEI (*e.g.,* FEP, fan shaft power) for a basic model that relies on an AEDM, all other representations would be required to be based on the same AEDM results used to generate the represented value of FEI. *Id.* at 87 FR 44242.

In response to the July 2022 NOPR, Robinson commented that it objects to the requirement of providing copies of AEDM calculations because the Robinson companies are privately held. (Robinson, No. 43 at p.11) DOE notes that manufacturers initially must certify whether basic model performance was determined with an AEDM or not. If DOE has questions on the AEDM used for a given basic model, DOE contacts the manufacturer for this information. DOE considers all AEDM data provided by manufacturers to be confidential. These data would not be publicly available. Additionally, DOE notes that use of an AEDM and AEDM representations are voluntary.

DOE did not receive any additional comments on these issues and requires that when making representations of values other than FEI (*e.g.,* FEP, fan shaft power) or efficacy (as applicable) for a basic model that relies on an AEDM, all other representations would be required to be based on the same AEDM results used to generate the represented value of FEI or efficacy.

3. AEDM Verification Testing

In the July 2022 NOPR, consistent with the provisions for certain commercial and industrial equipment, DOE proposed to include provisions related to AEDM verification testing for fans and blowers in 10 CFR 429.70(k), including: (1) selection of units from retail if available, or otherwise from a manufacturer, (2) independent, third-party testing if available, or otherwise at a manufacturer's facility, (3) testing performed without manufacturer representatives on site, (4) testing in accordance with the DOE test procedure, any active test procedures, any guidance issued by DOE, and lab communication with the manufacturer only if DOE organizes it, (5) notification of manufacturer if a model tests worse than its certified rating by an amount exceeding a 5 percent tolerance with opportunity for the manufacturer to respond, (6) potential finding of the rating for the model to be invalid, and (7) specifications regarding when a manufacturer's use of an AEDM may be restricted due to prior invalid represented values and how a manufacturer could regain the privilege of using an AEDM for rating. 87 FR 44194, 44242. DOE did not receive any comments related to these proposals and DOE is adopting these provisions as proposed.

4. Engineered-To-Order

In response to the July 2022 NOPR, New York Blower requested clarification regarding engineered-to-order products. Specifically, New York Blower requested clarification regarding what defines a product as an engineered-to-order product and whether that would impact sampling and AEDM requirements. New York Blower commented that engineered-to-order better describes custom fans which contain a design, but no distinct sizes. New York Blower commented that the sizes are dynamically created when the customer provides the specification and the fan is then designed and built once, for a single use. New York Blower requested clarification on whether this type of product is required to follow the sampling and testing requirements. New York Blower recommended that custom fan designs be certified at a single size and that at the time of order, the data from the tested size would be rescaled through an AEDM, built, and shipped. New York Blower further recommended that the certification of the original tested fan would be carried to the designed fan and no further sampling or testing would be required. New York Blower commented that this is how

[112] The FEI is equal to the reference FEP (FEP_{ref}) divided by the FEP of the actual fan. Therefore, if the FEP calculated using the AEDM (FEP–AEDM) is greater than or equal to 95 percent of the FEP (FEP-test) determined through testing, the FEP_{ref}/FEP–AEDM is less than or equal to 1/0.95 * FEP_{ref}/FEP-test.

custom fans have been designed for as long as the affinity laws have been understood. New York Blower noted that such approach would conflict with the definition of the basic model as each instance of the custom fan design is likely to consume a significantly different amount of energy from the tested fan and therefore would need to be considered a different basic model. In summary, New York Blower requested that DOE allow custom fan designs to be certified through a single certification for each design. (New York Blower, No. 33 at pp. 23–24)

As stated in section III.E of this document, DOE references section 8.2.1 of AMCA 214–21, ''Fan laws and other calculation methods for shaft-to-air testing,'' and section 8.2.3 of AMCA 214–21, ''Calculation to other speeds and densities for wire-to-air testing,'' as proposed in the July 2022 NOPR. (*See* 87 FR 44194, 44222.) Section 8.2.3 of AMCA 214–21 includes provisions which allow speed and size interpolations. In addition, as discussed in this section, DOE allows the use of AEDM in lieu of testing. For engineered-to-order equipment, manufacturers would have the option to determine the FEI of the engineered-to-order basic model through physical testing, application of the fan laws (in accordance with the test procedure), or application of an AEDM. Manufacturers would be required to certify the basic model.

As discussed in section III.C.7 of this document, with regards to custom fans for which a single made-to-order fan is manufactured, general sampling requirements for all covered equipment at 10 CFR 429.11(b), and § 429.11(b)(2) provides provisions for sampling when only one unit of a basic model is produced.[113] In accordance with these provisions, a single engineered-to-order product must be tested to ensure it complies with the standard. To reduce testing burden, DOE is adopting AEDM provisions that would allow certification using such AEDM, in lieu of testing (*i.e.,* physical testing or application of the fan laws as in accordance with the test procedure) and would apply to any basic model, including made-to-order products. Certification would be based on the test results of the one unit, or the AEDM ratings for the model.

J. Sampling Plan

DOE provides sampling provisions for determining represented values of energy use or energy efficiency of a covered product or equipment. *See* generally, 10 CFR part 429. These sampling provisions provide uniform statistical methods that require testing a sample of units that is large enough to account for reasonable manufacturing variability among individual units of a basic model, or variability in the test methodology, such that the test results for the overall sample will be reasonably representative of the efficiency of that basic model.

The general sampling requirement currently applicable to all covered products and equipment provides that a sample of sufficient size must be randomly selected and tested and that, unless otherwise specified, a minimum of two units must be tested to certify a basic model. 10 CFR 429.11. This minimum is implicit in the requirement to calculate a mean—an average—which requires at least two values. Manufacturers can increase their sample size to narrow the margin of error. The design of the sampling plan is intended to determine an accurate assessment of product or equipment performance, within specified confidence limits, without imposing an undue testing or economic burden on manufacturers. Different samples from the same population will generate different values for the sample average. An interval estimate quantifies this uncertainty in the sample estimate by computing lower and upper confidence limits (''LCL'' and ''UCL'') of an interval (centered on the average of the sample) which will, with a given level of confidence, contain the population average. Instead of a single estimate for the average of the population (*i.e.,* the average of the sample), a confidence interval generates a lower and upper limit for the average of the population. The interval estimate gives an indication of how much uncertainty there is in the estimate of the average of the population.[114] Confidence limits are expressed in terms of a confidence coefficient. For covered equipment and products, the confidence coefficient typically ranges from 90 to 99 percent.[115] The confidence coefficient 97.5 percent, for example, means that if an infinite number of samples are collected, and the confidence interval computed, 97.5 percent of these intervals would contain the average of the population: *i.e.,* although the average of the entire population is not known, there is a high probability (97.5 percent confidence level) that it is greater than or equal to the LCL and less than or equal to the UCL.

To ensure that the represented value of efficiency is no greater than the population average, the sampling plans for determination of the represented value typically consist of testing a representative sample to ensure that . . . (ii) Any represented value of energy efficiency[116] . . . shall be no greater than the lower of (A) the average of the sample () or (B) the lower XX confidence limit of the true mean divided by K, where the values for XX and K vary with product or equipment type. XX, the confidence limit, typically ranges from 90 to 99 percent, while K, an adjustment factor, typically ranges from 0.9 to 0.99. The specific values for XX and K for a particular product or equipment are selected based on an expected level of variability in product performance and measurement uncertainty. 10 CFR 429.14 through 10 CFR 429.66. Requiring that the represented value be less than or equal to the LCL would ensure that the represented value of efficiency is no greater than the population average. DOE divides the LCL by K to provide additional tolerance to account for variability in product performance and measurement uncertainty.[117] The comparison with the average of the sample further ensures that if LCL divided by K is greater than , the represented value is established using the average of the sample. In addition, DOE relies on a one-sided confidence limit to provide the option for manufacturers to rate more conservatively.

The Working Group recommended that a represented value of FEP of a basic model be based on a minimum of one test, where the represented value of FEP must be less than or equal to any energy conservation standard level, and greater than or equal to the tested value of FEP.[118] The Working Group did not

[113] Section 429.11(b)(2) specifies that if only one unit of the basic model is produced, that unit must be tested, and the test results must demonstrate that the basic model performs at or better than the applicable standard(s). If one or more units of the basic model are manufactured subsequently, compliance with the default sampling and representations provisions is required.

[114] NIST/SEMATECH e-Handbook of Statistical Methods, *www.itl.nist.gov/div898/handbook/eda/section3/eda352.htm.*

[115] Part 429 in 10 CFR outlines sampling plans for certification testing for product or equipment covered by EPCA.

[116] Or any other metric for which the consumer will favor a higher value, such as FEI.

[117] For example, if DOE expects that the variability for measured performance is within a margin of 3 percent, DOE will use a K value of 0.97. *See* for example 79 FR 32019, 32037 (June 3, 2014).

[118] DOE notes that this requirement can be converted into the FEI metric as follows: the represented value of FEI of the basic model must be based on a minimum of one test, where the represented value of FEI must be greater than or

Continued

provide recommendations to address a situation in which a manufacturer chooses to increase their test sample size. (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #23 at p. 12) The Petitioners also requested that manufacturers be allowed to establish FEP and FEI ratings of a fan basic model based on testing of a single unit. (Docket No. EERE–2020–BT–PET–0003, The Petitioners, No. 1.3 at p. 8)

In the July 2022 NOPR, DOE proposed that a minimum sample size of two units would be used when making representations of FEP, FEI, and fan shaft power, as applicable. This proposal is consistent with the statistical sampling requirements in place for other commercial and industrial equipment regulated by DOE.[119] 87 FR 44194, 44243. In addition, DOE proposed that the FEI be rounded to the nearest hundredth. *Id.* at 87 FR 44243.

AMCA commented that a 2-sample test was a deviation from the ASRAC term sheet, which required the industry and advocates to expend time and resources to research and analyze the implication of losing the historical record of fan tests. (AMCA, No. 41 at p. 2) AMCA commented that sample sizes of one unit must be allowed, as stipulated in Recommendation #23 of the term sheet. AMCA further cited the example of commercial packaged boilers as a covered product for which DOE allows a single unit sample (10 CFR 429.60). AMCA commented that, if DOE does not allow a single unit sample, much of the historical data for the fan industry would be eliminated. AMCA added that the industry does not have the financial or logistical resources to retest all products with two-sample tests. In addition, AMCA commented that AMCA 214–21 defines how to calculate the FEP and FEI at a single duty point or point of operation which consists of values of flow rate, pressure, power, and density. AMCA noted that the proposed statistics included in the NOPR imply FEP and FEI values can be averaged over multiple tests. However, AMCA commented that when considering multiple samples, the tests would have to have an identical number of sampled duty points and each duty point would have to be at the same flow, pressure, and density.[120] AMCA commented that while tests can be corrected to have all data points represented at the same density, it is highly unlikely each collected data point will be at the same flow and pressure. AMCA commented that there is no known methodology to combine multiple sets of test data to compute an expected mean value of performance[121] and commented that DOE would need to provide some methodology. AMCA added that the proposed statistics would function accurately under the following conditions: (1) A single value of performance (metric) was derived from the test (for example, the WFEI); or (2) The value from the test was captured at some specific operating condition that is repeatable across tests (for example at BEP). AMCA commented that the proposed test procedure is such that historical data would not pass the current test-procedure requirements and requiring two units to be tested will double the expense for manufacturers and lead to excessive testing burden. AMCA commented that units that are built for test cannot be placed back into stock and sold as new or offered for sale and all tested units would be an unrecoverable expense. AMCA commented that in addition to the costs, the time required to test two units of every basic model would span well beyond the compliance time period and could exceed 10 years. Instead, AMCA recommended to follow the guidelines of AMCA 214 and allow a single test where the FEP and FEI is calculated at each duty point (corrected to uniform speed and density as appropriate), and this data becomes the basis for the efficiency values presented in the market. (AMCA, No. 41 at pp. 38–40)

JCI and Morrison commented in support of AMCA's comments regarding the proposed sampling plan. (JCI, No. 34 at p. 2; Morrison, No. 42 at pp. 9–12)

NEEA recommends DOE work with AMCA to understand the burden associated with testing two units to certify a basic model and clarify DOE's stance on allowing the use of historic testing to be used in certifying fans. (NEEA, No. 36 at p. 3)

New York Blower commented that the sampling and statistics built into 10 CFR parts 429 and 431 will function as expected for a product-based metric. However, New York Blower added that the FEI metric is designed to be applicable to an entire fan performance envelope (flow, pressure, density, and power) and that there is no agreed upon methodology that allows for the combining of two or more fan curves into a representation of performance for a population. (New York Blower, No. 33 at p. 3) New York Blower added that requiring two-sample testing will double the costs of testing compared to creating ratings for a series of sizes within a product line from a single test. (New York Blower, No. 33 at p. 5)

New York Blower further commented that for a product-based metric where statistical representation of a population is required, a two sample minimum is appropriate. New York Blower added that a two-sample minimum could impose significant restrictions on the manufacturer, by amplifying any deviation between samples to predict population performance. New York Blower commented that a Weighted Average FEI value could be calculated from a single test. Presuming this would represent minimum energy consumption or maximum efficiency of the population of products would require the manufacturer to estimate any deviations from future samples and incorporate it in the ratings calculation. While not statistically supportable, it would be a method to create ratings and certify products from a single test. (New York Blower, No. 33 at p. 22)

Robinson commented that the two-sample minimum causes great concern for heavy industrial processing fans. Robinson commented that heavy industrial processing fans are uniquely designed and engineered for each installation and application. The material and parts are ordered specific to the job and only after the engineering and drawing of the individual product are complete. The NOPR indicates that the DOE would attempt to require two of each fan to be built to test its efficiency. Considering the number of heavy industrial processing fans and blowers sold in a year, Robinson commented that this will add a significant time and financial burden even if it were possible to design an AEDM. In the case of custom engineered equipment, Robinson stated that an accurate AEDM will be difficult and expensive to develop, requiring significant engineering expertise. (Robinson, No. 43 at pp. 3–4)

In addition, Robinson requested clarifications regarding the sampling process and noted that it is not unusual for a custom fan manufacturer to not

equal to any energy conservation standard and less than or equal to the tested value of FEI.

[119] The general sampling requirement currently applicable to all covered products and equipment provides that a sample of sufficient size must be randomly selected and tested to ensure compliance and that, unless otherwise specified, a minimum of two units must be tested to certify a basic model as compliant. *See* 10 CFR 429.11.

[120] At a given density, each duty point is defined as a value of pressure and flow at a given speed, and the test procedure provides methods to determine the electrical or FEP at that duty point.

[121] AMCA commented that AMCA 211 provides a method of comparing fan-performance data to a reference rating and an interpolation method for estimating performance between two sets of performance data but does not provide a method of combining more than one set of test data to provide average prediction of performance. (AMCA, No. 41 at p. 39)

make a particular size for years depending on the needs of the market. Robinson commented it was their understanding that one test would be required to certify a design as custom fan manufacturers would have historical design data available regarding the original design. Robinson commented that the definition of basic models and varying full width size classes suggests that an extraordinary amount of testing would need to be conducted to certify basic models. (Robinson, No. 43 at p. 12)

Greenheck commented that the proposed two-test requirement is disruptive and an extreme burden to the industry. Greenheck commented that the fan test procedure and certified ratings program (''CRP''), developed by AMCA and utilized by the fan industry, requires a single-sample precertification test and recurring surveillance audits. Greenheck commented that a two-sample requirement will not focus the industry on development of higher efficiency products and support energy savings. Instead, it will eliminate currently available fan performance data and shackle manufacturers with years of recertification of existing products. Greenheck commented that the improved accuracy of two-sample testing provides no value or energy savings for products already following the AMCA CRP program. Greenheck recommended that DOE accept AMCA CRP historical data and allow single unit performance data following AMCA 210 and AMCA 211 moving forward. (Greenheck, No. 39 at pp. 2–3)

AHRI commented that the Working Group explicitly recommended that a represented value of a basic model be based on a minimum of one test, where the tested value must be less than the represented value. AHRI commented that this was deemed appropriate by the Working Group after lengthy discussion about the substantial burden retesting on the industry. AHRI commented that the ratings and sampling methods embodied in AMCA Publication 211, ''Certified Ratings Program Product Rating Manual for Fan Air Performance,'' have long been used and have been offered for regulatory purposes. AHRI does not support DOE's proposal that a minimum sample size of two units would be used when making representations of FEP, FEI, and BHP, as applicable, be required when that was explicitly recommended against by the cognizant Working Group. AHRI added that DOE has offered no data or analysis that the agreed upon methodology would be insufficient or deviate substantially from current practices. (AHRI, No. 40 at p. 7)

ebm-papst commented that they were unable to see through the complexities and important nuances of the AEDM and the statistical procedures that the NOPR proposed to implement. Instead, ebm-papst recommended adoption of AMCA 211 certification program into this fan rulemaking. (ebm-papst, No. 31 at p. 13)

Rheem commented that having multiple samples can be beneficial (Public Meeting Transcript, No 42 at pp. 85–86)

For fans and blowers other than air circulating fans, DOE is following the recommendation of the Working Group (Docket No. EERE–2013–BT–STD–0006, No. 179, Recommendation #23 at p. 12) and providing the option to test a minimum of one unit, where the tested value must be less than the represented value. If, however, a fan manufacturer chooses to certify compliance of a basic model based on the test result of a single unit, DOE notes that it may consider using a minimum sample size of one unit for enforcement testing, and if a single unit of this fan basic model does not meet the applicable Federal energy conservation standard, the fan basic model will be considered non-compliant. If a manufacturer chooses to certify compliance of a basic model based on the test result of a sample of more than one unit, DOE may consider performing enforcement testing based on a sample of more than one unit. As discussed in section III.K, DOE is not adopting enforcement provisions in this document and will address enforcement provisions in a future energy conservations standards rulemaking.

As stated, the Working Group did not provide recommendations to address a situation in which a manufacturer chooses to increase their test sample size, specifically in terms of the methodology to use when averaging the FEI of two or more duty points, which may not be exactly at the same flow and pressure due to testing variations. To address the situation where a manufacturer may choose to increase the test sample, DOE adds provisions to clarify how to perform the average FEI calculation: for each speed and flow value for which the manufacturer chooses to make a representation, the average FEI is the average of the FEI determined by each test and the duty point is defined as the value of speed, flow, and average of the pressures determined by each test. DOE notes that AMCA 214–22 provides methods to convert performance data from one speed to another speed (*see* Annex G and Annex H of AMCA 214–22 as well as section 7.9.1 of AMCA 210–216), as well as interpolation methods to determine the performance along the fan curve (*i.e.,* at any flow value) at a given speed.[122] Therefore, separate test results can be converted to the same flow and speed. The remaining pressure value would then be averaged to provide the average duty point pressure.

Regarding the use of historical test data, DOE understands that manufacturers of fans and blowers likely have historical test data which were developed with methods consistent with the DOE test procedure being adopted in this final rule. DOE does not expect manufacturers to regenerate all of the historical test data unless the rating resulting from the historical methods, which is based on the same methodology being adopted in this final rule, would no longer be valid.

Regarding the use of AMCA 211–22, DOE develops its own certification, compliance, and enforcement provisions and will consider the provisions in AMCA 211–22 to the extent possible in a separate certification-focused rulemaking.

AHAM commented that deviation from an agreed-upon term sheet diminished the value of participating in ASRAC negotiations and could result in reduced interest in participating in such negotiations in the future. AHAM stated that stakeholders from all perspectives (*e.g.,* manufacturers, efficiency advocates, States, and utilities) and DOE alike see value in that process. AHAM commented that they are a strong supporter of negotiated standards—both through the ASRAC process and through ''private'' negotiations among stakeholders with various points of view. (AHAM, No. 35 at p. 9)

AMCA commented that, DOE always reserves and retains the right to diverge from the ASRAC consensus, but in the interest of encouraging future participation in a process generally acknowledged to be a classic example of good regulatory policy and practice, DOE last-minute divergence in fundamental ways from the ASRAC consensus (especially where that consensus has been used as a guide for the more rapidly developed related regulation in California) will only serve as a disincentive for future parties to participate in ASRAC negotiations. (AMCA No. 41 at p. 3)

DOE notes that the adopted provisions to allow a sample of at least one unit aligns with the term sheet. As noted throughout the notice, DOE aligned with the recommendations of

[122] Sections 7.13.1 and 7.13.2 of AMCA 214–22 state: ''If needed, duty points between laboratory tested points (determinations), are obtained by fitting a cubic polynomial based on the four closest determinations.''

the term sheet except on the metric (FEI vs. FEP), where DOE aligned with the latest industry standard. *See* section III.G.1 of this document. DOE established the ASRAC in an effort to further improve DOE's process of establishing energy efficiency standards for certain appliances and commercial equipment. ASRAC allows DOE to use negotiated rulemaking as a means to engage all interested parties, gather data, and attempt to reach consensus on establishing energy-efficiency standards.

For air circulating fans, DOE did not receive any comments specific to the sampling plan. For air circulating fans, the metric is evaluated at a single operating point (*i.e.,* maximum speed, *See* Section III.G.2 of this document) and each basic model's performance is represented by a single rating. This metric approach is different from the one used for fans blowers other than air circulating fans where the metric is evaluated at each of the fan's operating points within the range of air power and shaft input power in scope (*i.e.,* at each duty point, as specified by the manufacturer within the range of air power and shaft input power in scope; *see* Section III.B.1 of this document) and requires the determination of the FEI at each duty point as specified by the manufacturer, resulting in multiple FEI ratings for the same basic model. For this reason, DOE believe it is appropriate to allow a minimum of one unit for fans and blowers other than air circulating fans, and to require a minimum of two units for air circulating fans. Thus, DOE is requiring a minimum of two units, as proposed in the July 2022 NOPR. As noted, a minimum of two units is consistent with the statistical sampling requirements in place for other commercial and industrial equipment regulated by DOE.[123]

K. Enforcement Provisions

In the July 2022 NOPR, DOE proposed to add specific enforcement testing provisions for fans and blowers at 10 CFR 429.110 and proposed that DOE would use an initial sample size of not more than four units and would determine compliance based on the arithmetic mean of the sample. This is similar to existing enforcement testing provisions for pumps and HVACR equipment. DOE also proposed to add product-specific enforcement provisions for fans and blowers other than air circulating fans to specify that: (1) geometric similarity of two or more fans will be verified by requiring that the manufacturer provides all fan design dimensions as described in Annex K of AMCA 214–21; and (2) DOE will test each fan basic model according to the test method (specified by the manufacturer in any certification report (*i.e.,* based on section 6.1, 6.2, 6.3, or 6.4 of AMCA 214–21). 87 FR 44194, 44243.

DOE did not receive any comments specific to this issue. In this final rule, DOE is not adopting enforcement provisions as proposed in the July 2022 NOPR. At this time, DOE has not established any energy conservation standards for fans and blowers and will consider establishing enforcement provisions as part of any future energy conservation standards rulemaking.

L. Effective and Compliance Dates

The effective date for the adopted test procedure will be 30 days after publication of this final rule in the **Federal Register**. EPCA prescribes that all representations of energy efficiency and energy use, including those made on marketing materials and product labels, for certain equipment, including fans and blowers, must be made in accordance with an amended test procedure, beginning 180 days after publication of the final rule in the **Federal Register**. (42 U.S.C. 6314(d)(1)) EPCA provides an allowance for individual manufacturers to petition DOE for an extension of the 180-day period if the manufacturer may experience undue hardship in meeting the deadline. (42 U.S.C. 6314(d)(2)) To receive such an extension, petitions must be filed with DOE no later than 60 days before the end of the 180-day period and must detail how the manufacturer will experience undue hardship. (*Id.*)

AMCA commented that if DOE's test procedure results in a comprehensive need for industry testing, there would not be sufficient throughput to meet, for example, a 180-calendar-day deadline. In actuality, it would likely take years for industry to retest everything. (AMCA No. 41, at p. 40)

JCI stated that it shares AMCA's comments regarding the 180-day compliance window between rule finalization and the effective date which is not possible for a product sector being regulated for the first time under the proposed NOPR requirements; either the proposed test procedures need to be revised or the time period needs to be extended to 6 years. (JCI, No. 34 at p. 2)

DOE understands that manufacturers of fans and blowers likely have historical test data which were developed with methods consistent with the DOE test procedure being adopted in this final rule. DOE notes that it does not expect manufacturers to regenerate all of the historical test data, unless the rating resulting from the historical methods, which is based on the same methodology being adopted in this final rule, would no longer be valid. EPCA provides a 180-day timeline for all representations regarding energy consumption or the cost of energy consumed by fans and blowers to be made according to the DOE test procedure. (42 U.S.C. 6314(d)(1)) This is a statutory requirement and not a timeline chosen by DOE.

AHRI commented that once the test procedure is finalized, fan manufacturers will have 180 days to comply with the new procedure. AHRI commented that this is an unrealistic timeline. AHRI commented that component fans that were once available for a product's full operating range may no longer be available and OEMs will not have the information about market availability of new component fans until well after the motor has been tested and certified. AHRI added that after assessing the availability on the market, OEMs may have to redesign equipment to accommodate for a different motor size, which could also negatively impact performance and efficiency. AHRI stated that redesign and testing take years to complete, and the information required for this equipment assessment will not be available until after fan manufacturers are actually complying with the test procedure. (AHRI, No. 40 at p. 9) AHRI added detailed descriptions and estimates of the costs to incorporate a redesigned fan into an OEM equipment. (AHRI, No. 40 at pp. 9–10)

As discussed previously, EPCA prescribes that all representations for fans and blowers must be made in accordance with an amended test procedure, beginning 180 days after publication of the final rule in the **Federal Register**. (42 U.S.C. 6314(d)(1)) At this time, DOE is not adopting energy conservation standards for fans and blowers, and the test procedure would not impact the availability of current models. The test procedure does not set any energy conservation standards and does not result in any non-compliant fans.

M. Test Procedure Costs and Impacts

As previously discussed, DOE is establishing a test procedure for fans and blowers at 10 CFR part 431, subpart J and a new appendix A and appendix

[123] The general sampling requirement currently applicable to all covered products and equipment provides that a sample of sufficient size must be randomly selected and tested to ensure compliance and that, unless otherwise specified, a minimum of two units must be tested to certify a basic model as compliant. *See* 10 CFR 429.11.

B. Additionally, DOE is (1) adopting through reference the test methods in AMCA 214–21 and AMCA 230–23, with certain modifications; (2) adopting through reference certain test procedure provisions in AMCA 210–16; and (3) specifying FEP and FEI, based on AMCA 214–21, and CFM/W, based on AMCA 230–23, as the relevant metrics. DOE is also adding section 69 to 10 CFR part 429, which adds fan and blower sampling requirements and provisions related to determining represented values, and is adding paragraph (n) to 10 CFR 429.70, which specifies alternative efficiency determination method requirements. DOE has determined that the test procedure would impact testing costs as discussed in the following paragraphs.

By adopting industry standards, DOE has determined that the test procedure in this final rule would be reasonably designed to produce test results that reflect energy efficiency and energy use of fans and blowers during a representative average use cycle and that would not be unduly burdensome for manufacturers to conduct. In the July 2022 NOPR, DOE presented costs associated with performing testing according to the proposed test procedure at third-party testing facilities (*i.e.,* facilities that are not operated by the manufacturer whose product is being tested). 87 FR 44194, 44243.

In the July 2022 NOPR, DOE assumed that both AMCA and non-AMCA members could test products at the AMCA testing facilities, with non-AMCA member costs being double the cost of AMCA members. 87 FR 44194, 44243. DOE has since learned that it is uncommon for the AMCA testing facility to test non-AMCA member products. In the July 2022 NOPR, DOE had estimated that 40 percent of fan manufacturers are not AMCA members. *Id.*

In the July 2022 NOPR, DOE had expected that manufacturers could have substantial initial capital costs if they established a test laboratory capable of testing to the proposed test procedure; however, DOE had anticipated that the cost to perform a test would be less for in-house testing than for third-party testing. *Id.* In other words, DOE had expected that over the lifetime of a new test laboratory, the initial capital costs would be less than the total cost of third-party testing.

In the July 2022 NOPR, DOE provided estimated costs for testing fans at third-party laboratories; however, based on stakeholder comments, DOE anticipates that the cost to perform a test would be less for in-house testing than for third-party testing. *Id.* DOE requested feedback on its assumption that it would cost an average of $4,200 to test one fan for both general fans and air circulating fans. DOE also requested feedback on the method described for estimating manufacturer per-model testing costs of general fans and air circulating fans. Additionally, DOE requested feedback and data on the total testing costs per basic model for testing at third-party facilities and on third-party laboratory testing costs (other than AMCA). *Id.*

AMCA commented that testing for air circulating fans per AMCA 230 would cost $1,420 per fan with an added cost of $350 per fan speed. (AMCA, No. 41 at p. 35) Additionally, AMCA provided an estimated cost of $6,300 to test a general fan. (AMCA, No. 41 at p. 40) New York Blower commented that the third-party testing costs were reasonable. (New York Blower, No. 33 at p. 22). AMCA, New York Blower, and Morrison commented that DOE did not consider the cost to ship fans to third-party facilities in its estimated test costs. (AMCA, No. 41 at p. 40; New York Blower, No. 33 at p. 22; Morrison, No. 42 at p. 12).

AMCA also commented that BESS Labs traditionally tests circulating fans; however, AMCA's policy is not to report on other organizations' pricing, so it did not provide details on BESS Labs and its testing programs. (AMCA, No. 41 at p. 40). JCI commented that there are limited laboratory facilities available for testing. (JCI, No. 34 at p. 1) DOE recognizes that third-party testing is currently not widely available and is not aware of any third-party testing facilities that can accommodate both general fans and air circulating fans aside from AMCA's testing facilities; therefore, DOE has updated its cost estimates to recognize that some fan manufacturers may need to build a test lab to test and certify fans according to the DOE test procedure.

Based on DOE's additional evaluation, and from stakeholder comments, in this final rule, DOE presents costs for building an in-house test facility to obtain representative efficiency values for fans and blowers according to the test procedure. As such, DOE has assumed that the in-house facilities would be connected to or within reasonable distance to the manufacturer production facility to eliminate the need to ship fans to the test lab. DOE has worked to minimize testing burden while maintaining the rigor of the test procedure is this final rule by: (1) requiring a minimal certification sample size of one unit per basic model, reduced from a minimum of two proposed in the July 2022 NOPR (87 FR 44194, 44243); (2) requirements for testing with appurtenances is now consistent with AMCA 210–16 and AMCA 230–23, which allows manufacturers to use historical data; (3) clarifying the definition of a basic model that was proposed in the July 2022 NOPR (87 FR 44194, 44213); and (4) allowing the use of AEDMs in lieu of testing. DOE addresses cumulative costs and burden and discusses its estimated test costs in detail in the following sections. Ultimately, DOE has determined that the costs to conduct the test procedure in this final rule do not outweigh the benefits and that the text procedure is not unduly burdensome for manufacturers to conduct.

1. Cumulative Costs and Burden

In response to the July 2022 NOPR, stakeholders commented that cumulative testing costs and burden would be significant based on the proposed test procedure.

Morrison commented that they estimate testing to take from 3 to 5 years and would require expanding lab operation and personnel. (Morrison, No. 42 at p. 12) Morrison additionally stated that they would need to test each of their thousands of basic models two times. *Id.* Additionally, Morrison stated that by dedicating more time to testing, they would not be able to dedicate as much time to customer development or research and design. *Id.* AMCA commented that it would take longer than 180 days, and most likely years, for the industry to retest all fans, either at a third-party lab or at an in-house laboratory. (AMCA, No. 41 at pp. 40–41) AMCA also stated that the amount of time required to test fans is dependent on the number of basic models. *Id.* JCI stated that they expect the cumulative test cost to be in the tens of millions of dollars and to take 6 years to complete. (JCI, No. 34 at p.1) AHRI commented that it would likely take fan manufacturers longer than 180 days after the test procedure is finalized to begin certifying fans. (AHRI, No. 40 at pp. 9–11) New York Blower commented that the cumulative testing burden would be significant when the number of basic models, samples, and appurtenances are considered. (New York Blower, No. 33 at p. 4)

New York Blower additionally commented that the proposed test procedure would not allow manufacturers to use historical test data and that manufacturers need to use historical test data to comply with standards in time. (New York Blower, No. 33 at p. 4)

DOE understands the comments from stakeholders to be in response to DOE's proposal in the July 2022 NOPR to require a minimum of two samples to rate a basic model. 87 FR 44194, 44243. Additionally, DOE recognizes that the concerns over test costs and burden may be in response to DOE's proposals for testing with appurtenances (87 FR 44194, 44226), testing air circulating fans at multiple speeds (87 FR 44194, 44227), and DOE's consideration of a WFEI metric for fans and blowers that are not air circulating fans (87 FR 44194, 44237–44238) in the July 2022 NOPR.

In response to stakeholder concerns regarding cumulative test costs and burden, DOE is providing the option to test a minimum of one unit, rather than two units, for rating and certification (see Section III.J). As discussed in section III.E.12, DOE is aligning the provisions for testing with appurtenances with industry test standards AMCA 214–21 and AMCA 230–23. Finally, DOE is requiring that air circulating fans be tested at a single speed, as discussed in section III.E.14 of this document. As a result, DOE expects that manufacturers may use historical test results and the cumulative test cost and the time required to test products will be substantially decreased.

Furthermore, DOE notes that the deadline for manufacturers to comply with the test procedure 180 days after it is published is for voluntary representations, which is further discussed in section III.L of this document. If DOE were to set standards for general fans and air circulating fans, certification based on the sampling plan discussed in section III.J would be required on the compliance date of the standard, which could be between 3 and 5 years after the publication date of the energy conservation standards final rule.

JCI commented that the cost of testing was underestimated and that DOE did not consider the cost of building prototypes for test. (JCI, No. 34 at p. 1) Robinson stated that DOE did not consider the cost of building a custom fan in duplicate to test (Robinson, No. 43 at p. 12). The test procedure that DOE is adopting is non-destructive, meaning that test does not alter the operation and performance of the fan; therefore, DOE does not see a reason for that a prototype or duplicate fan needs to be produced solely for testing DOE is not including the cost of the fan in its updated test procedure cost estimates.

2. Estimated Costs for Building and Testing of Fans and Blowers Other Than Air Circulating Fans at an In-House Facility

a. Capital Costs

In the maximum-burden case where a fan manufacturer would be required to construct a test lab from scratch, manufacturers would be required to make capital outlays to acquire or build a testing facility and purchase test equipment. DOE has estimated costs for fans based on the AMCA 210–16 industry standard that DOE is referencing in this final test procedure. DOE estimated minimum and maximum costs, then used these two values to determine an average cost.

To estimate the costs to build an in-house testing facility, DOE assumed a single-story building built in the U.S. using 2022 costs. DOE estimated test facility square footage by using information from manufacturers and by evaluating outlet duct setups in AMCA 210–16, with length and width buffers applied. DOE estimated an average floor area of 3,450 square feet.[124] Using this average square footage value, DOE estimated a one-time building cost for warehouse and storage to be $321,000.[125]

DOE has identified that the test structure to test in accordance with AMCA 210–16 would consist of a traverse pitot duct and a main chamber. DOE has estimated that the average one-time cost for the traverse pitot duct and the main chamber would be $1,800.

The test procedure for fans and blowers other than air circulating fans, which aligns with AMCA 210–16, requires pressure, flow, power, and air density to be measured or calculated by equipment with specific calibrations and accuracies. The cost of this test equipment is considered as a one-time cost. The pressure measurement requires a manometer and a pitot-static tube. DOE has estimated the average cost of a manometer to be $590 and the average cost of a pitot-static tube to be $290. Flow can also be measured with the pitot-static tube. According to AMCA 210–16, power can be determined indirectly or directly. The indirect determination of power requires force or torque measurements by either a reaction dynamometer or torque meter, respectively, and power is calculated using equations in AMCA 210–16. The direct measurement of power requires either a calibrated motor or an electric meter. DOE has assumed that a testing facility would have all equipment necessary to determine power either directly or indirectly (*i.e.,* a reaction dynamometer, torque meter, calibrated motor and electric meter) to provide testing flexibility. This assumption is also the most conservative. DOE has estimated the average costs of a reaction dynamometer to be $5,700, a torque meter to be $1,600, a calibrated motor to be $1,700, and an electric meter to be $9,700. The air density is calculated using measurements of air temperature with a thermometer and pressure with a barometer. DOE has estimated the average costs of a thermometer to be $600 and a barometer to be $330. In sum, DOE has estimated that the cost to acquire all of the necessary test equipment to perform the general fans test procedure is, on average, $20,500.

In total, DOE has estimated the average capital cost of building an in-house testing facility for fans as $343,300. DOE notes that some fan manufacturers have indicated they already have existing facilities and equipment to test general fans according to AMCA 210–16, which DOE references in this final test procedure.

b. Annual Costs

DOE has estimated annual costs for operating a testing facility, which include utilities and equipment calibration. DOE has estimated that the annual utilities costs would be $8,000,[126] based on the average floor area discussed in the previous section. Equipment would need to be calibrated

[124] DOE used the AMCA 2012 general fans database to estimate the maximum diameter of a general fan. DOE then used the maximum diameter to determine the floor area necessary to build a main chamber and ductwork in accordance with the test set-ups in AMCA 210–16 with a buffer of 5 times the estimated area. DOE calculated the average floor area to be 6,500 square feet, which DOE then used as the maximum square footage value. DOE used 400 square feet as the minimum floor area, which DOE determined from communication with manufacturers. DOE calculated the average of these two values to estimate an average floor area of 3,450 square feet ((6,500 + 400) ÷ 2 = 3,450).

[125] DOE estimated the building cost for warehouse and storage based on the RSMeans Facilities Construction Cost Data (2011). DOE then used the Federal Reserve Economic Data's ''Producer Price Index by Industry: Fan, Blower, Air Purification Equipment Manufacturing'' to account for inflation to 2022 prices. (*https://fred.stlouisfed.org/series/PCU333413333413*)

[126] DOE estimated the commercial utility costs to be $0.1122/kWh using data from EIA's ''2021 Average Monthly Bill'' and commercial utility use to be 20.70 kWh/square foot using EIA's ''2018 Commercial Buildings Energy Consumption Survey'' (*www.eia.gov/electricity/sales_revenue_price/pdf/table5_b.pdf; https://www.eia.gov/consumption/commercial/data/2018/pdf/CBECS%202018%20CE%20Release%202%20Flipbook.pdf*). DOE then calculated total average commercial utility costs to be $8,000 ($0.1122/kWh × 20.70 kWh/square foot × 3,450 square feet = $8,013).

each year, which DOE has estimated to be $21,500 [127] based on 2016 calibration price lists from the National Institute of Standards and Technology (''NIST'').

In total, DOE has estimated the annual cost of operating an in-house testing facility for general fans as approximately $29,500.

c. Testing Costs

This final rule includes requirements regarding the sampling plan and representations for covered fans at subpart B of 10 CFR part 429. The sampling plan requirements require a minimum sample size of one unit per general fan basic model be tested when determining representative values of FEI, as well as other fan performance metrics.

Fan test costs include the cost of labor to set-up, test, and disassemble the fan. DOE estimated that it would take an average of 4 hours to set-up and disassemble a general fan and 2 hours to test a general fan, resulting in a total of 6 hours of labor per test. DOE has also assumed that a mechanical engineering technician would set-up and perform the testing. Based on wage and salary data from the Bureau of Labor Statistics (''BLS''), DOE has estimated a fully burdened hourly mechanical engineering technician wage of $43.[128] DOE has calculated the total cost of labor for testing a general fan to be approximately $260 per basic model, assuming one fan is tested per basic model.

d. AEDM Costs

As previously discussed, an AEDM is a mathematical model developed by a manufacturer that estimates the energy efficiency or energy consumption characteristics of a basic model as measured by the applicable DOE test procedure. Before using an AEDM, a fan manufacturer must validate the AEDM's accuracy and reliability by physically testing two basic models and comparing the test results to the output of the AEDM (see discussion in III.I.3 of this document).

In the July 2022 NOPR, DOE assumed a mechanical engineer would develop and validate a new AEDM. 87 FR 44194, 44243. DOE estimated that it would take 24 labor hours per validation class for an engineer to develop and validate an AEDM using existing simulation tools. *Id.* 87 FR at 44243–44244. DOE assumed a mechanical technician would implement an AEDM once it is developed. *Id.* DOE estimated that it would take a mechanical technician 1 hour to determine the representative values necessary to certify a basic model using an AEDM. *Id.*

In response to the July 2022 NOPR, several stakeholders commented that DOE underestimated the time it would take to develop an AEDM and to develop certified ratings from that AEDM. AMCA provided a list of steps required to validate an AEDM and estimated that it would take 56 working hours to develop an AEDM and 24 working hours to develop certified ratings. (AMCA, No. 41 at . 42) New York Blower commented that it would take between 100 and 200 working hours to develop an AEDM and 3 hours to develop certified ratings because using computational fluid dynamics to estimate fan performance is complex. (New York Blower, No. 33 at p. 23) Robinson suggested that it would take on the order of several days to weeks to develop an AEDM (Robinson, No. 43 at p. 12) Morrison commented that it would take at least 80 working hours to develop an AEDM. (Morrison, No. 42 at p. 13) Additionally, the same stakeholders commented that the development of certified ratings from an AEDM would need to be done by a mechanical engineer, not a mechanical technician. (AMCA, No. 41 at . 42; New York Blower, No. 33 at p. 23; Robinson, No. 43 at p. 12; Morrison, No. 42 at p. 12)

After considering stakeholder comments, DOE has updated the costs to develop, validate, and implement an AEDM. DOE used the values provided in stakeholder comments to estimate the labor hours required to develop, validate, and implement an AEDM. Additionally, DOE has updated its estimates to reflect stakeholder comments that a mechanical engineer would be required to complete all stages of the AEDM.

For this final rule, DOE assumes a mechanical engineer would develop, validate, and implement a new AEDM. Based on wage and salary data from the BLS, DOE estimated the fully burdened hourly mechanical engineering wage to be approximately $66.[129] Considering the values provided in stakeholder comments, DOE estimates an average of 128 labor hours per validation class for an engineer to develop and validate an AEDM for general fans using existing simulation tools. Therefore, DOE estimates the cost of a fully burdened mechanical engineer as approximately $8,500 per validation class. As discussed in section III.J.1, testing of two basic models is required to validate an AEDM for a specific validation class while one unit must be tested per basic model in order to validate an AEDM. Therefore, two physical tests on two different basic models are required for validation of a AEDM for general fans. As discussed previously, DOE estimates the labor cost per test to be $260. Therefore, the total estimated manufacturer labor cost to develop and validate an AEDM for a single validation class is estimated to be $9,020 which is the cost to perform one test on two basic models ($520) plus the fully burdened cost of a mechanical engineer's time to develop and validate the AEDM ($8,500).

DOE also assumes a mechanical engineer will implement an AEDM once it is developed. Using the values provided in stakeholder comments, DOE estimates that it would take a mechanical engineer an average of 14 labor hours to determine the representative values necessary to certify a basic model using an AEDM. Therefore, the estimated cost to implement an AEDM to develop certified ratings is $950 per basic model.

In response to the July 2022 NOPR, AMCA and Robinson commented that not all manufacturers have the simulation tools necessary to validate and implement an AEDM. (AMCA, No. 41 at . 42; Robinson, No. 43 at pp. 11–12) DOE acknowledges that computational fluid dynamics (''CFD'') software is necessary to validate and implement an AEDM for fans and blowers and has concluded that the cost to purchase the software should be included as an AEDM one-time cost.

[127] DOE estimated the NIST calibration fee from *www.nist.gov/system/files/documents/2016/10/31/FeeSchedule-2016.pdf.* However, this catalog does not list calibration prices for the following equipment: manometer, pitot-static tube, and barometer; therefore, DOE used similar thermodynamic and mechanical type instruments that measure velocity of airflow and pressure from NIST.

[128] DOE estimated the hourly wage using data from BLS's ''Occupational Employment and Wages, May 2021'' publication. DOE used the ''Mechanical Engineering Technologies and Technicians'' mean hourly wage of $30.47 to estimate the hourly wage rate (*www.bls.gov/oes/current/oes173027.htm*). Last accessed on April 3, 2023. DOE then used BLS's ''Employer Costs for Employee Compensation—December 2022'' to estimate that wages and salary account for approximately 70.5 of employer labor costs for private industry workers. (*www.bls.gov/news.release/pdf/ecec.pdf*). Last accessed on April 3, 2023. Therefore, DOE estimated a fully-burdened labor rate of $43 ($30.47 ÷ 0.705 = $43.21).

[129] DOE estimated the hourly wage using data from BLS's ''Occupational Employment and Wages, May 2021'' publication. DOE used the ''Mechanical Engineers'' mean hourly wage of $46.64 to estimate the hourly wage rate (*www.bls.gov/oes/current/oes172141.htm*). Last accessed on April 3, 2023. DOE then used BLS's ''Employer Costs for Employee Compensation—December 2022'' to estimate that wages and salary account for approximately 70.5 percent of employer labor costs for private industry workers. (*www.bls.gov/news.release/pdf/ecec.pdf*). Last accessed on April 3, 2023. Therefore, DOE estimated a fully-burdened labor rate of $66 ($46.64 ÷ 0.705 = $66.16).

Robinson estimated that the investment in hardware and software would be on the order of $125,000. (Robinson, No. 43 at p. 11)DOE reviewed CFD prices online and found a CFD free of cost,[130] so used $0 as its minimum CFD cost and the estimate from Robinson as the maximum cost for CFD software. DOE averaged these two values to determine an average CFD software cost of $62,500. DOE estimated the cost of a workstation with the necessary system requirements to run CFD software to be $3,000, with a minimum of $1,000 and a maximum of $5,000; however, DOE notes that many CFD software packages are cloud-and license-based. DOE has estimated the average cost of CFD software and compatible hardware to be $65,500 (62,500 + 3,000 = 65,500).

3. Estimated Costs for Building and Testing Air Circulating Fans at an In-House Facility

In response to the July 2022 NOPR, DOE only received comment from AMCA containing cost estimates for testing air circulating fans at a third-party laboratory. To estimate the costs for testing air circulating fans, DOE used the comment received, its own testing experience with these fans, information provided by manufacturers during interviews, and in some cases made assumptions relative to the values estimated for general fans.

a. Capital Costs

In the maximum-burden case where ACF manufacturers would have to construct a test lab from scratch, manufacturers would be required to make capital outlays to acquire or construct a test facility and purchase test equipment. DOE has estimated its test costs for ACFs based on the AMCA 230–23 industry standard that DOE is referencing in this final rule. DOE estimated a minimum and maximum costs, then used these two values to determine an average cost.

To estimate building costs of an in-house testing facility, DOE assumed a single-story building in the U.S. using 2022 costs. DOE estimated test facility square footage by using information from manufacturers and by evaluating standard setups in AMCA 230–23, with length and width buffers applied. DOE estimated an average floor area 315 square feet.[131] Using this average square footage value, DOE has estimated one-time building cost for warehouse and storage to be $29,300.

DOE has identified that the test structure to test in accordance with AMCA 230–23 would consist of a lever arm and a test station. DOE has estimated that the average one-time cost for the lever arm and the test station would be $400.

The test procedure for ACFs, which aligns with AMCA 230–23, requires thrust, power, and air density to be measured or calculated by equipment with specific calibrations and accuracies. The cost of this test equipment is considered as a one-time cost. According to the test procedure, thrust can be measured with a load cell or standard weights. DOE has assumed that a testing facility should be equipped with both equipment types to accommodate various testing configurations and to take a conservative approach. DOE has estimated the cost of a load cell to be $1,500 and a set of standard weights to be $1,300. The power measurement is taken directly from an electric meter, which DOE has estimated to cost $9,700. The air density is calculated using measurements of air temperature with a thermometer and pressure with a barometer. DOE has estimated the costs of a thermometer to be $600 and a barometer to be $330. In sum, DOE has estimated that the cost to acquire all the necessary test equipment to perform the ACF test procedure is, on average, $13,430.

In total, DOE has estimated the capital cost of building an in-house testing facility for ACFs, on average, as $43,130. DOE notes that some fan manufacturers have indicated they already have existing facilities and equipment to test ACFs according to AMCA 230–23, which DOE references in this final test procedure.

b. Annual Costs

DOE has estimated annual costs for operating a testing facility, which include utilities and equipment calibration. DOE has estimated that the annual utilities costs would be $730,[132] based on the average floor area discussed in the previous section. Equipment would need to be calibrated each year, which DOE has estimated to be $16,600 based on 2016 calibration price lists from NIST.[133]

In total, DOE has estimated the annual cost of operating an in-house testing facility for ACFs as approximately $17,330.

c. Testing Costs

This final rule includes requirements regarding the sampling plan and representations for covered air circulating fans at subpart B of 10 CFR part 429. The sampling plan requires a minimum sample size of one unit per ACF basic model be tested when determining representative values of CFM/W, as well as other general fan performance metrics. Test costs include the cost of labor to set-up, test, and disassemble the fan. DOE estimated that it would take an average of 4 hours to set-up and disassemble a fan and 2 hours to test a fan, resulting in a total of 6 hours of labor per test. DOE has also assumed that a mechanical engineering technician would set-up and perform the testing. Based on wage and salary data from the BLS, DOE has estimated a fully burdened mechanical engineering technician wage of $44 per hour.[134] DOE has calculated the total cost of labor for testing an ACF to be approximately $260 per basic model.

d. AEDM Costs

As discussed previously in section III.M.2.d of this document, DOE assumes that a mechanical engineer would develop, validate, and implement a new AEDM. Based on wage and salary data from the BLS, DOE estimated the fully burdened mechanical engineering wage to be approximately $66 per

[130] *openfoam.org/*

[131] DOE used its air circulating fan database to estimate the average and maximum diameter of an ACF to be 40 inches and 61 inches, respectively. DOE then used these diameters to determine the floor area necessary to build a test structure for each fan in accordance with the test set-ups in AMCA 230–23 with a buffer of 1.2. DOE calculated the average floor area to be 180 square feet and the maximum floor area to be 430 square feet. DOE then took the average of these two values to estimate that the average floor area would be 315 square feet ((180 + 430) ÷ 2 = 315).

[132] DOE estimated the commercial utility costs to be $0.11/kWh using data from EIA's ''2021 Average Monthly Bill'' and commercial utility use to be 20.70 kWh/square foot using EIA's ''2018 Commercial Buildings Energy Consumption Survey'' (*www.eia.gov/electricity/sales_revenue_price/pdf/table5_b.pdf; www.eia.gov/consumption/commercial/data/2018/ppt/CBECS%202018%20C&E%20Flipbook.ppt*). DOE then calculated total average commercial utility costs to be $730 ($0.1122/kWh × 20.70 kWh/square foot × 315 square feet = $731).

[133] DOE estimated the NIST calibration fee from *www.nist.gov/system/files/documents/2016/10/31/FeeSchedule-2016.pdf*. However, this catalog does not list calibration prices for barometers; therefore, DOE used pricing for similar thermodynamic instruments.

[134] DOE estimated the hourly wage using data from BLS's ''Occupational Employment and Wages, May 2021'' publication. DOE used the ''Mechanical Engineering Technologies and Technicians'' mean hourly wage of $30.47 to estimate the hourly wage rate (*www.bls.gov/oes/current/oes173027.htm*). Last accessed on April 3, 2023. DOE then used BLS's ''Employer Costs for Employee Compensation—December 2022'' to estimate that wages and salary account for approximately 70.5 percent of employer labor costs for private industry workers. (*www.bls.gov/news.release/pdf/ecec.pdf*). Last accessed on April 3, 2023. Therefore, DOE estimated a fully-burdened labor rate of $43 ($30.47 ÷ 0.705 = $43.21).

hour.[135] Since product lines for air circulating fans are less complex than those for general fans, DOE also estimates that it would take roughly half the time to develop an AEDM for ACFs than it would to develop an AEDM for general fans; therefore, DOE assumed 62 labor hours per validation class for an engineer to develop and validate an AEDM for ACFs fans using existing simulation tools. Therefore, DOE estimates the cost of a fully burdened mechanical engineer as approximately $4,100 per validation class. As discussed in section III.I.1, testing of two basic models is required to validate an AEDM for a specific validation class. One unit must be tested per basic model in order to validate an AEDM. Therefore, two physical tests on two different basic models are required for validation of an ACF AEDM. As discussed in the previous section, DOE estimates the labor cost per test to be $260. Therefore, the total estimated manufacturer labor cost to develop and validate an AEDM for a single validation class is estimated to be $4,620, which is the cost to perform one test on two basic models ($520) plus the fully burdened cost of a mechanical engineer's time to develop and validate the AEDM ($4,100).

DOE also assumes a mechanical engineer would implement an AEDM once it is developed. DOE estimates that it would take a mechanical engineer 7 labor hours to determine the representative values necessary to certify a basic model using an AEDM. Therefore, the estimated cost to implement an AEDM to develop certified ratings for ACFs is $460 per basic model.

Additionally, DOE acknowledges that computational fluid dynamics software is necessary to validate and implement an AEDM and has concluded that the cost to purchase the software should be included as a one-time cost to use AEDMs. Software and hardware requirements and estimated cost are expected to be similar to that estimated for general fans (*i.e.,* $63,000).

[135] DOE estimated the hourly wage using data from BLS's ''Occupational Employment and Wages, May 2021'' publication. DOE used the ''Mechanical Engineers'' mean hourly wage of $46.64 to estimate the hourly wage rate (*www.bls.gov/oes/current/oes172141.htm*). DOE then used BLS's ''Employer Costs for Employee Compensation—June 2022'' to estimate that wages and salary account for approximately 70.5 percent of employer labor costs for private industry workers. (*www.bls.gov/news.release/pdf/ecec.pdf*). Last accessed on April 3, 2023. Therefore, DOE estimated a fully-burdened labor rate of $66 ($46.64 ÷ 0.705 = $66.16).

e. Voluntary Representations

Manufacturers of fans included within the scope of the test procedure adopted in this final rule would not be required to test fans and blowers in accordance with the DOE test procedure until the compliance date of a final rule adopting new energy conservation standards for fans and blowers. If manufacturers are currently reporting FEI for fans and blowers that are not air circulating fans or CFM/W for air circulating fans, they would need to ensure that the product is tested using the DOE test procedure and any representations in their marketing materials disclose the results of such test.[136] Although DOE is not requiring manufacturers to report FEI for fans and blowers that are not air circulating fans or CFM/W for air circulating fans prior to the compliance date of any new efficiency standards, DOE is assuming that manufactures may incur additional costs to remove or add FEI or CFM/W to their marketing materials to effect voluntary representations prior to the compliance date and independent of any new efficiency standards.

DOE anticipates that manufacturers currently making voluntary representations would update their online selection software, online catalogs, and product labels to remove or update efficiency representations in accordance with the DOE test procedure. DOE assumes that manufacturers would only need to update future print marketing materials, rather than create new materials as a result of the test procedure. DOE estimates that this effort would consist of no more than an hour of time for a graphic designer, along with two hours of time for a web developer, and one hour for a mechanical engineering technician—for a cost of approximately $195.01—per manufacturer.[137] If manufacturers decide to voluntarily test their products to provide an updated representation, manufacturers would incur the previously estimated testing costs along with this marketing materials related cost.

[136] If manufacturers voluntarily make representations regarding the FEI of fans and blowers that are not air circulating fans or CFM/W of air circulating fans, they would be required to test according to the DOE test procedure. *See* 42 U.S.C 6314(d)(1)

[137] Graphic designer salary of $28.83 per hour, web developer salary of $39.09 per hour, and mechanical technician salary of $29.07 per hour. Wages account for 70.5 percent of employer labor costs. DOE estimated the hourly wage using data from BLS's ''Occupational Employment and Wages, May 2021'' publication for each occupation (*www.bls.gov/oes/current/oes172141.htm*). Last accessed on April 3, 2023. DOE then used BLS's ''Employer Costs for Employee Compensation—December 2022'' to estimate that wages and salary account for approximately 70.5 percent of employer labor costs for private industry workers. (*www.bls.gov/news.release/pdf/ecec.pdf*). Last accessed on April 3, 2023. ($28.83 + $39.09 * 2 + $30.47)/0.705 = $195.01.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Executive Order (''E.O.'')12866, ''Regulatory Planning and Review,'' as supplemented and reaffirmed by E.O. 13563, ''Improving Regulation and Regulatory Review, 76 FR 3821 (Jan. 21, 2011) and E.O. 14094, ''Modernizing Regulatory Review,'' 88 FR 21879 (April 11, 2023), requires agencies, to the extent permitted by law, to (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs (''OIRA'') in the Office of Management and Budget (''OMB'') has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, this final regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit ''significant regulatory actions'' to OIRA for review. OIRA has determined that this final regulatory action does not constitute a ''significant regulatory action'' under section 3(f) of E.O. 12866. Accordingly, this action was not submitted to OIRA for review under E.O. 12866.

B. Review Under the Regulatory Flexibility Act

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

DOE has determined that the only non-voluntary costs imposed by this test procedure would be changes to marketing materials for companies currently making efficiency representations—constituting $195.01 per manufacturer as estimated previously. This cost is not expected to differ between small and large manufacturers. The testing costs estimated previously would either be imposed following possible new energy conservation standards on covered fans and blowers or voluntarily undertaken by manufacturers. As such, DOE has concluded that there would not be significant economic impact on small entities as a result of this test procedure. Still, although such is not currently required, DOE has recently conducted a focused inquiry into small business manufacturers of the fans and blowers covered by this rulemaking in relation to the test procedure related costs that would be imposed as a result of possible future energy conservation standards.

DOE used the Small Business Administration (SBA) size standards to determine whether any small entities would be subject to the requirements of the proposed rule. The small business size standards are listed by North American Industry Classification System (''NAICS'') code as well as by industry description and are available at *www.sba.gov/document/support--table-size-standards.* Manufacturing commercial and industrial fans and blowers is classified under NAICS 333413, ''Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing.'' The SBA sets a threshold of 500 employees or fewer for an entity to be considered as a small business for this category. DOE used a combination of publicly available information and a private stakeholder database to create a list of potential manufacturers. DOE additionally referenced manufacturer lists for similar products derived from Compliance Certification Database.[138] Once DOE created a list of potential manufacturers, DOE used market research tools to determine whether any met the SBA's definition of a small entity, based on the total number of employees for each company including parent, subsidiary, and sister entities.

Based on DOE's analysis, over 200 companies potentially selling commercial and industrial fans and blowers covered by this proposed test procedure were identified. DOE screened out companies that do not meet the small entity definition and additionally screened out companies that are largely or entirely foreign owned and operated. Of the identified companies, 51 were further identified as a potential small business manufacturing commercial and industrial fans and blowers. Through a review of each business' respective website DOE established that 20 of the 51 businesses were distinct OEMs directly producing covered equipment. Below is a discussion of the various potential testing costs associated with these small manufacturers and potential future energy conservation standards for fans and blowers.

1. Creation of Testing Facility—General Fans

DOE does not expect costs for a test facility to differ between large and small businesses. As outlined in section III.M of this document, DOE estimated the capital investment for a new general fan testing facility and equipment to be $343,300 along with approximately $8,000 in yearly utility costs and $21,500 in yearly calibration costs.

2. AEDM Creation and Testing Costs—General Fans

DOE likewise does not expect that general fan per model in-house testing costs or AEDM creation costs would differ between large and small manufacturers. As outlined in section III.M, DOE estimated the average total labor cost of testing a covered general fan to be $260 per model (Which will need to be done for two basic models per validation class) and approximately $8,700 to develop the AEDM for a validation class—for a total of $9,220.

Due to the lack of a model database and the large number of potential small businesses, DOE reviewed the websites and, where available, the product catalogs of each of the small businesses manufacturers. While detailed product information was not availiable for three of the sampled small businesses, DOE identified, maximally, 2,709 models of commercial and industrial fans and blowers that are covered by the proposed test procedure across the remaining 17 small businesses. The number of models identified ranged from 7 to 636 across the applicable manufacturers, for an average of 159 and a median of 40 models per manufacturer. Across all 20 small business manufacuters, DOE estimates that 65 AEDMs would be required—with manufacturers offering between one and six of the general fans categories covered by this rulemaking, for a median value of two. Accordingly, DOE has estimated that total unit testing and AEDM creation costs would be $599,300 for all small businesses.

3. Creation of Testing Facility—Air Circulating Fans

DOE does not expect costs for a test facility for air circulating fans to differ between large and small businesses. As outlined in section III.M of this document, DOE estimated the capital investment for a new air circulating fans testing facility and equipment to be $43,130 on average, along with approximately $730 in yearly utility costs and $16,660 in yearly calibration costs.

4. AEDM Creation and Testing Costs—Air Circulating Fans

DOE likewise does not expect that air circulating fans per model in-house testing costs or AEDM creation costs would differ between large and small manufacturers. As outlined in section III.M of this document, DOE estimated the average total labor cost of testing a covered general fan to be $260 per model (Which will need to be done for two basic models per validation class) and approximately $4,100 to develop the AEDM for a validation class—for a total of $4,620.

Out of the 20 small business manufacturers identified, four produce

[138] U.S. Department of Energy Compliance Certification Database, available at *www.regulations.doe.gov/certification-data/products.html.*

covered air circulating fans in addition to general fans. The number of models offered range from four to 30 and each of these small businesses only offers one validation category of air circulating fan. Accordingly, all four small businesses would incur an aggregate additional $18,480 in testing and AEDM creation costs.

5. Total Costs

Total potential costs to the identified small businesses would be approximately $7,244,000 and the average cost would be approximately $381,260. 16 of the small businesses would also incur an average of $8,000 in yearly utility costs and $21,500 in yearly calibration costs and four of small businesses would incur around $8,730 in yearly utility costs and $38,160 in yearly calibration costs. DOE was able to find annual revenue estimates for 19 of the small businesses. Estimated one-time testing costs as a pecentage of estimated annual revenue range widely—from less than one 0.4 percent to 44.6 percent—for an average of approximately 7.7 percent. Additionally, Manufacturers would not be required to test their products according to the DOE test procedure unless and until possible new energy conservation standards are established. Manufacturers would need to test their products according to the DOE test procedure if they wish to make representations about efficiency in their marketing material—as mentioned previously, updating marketing materials is expected to cost $195.01.

6. Certification Statement

As noted previously, almost no non-voluntary costs are anticipated as a result of this rulemaking—since testing would not be required unless and until new energy conservation standards are established for covered fans and blowers. Based on the de minimis cost impacts, DOE certifies that this final rule does not have a ''significant economic impact on a substantial number of small entities,'' and determined that the preparation of a FRFA is not warranted. DOE will transmit a certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the Small Business Administration for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

Although no energy conservation standards have been established for fans and blowers as of the publication of this final rule, manufacturers of fans and blowers would need to certify to DOE that their products comply with any potential future applicable energy conservation standards. To certify compliance, manufacturers must first obtain test data for their equipment according to the DOE test procedures, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including fans and blowers. (*See* generally 10 CFR part 429.) The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (''PRA''). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 35 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.

Certification data will be required for fans and blowers; however, DOE is not establishing certification or reporting requirements for fans and blowers in this final rule. Instead, DOE may consider proposals to establish certification requirements and reporting for fans and blowers under a separate rulemaking regarding appliance and equipment certification. DOE will address changes to OMB Control Number 1910–1400 at that time, as necessary.

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

D. Review Under the National Environmental Policy Act of 1969

In this final rule, DOE establishes test procedure amendments that it expects will be used to develop and implement future energy conservation standards for fans and blowers. 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, DOE has determined that adopting test procedures for measuring energy efficiency of consumer products and industrial equipment is consistent with activities identified in 10 CFR part 1021, appendix A to subpart D, A5 and A6. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

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

F. Review Under Executive Order 12988

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

G. Review Under the Unfunded Mandates Reform Act of 1995

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

H. Review Under 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 final rule will not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

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

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

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). Pursuant to OMB Memorandum M–19–15, Improving Implementation of the Information Quality Act (April 24, 2019), DOE published updated guidelines which are available at *www.energy.gov/sites/prod/files/2019/12/f70/DOE%20Final%20Updated%20IQA%20Guidelines%20Dec%202019.pdf.* DOE has reviewed this final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

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

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

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

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

The modifications to the test procedure for fans and blowers adopted in this final rule incorporates testing methods contained in certain sections of the following commercial standards: AMCA 214–21, AMCA 210–16, AMCA 230–23, AMCA 240–15, ISO 5801:2017, ISO 80079–36:2016, and UL 705. DOE has evaluated these standards and is unable to conclude whether it fully complies with the requirements of section 32(b) of the FEAA (*i.e.,* whether it was developed in a manner that fully provides for public participation, comment, and review.) DOE has consulted with both the Attorney General and the Chairman of the FTC about the impact on competition of using the methods contained in these standards and has received no comments objecting to their use.

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule before its effective date. The report will state that it has been determined that the rule is not a ''major rule'' as defined by 5 U.S.C. 804(2).

N. Description of Materials Incorporated by Reference

In this final rule, DOE incorporates by reference the following test standards:

AMCA 214–21 is an industry-accepted test procedure that provides methods to determine fan electrical shaft power and/or electrical power, flow, and pressure and calculate the fan energy index (FEI) and is applicable to product sold in North America. AMCA 214–21 specifies testing conducted in accordance with other industry-accepted test procedures (also proposed for incorporation by reference). The test procedure established by this final rule references various sections of AMCA 214–21 that address test setup, test conduct, and calculation of the FEI for fans and blowers other than air circulating fans.

AMCA 210–16 and AMCA 230–23 are industry-accepted test procedures that provides methods of tests for fans and blowers other than air circulating fans, and air circulating fans, respectively, in the United States. These methods are referenced in AMCA 214–21.

AMCA 240–15 is an industry-accepted test procedure that provides definitions and methods of tests for positive pressure ventilator.

Copies of AMCA 214–21, AMCA 210–16, AMCA 230–23, and AMCA 240–15, may be purchased from AMCA International at 30 West University Drive, Arlington Heights, IL 60004–1893, or by going to *www.amca.org.*

ISO 5801:2017 is the industry-accepted test procedure that provides methods of tests for fans and blowers that are not air circulating fans, internationally.

ISO 80079–36:2016, specifies the method and requirements for design, construction, testing and marking of non-electrical equipment intended for use in potentially explosive atmospheres.

Copies of ISO 5801:2017 and ISO 80079–36:2016 may be purchased from International Organization for Standardization, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, or by going to *www.iso.org.*

UL 705–22 provides safety requirements for power ventilators.

Copies of UL 705–2022 can be obtained from UL, 333 Pfingsten Road, Northbrook, IL, 60062 or *www.shopulstandards.com.*

V. Approval of the Office of the Secretary

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

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Intergovernmental relations, Reporting and recordkeeping requirements, Small businesses.

10 CFR Part 431

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

Signing Authority

This document of the Department of Energy was signed on April 20, 2023, by Francisco Alejandro Moreno, Acting Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on April 20, 2023.

Treena V. Garrett,

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

For the reasons stated in the preamble, DOE amends parts 429 and 431 of Chapter II of Title 10, Code of Federal Regulations as set forth below:

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

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

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

§ 429.11 [Amended]

■ 2. Section 429.11 is amended in paragraphs (a) and (b)(1) by removing ''429.68'' and adding in its place ''429.69''.

■ 3. Add § 429.69 to subpart B to read as follows:

§ 429.69 Fans and blowers.

(a) *Determination of represented values of fans and blowers other than air circulating fans.* A manufacturer must determine the represented values for each basic model, either by testing in conjunction with the applicable sampling provisions or by applying an AEDM as set forth in this section and in § 429.70(n). Manufacturers must update represented values to account for any change in the applicable motor standards in Table 5 of § 431.25 of this chapter and certify amended values as of the next annual certification (as applicable).

(1) *Testing.* (i) If the represented values for a given basic model are determined through testing, a sample of at least one unit must be selected and the requirements of § 429.11 apply.

(ii) If only one unit is tested, at each duty point characterized by a flow and speed value, any represented value of fan electrical input power (''FEP''), fan shaft input power, or other measure of energy consumption of a basic model for which consumers would favor lower values shall be greater than or equal to the tested value. Represented values must be rounded to the nearest hundredth.

(iii) If only one unit is tested, at each duty point characterized by a flow and speed value, any represented value of fan electrical input power (''FEI''), or other measure of energy consumption of a basic model for which consumers would favor higher values shall be less than or equal to the tested value. Represented values must be rounded to the nearest hundredth.

(iv) If more than one unit is tested, at each duty point characterized by a flow and speed value, any represented value of fan electrical input power (''FEP''), fan shaft input power, or other measure of energy consumption of a basic model for which consumers would favor lower values shall be greater than or equal to the higher of:

(A) The mean of the sample, where

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

Where is $\bar{x}$ the sample mean; n is the number of samples, and x_i is the i[th] sample. Or,

(B) The upper 95 percent confidence limit (UCL) of the true mean divided by 1.05, where:

$$UCL = \bar{x} + t_{0.95}\left(\frac{s}{\sqrt{n}}\right)$$

and $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.95}$ is the t statistic for a 95 percent one-tailed confidence interval with n-1 degrees of freedom (from appendix A of subpart B of this part). Represented values must be rounded to the nearest hundredth.

(v) If more than one unit is tested, any represented value of the fan energy index (''FEI''), or other measure of energy consumption of a basic model for which consumers would favor higher values shall be less than or equal to the lower of:

(A) The mean of the sample, where

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

Where $\bar{x}$ is the sample mean; n is the number of samples, and x_i is the i^{th} sample. Or,

(B) The lower 95 percent confidence limit (LCL) of the true mean divided by 0.95, where:

$$LCL = \bar{x} - t_{0.95}\left(\frac{s}{\sqrt{n}}\right)$$

and $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.95}$ is the t statistic for a 95 percent one-tailed confidence interval with n-1 degrees of freedom (from appendix A of subpart B of this part). Represented values must be rounded to the nearest hundredth.

(vi) At each duty point characterized by a flow and speed value, the representative value of static or total pressure of a basic model of must be the mean of the tested static or total pressure for each tested unit. If only one unit is tested, the representative value of static or total pressure at the duty point of a basic model is the tested value.

(2) *Alternative efficiency determination methods.* In lieu of testing, the represented values for a basic model must be determined through the application of an AEDM pursuant to the requirements of § 429.70(n) and the provisions of this section, where: the represented values of any basic model used to validate an AEDM must be calculated under paragraph (b)(1) of this section.

(b) *Determination of represented values for air circulating fans.* A manufacturer must determine the represented values for each basic model, either by testing in conjunction with the applicable sampling provisions or by applying an AEDM as set forth in this section and in § 429.70(n).

(1) *Testing.* (i) If the represented values for a given basic model are determined through testing, the requirements of § 429.11 apply.

(ii) Any represented value of fan electrical input power (''W_E''), or other measure of energy consumption of a basic model for which consumers would favor lower values shall be greater than or equal to the higher of:

(A) The mean of the sample, where

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

Where $\bar{x}$ is the sample mean; n is the number of samples, and x_i is the i^{th} sample. Or,

(B) The upper 95 percent confidence limit (UCL) of the true mean divided by 1.05, where:

$$UCL = \bar{x} + t_{0.95}\left(\frac{s}{\sqrt{n}}\right)$$

and $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.95}$ is the t statistic for a 95 percent one-tailed confidence interval with n-1 degrees of freedom (from appendix A of subpart B of this part). Represented values must be rounded to the nearest hundredth.

(iii) Any represented value of efficacy (Eff_{circ}) or other measure of energy consumption of a basic model for which consumers would favor higher values shall be less than or equal to the lower of:

(A) The mean of the sample, where

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

Where $\bar{x}$ is the sample mean; n is the number of samples, and x_i is the i^{th} sample. Or,

(B) The lower 95 percent confidence limit (LCL) of the true mean divided by 0.95, where:

$$LCL = \bar{x} - t_{0.95}\left(\frac{s}{\sqrt{n}}\right)$$

and $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.95}$ is the t statistic for a 95 percent one-tailed confidence interval with n-1 degrees of freedom (from appendix A of subpart B of this part). Represented values must be rounded to the nearest hundredth.

(2) *Alternative efficiency determination methods.* In lieu of testing, the represented values for a basic model must be determined through the application of an AEDM pursuant to the requirements of § 429.70(n) and the provisions of this section, where: the represented values of any basic model used to validate an AEDM must be calculated under paragraph (b)(1) of this section.

■ 4. Amend § 429.70 is amended by:

■ a. In paragraph (a), removing ''429.65'' and, adding its place, ''429.69''; and

■ b. Adding paragraph (n).

The additions reads as follows:

§ 429.70 Alternative methods for determining energy efficiency or energy use.

* * * * *

(n) *Alternative efficiency determination method (AEDM) for fans and blowers.* (1) *Criteria an AEDM must satisfy.* A manufacturer is not permitted to apply an AEDM to a basic model of fan or blower to determine represented values pursuant to this section unless:

(i) The AEDM is derived from a mathematical model that estimates the energy use characteristics of the basic model as measured by the applicable DOE test procedure and accurately represents the performance characteristics of that basic model;

(ii) The AEDM is based on engineering or statistical analysis, computer simulation or modeling, or other analytic evaluation of actual performance data; and

(iii) The manufacturer has validated the AEDM in accordance with paragraph (n)(2) of this section.

(2) *Validation of an AEDM.* Before using an AEDM, the manufacturer must validate the AEDM's accuracy and reliability by comparing the simulated FEI, or simulated efficacy, as applicable, to the tested FEI or tested efficacy, as applicable (determined by testing), as follows.

(i) *Select basic models.* For each fan or blower validation class listed as follows: centrifugal housed fan; radial housed fan; centrifugal inline fan; centrifugal unhoused fan; centrifugal power roof ventilator exhaust fan; centrifugal power roof ventilator supply fan; axial inline fan; axial panel fan; axial centrifugal power roof ventilator fan; unhoused ACFH; axial housed ACFH; and housed centrifugal air circulating fan to which the AEDM is applied, a manufacturer must select at least two basic models compliant with any energy conservation standards in subpart J of part 431 of this chapter. In addition, at least one basic model selected for validation testing should include a motor, or a motor and controller if the AEDM is applied to a basic model with a motor or to a basic model with a motor and controller.

(ii) *Apply the AEDM* to the selected basic models. Using the AEDM, calculate the simulated FEI, or efficacy, as applicable, for each of the selected basic models.

(iii) *Testing.* Test a sample of units of each of the selected basic models in accordance with 10 CFR 431.174 and determine the FEI or efficacy, as applicable, in accordance with § 429.69(a)(1) and (b)(1) as applicable.

(iv) *Compare.* The simulated FEI or simulated efficacy, as applicable, for each basic model must be less than or equal to 105 percent of the FEI or efficacy, as applicable, determined in paragraph (n)(2)(iii) of this section through testing.

(v) *Additional AEDM requirements.* When making representations of values other than FEI (*e.g.,* FEP, fan shaft power) or efficacy (as applicable) for a basic model that relies on an AEDM, all other representations are required to be based on the same AEDM results used to generate the represented value of FEI or efficacy.

(3) *Verification of an AEDM*—(i) *Periodic review*s. Each manufacturer must periodically select basic models representative of those to which it has applied an AEDM. The manufacturer must select a sufficient number of basic models to ensure the AEDM maintains its accuracy and reliability. For each basic model selected for verification: subject at least one unit to testing in accordance with 10 CFR 431.174. The provisions in paragraph (n)(2)(iv) of this section must be met.

(ii) *Inspection records.* Each manufacturer that has used an AEDM under this section must have available for inspection by the Department of Energy records showing:

(A) The method or methods used to develop the AEDM;

(B) The mathematical model, the engineering or statistical analysis, computer simulation or modeling, and other analytic evaluation of performance data on which the AEDM is based;

(C) Complete test data, equipment information, and related information that the manufacturer has generated or acquired pursuant to paragraphs (n)(2) and (3) of this section; and

(D) The calculations used to determine the simulated FEI or simulated weighted-average FEI, as applicable, of each basic model to which the AEDM was applied.

(iii) *Simulations.* If requested by the Department, the manufacturer must:

(A) Conduct simulations to predict the performance of particular basic models of electric motors specified by the Department;

(B) Provide analyses of previous simulations conducted by the manufacturer; and/or

(C) Conduct testing of basic models selected by the Department.

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

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

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

■ 6. Section 431.172 is revised to read as follows:

§ 431.172 Definitions.

Air circulating axial panel fan means an axial housed air circulating fan head without a cylindrical housing or box housing that is mounted on a panel, orifice plate or ring.

Air circulating fan means a fan that has no provision for connection to ducting or separation of the fan inlet from its outlet using a pressure boundary, operates against zero external static pressure loss, and is not a jet fan.

Air circulating fan discharge area: area of a circle having a diameter equal to the blade tip diameter.

Air circulating fan outlet area means the gross inside area measured at the plane of the outlet opening.

Air-cooled steam condenser means a device for rejecting heat to the atmosphere through the indirect condensing of steam inside air-cooled finned tubes.

Axial inline fan means a fan with an axial impeller and a cylindrical housing with or without turning vanes.

Axial panel fans means an axial fan, without cylindrical housing, that includes a panel, orifice plate, or ring with brackets for mounting through a wall, ceiling, or other structure that separates the fan's inlet from its outlet.

Basic model, with respect to fans and blowers, means all units of fans and blowers manufactured by one manufacturer, having the same primary energy source, and having essentially identical electrical, physical, and functional (*e.g.,* aerodynamic) characteristics that affect energy consumption. In addition:

(1) All variations of blade pitches of an adjustable-pitch axial fan may be considered a single basic model; and

(2) All variations of impeller widths and impeller diameters of a given full-width impeller and full-diameter impeller centrifugal fan may be considered a single basic model.

Box fan means an axial housed air circulating fan head without a cylindrical housing that is mounted on a panel, orifice plate or ring and is mounted in a box housing.

Centrifugal housed fan means a fan with a centrifugal or mixed flow impeller in which airflow exits into a housing that is generally scroll-shaped to direct the air through a single fan outlet. A centrifugal housed fan does not include a radial impeller.

Centrifugal inline fan means a fan with a centrifugal or mixed flow impeller in which airflow enters axially at the fan inlet and the housing redirects radial airflow from the impeller to exit the fan in an axial direction.

Centrifugal unhoused fan means a fan with a centrifugal or mixed flow impeller in which airflow enters through a panel and discharges into free space. Inlets and outlets are not ducted. This fan type also includes fans designed for use in fan arrays that have partition walls separating the fan from other fans in the array.

Cross-flow fan means a fan or blower with a housing that creates an airflow path through the impeller in a direction at right angles to its axis of rotation and with airflow both entering and exiting the impeller at its periphery. Inlets and outlets can optionally be ducted.

Cylindrical air circulating fan means an axial housed air circulating fan head with a cylindrical housing that is not a Positive Pressure Ventilator as defined in AMCA 240–15 (incorporated by reference, see § 431.173).

Evaporative field erected closed-circuit cooling tower means a structure which rejects heat to the atmosphere through the indirect cooling of a process fluid stream to a lower temperature by partial evaporation of an external recirculating water flow.

Evaporative field erected open-circuit cooling tower means a structure which rejects heat to the atmosphere through the direct cooling of a water stream to a lower temperature by partial evaporation.

Fan or *blower* means a rotary bladed machine used to convert electrical or mechanical power to air power, with an energy output limited to 25 kilojoule (kJ)/kilogram (kg) of air. It consists of an impeller, a shaft and bearings and/or driver to support the impeller, as well as a structure or housing. A fan or blower may include a transmission, driver, and/or motor controller.

Fan static air power means the static power delivered to air by the fan or blower; it is proportional to the product of the fan airflow rate, the fan static pressure and the compressibility coefficient and is calculated in accordance with section 7.8.1 of AMCA 210–16 (incorporated by reference, see § 431.173), using static pressure instead of total pressure.

Fan total air power means the total power delivered to air by the fan or blower; it is proportional to the product of the fan airflow rate, the fan total pressure and the compressibility coefficient and is calculated in accordance with section 7.8.1 of AMCA 210–16 (incorporated by reference, see § 431.173).

Field erected air-cooled (dry) cooler means a structure which rejects heat to the atmosphere from a fluid, either liquid, gas or a mixture thereof, flowing through an air-cooled internal coil.

Field erected evaporative condenser means a structure which rejects heat to the atmosphere through the indirect condensing of a refrigerant in an internal coil by partial evaporation of an external recirculating water flow.

Full-diameter impeller means maximum impeller diameter with which a given fan or blower basic model is distributed in commerce.

Full-width impeller means the maximum impeller width with which a given fan or blower basic model is distributed in commerce.

Housed air circulating fan head means an air circulating fan with an axial or centrifugal impeller, and a housing.

Housed centrifugal air circulating fan means a housed air circulating fan head with a centrifugal or radial impeller in which airflow exits into a housing that is generally scroll shaped to direct the air through a single, narrow fan outlet.

Induced flow fan means a type of laboratory exhaust fan with a nozzle and windband; the fan's outlet airflow is greater than the inlet airflow due to induced airflow. All airflow entering the inlet exits through the nozzle. Airflow exiting the windband includes the nozzle airflow plus the induced airflow.

Jet fan means a fan designed and marketed specifically for producing a high velocity air jet in a space to increase its air momentum. Jet fans are rated using thrust. Inlets and outlets are not ducted but may include acoustic silencers.

Packaged air-cooled (dry) cooler means a device which rejects heat to the atmosphere from a fluid, either liquid, gas or a mixture thereof, flowing through an air-cooled internal coil.

Packaged evaporative closed-circuit cooling tower means a device which rejects heat to the atmosphere through the indirect cooling of a process fluid stream in an internal coil to a lower temperature by partial evaporation of an external recirculating water flow.

Packaged evaporative condenser means a device which rejects heat to the atmosphere through the indirect condensing of a refrigerant in an internal coil by partial evaporation of an external recirculating water flow.

Packaged evaporative open-circuit cooling tower means a device which rejects heat to the atmosphere through the direct cooling of a water stream to a lower temperature by partial evaporation.

Power roof ventilator means a fan with an internal driver and a housing to prevent precipitation from entering the building. It has a base designed to fit over a roof or wall opening, usually by means of a roof curb.

Radial-housed fan means a fan with a radial impeller in which airflow exits into a housing that is generally scroll-shaped to direct the air through a single fan outlet. Inlets and outlets can optionally be ducted.

Safety Fan means:

(1) A reversible axial fan in cylindrical housing that is designed and marketed for use in ducted tunnel ventilation that will reverse operation under emergency ventilation conditions;

(2) A fan for use in explosive atmospheres tested and marked according to the English version of ISO 80079–36:2016 (incorporated by reference, see § 431.173);

(3) An electric-motor-driven-Positive Pressure Ventilator as defined in AMCA 240–15 (incorporated by reference, see § 431.173);

(4) A fan bearing a listing for ''Power Ventilators for Smoke Control Systems'' in compliance with UL 705 (incorporated by reference, see § 431.173); or

(5) A laboratory exhaust fan designed and marketed specifically for exhausting contaminated air vertically away from a building using a high-velocity discharge.

Unhoused air circulating fan head means an air circulating fan without a housing, having an axial impeller with a ratio of fan-blade span (in inches) to maximum rate of rotation (in revolutions per minute) less than or equal to 0.06. The impeller may or may not be guarded.

■ 7. Section 431.173 is added to read as follows:

§ 431.173 Materials incorporated by reference.

(a) Certain material is incorporated by reference into this subpart with the approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, DOE must publish a document in the **Federal Register** and the material must be available to the public. All approved incorporation by reference (IBR) material is available for inspection at DOE, and at the National Archives and Records Administration (NARA). Contact DOE at: the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, 1000 Independence Ave. SW, EE–5B, Washington, DC 20585, (202) 586–9127, *Buildings@ee.doe.gov*, *https://www.energy.gov/eere/buildings/building-technologies-office.* For information on the availability of this material at NARA, visit *www.archives.gov/federal-register/cfr/ibr-locations.html* or email: *fr.inspection@nara.gov.* The material may be obtained from the sources in the following paragraphs of this section.

(b) *AMCA.* Air Movement and Control Association International, Inc., 30 West University Drive, Arlington Heights, IL 60004–1893; (847) 394–0150; *www.amca.org.*

(1) ANSI/AMCA Standard 21016 (''AMCA 210–16''), *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating,* ANSI-approved August 26, 2016; IBR approved for § 431.172; appendix A to this subpart. (Co-published as ASHRAE 51–16).

(2) ANSI/AMCA Standard 214–21 (''AMCA 214–21''), *Test Procedure for Calculating Fan Energy Index (FEI) for Commercial and Industrial Fans and Blowers,* ANSI-approved March 1, 2021; IBR approved for § 431.174; appendix A to this subpart.

(3) ANSI/AMCA Standard 230–23 (''AMCA 230–23''), *Laboratory Methods of Testing Air Circulating Fans for Rating and Certification,* ANSI-approved February 10, 2023. IBR approved for appendix B to this subpart.

(4) ANSI/AMCA Standard 240–15 (''AMCA 240–15''), *Laboratory Methods of Testing Positive Pressure Ventilators for Aerodynamic Performance Rating,* ANSI-approved May 9, 2015; IBR approved for § 431.172.

(c) *ISO.* International Organization for Standardization, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland; *www.iso.org.*

(1) ISO 5801:2017(E) (''ISO 5801:2017''), *Fans—Performance testing using standardized airways,* Third Edition, approved September 2017; IBR approved for appendix A to this subpart.

(2) ISO 80079–36:2016, *Explosive atmospheres—Part 36: Non-electrical equipment for explosive atmospheres—Basic method and requirements,* Edition 1.0, February 2016; IBR approved for § 431.172.

(d) *UL.* Underwriters Laboratories, 333 Pfingsten Road, Northbrook, Illinois, 60062; *www.shopulstandards.com.*

(1) UL 705, *Standard for Safety for Power Ventilators,* Edition 7, July 19, 2017 (including revisions through August 19, 2022); IBR approved for § 431.172.

(2) [Reserved].

■ 8. Section 431.174 is added to read as follows:

§ 431.174 Test Procedure for fans or blowers.

(a) *Scope for fans and blowers other than air circulating fans.* A fan or blower, other than an air circulating fan is subject to the test procedure in this section if it meets the following criteria:

(1) Is a centrifugal housed fan; radial housed fan; centrifugal inline fan; centrifugal unhoused fan; centrifugal power roof ventilator exhaust fan; centrifugal power roof ventilator supply fan; axial inline fan; axial panel fan; or axial centrifugal power roof ventilator fan;

(2) Is not:

(i) A radial housed unshrouded fan with blade diameter at tip less than 30 inches or a blade width of less than 3 inches;

(ii) A safety fan;

(iii) An induced flow fan;

(iv) A jet fan;

(v) A cross-flow fan;

(vi) A fan manufactured exclusively to be powered by internal combustion engines;

(vii) A fan that create a vacuum of 30 inches water gauge or greater;

(viii) A fan that is designed and marketed to operate at or above 482 degrees Fahrenheit (250 degrees Celsius); or

(ix) A fan and blower embedded in the equipment listed in paragraph (a)(3) of this section;

(3) Is not an embedded fan subject to the following exclusions:

(i) The test procedure in this section does not apply to fans or blowers that are embedded in:

(A) Single phase central air conditioners and heat pumps rated with a certified cooling capacity less than 65,000 British thermal units per hour (''Btu/h'') cooling capacity, that are subject to DOE's energy conservation standard at 10 CFR 430.32(c);

(B) Three phase, air-cooled, small commercial packaged air-conditioning and heating equipment rated with a certified cooling capacity less than 65,000 Btu/h cooling capacity, that are subject to DOE's energy conservation standard at § 431.97(b);

(C) Transport refrigeration (*i.e.,* Trailer refrigeration, Self-powered truck refrigeration, Vehicle-powered truck refrigeration, Marine/Rail container refrigerant);

(D) Vacuum cleaners;

(E) Heat Rejection Equipment: Packaged evaporative open-circuit cooling towers; Evaporative field-erected open-circuit cooling towers; Packaged evaporative closed-circuit cooling towers; Evaporative field-erected closed-circuit cooling towers; Packaged evaporative condensers; Field-erected evaporative condensers; Packaged air-cooled (dry) coolers; Field-erected air-cooled (dry) cooler; Air-cooled steam condensers; Hybrid (water saving) versions of all of the previously listed equipment that contain both evaporative and air-cooled heat exchange sections;

(F) Air curtains; and

(G) Direct expansion-dedicated outdoor air system that are subject to any of DOE's test procedures in appendix B to subpart F of this part.

(ii) The test procedure in this section does not apply to supply or condenser fans or blowers that are embedded in:

(A) Air-cooled commercial package air conditioners and heat pumps (''CUAC,'' ''CUHP'') with a certified cooling capacity between 5.5 ton (65,000 Btu/h) and 63.5 ton (760,000 Btu/h) that are subject to DOE's energy conservation standard at § 431.97(b);

(B) Water-cooled and evaporatively-cooled commercial air conditioners that are subject to DOE's energy conservation standard at § 431.97(b);

(C) Water-source heat pumps that are subject to DOE's energy conservation standard at § 431.97(b);

(D) Single package vertical air conditioners and heat pumps that are subject to DOE's energy conservation standard at § 431.97(d);

(E) Packaged terminal air conditioners (''PTAC'') and packaged terminal heat pumps (PTHP) that are subject to DOE's energy conservation standard at § 431.97(c);

(F) Computer room air conditioners that are subject to DOE's energy conservation standard at § 431.97(e); and

(G) Variable refrigerant flow multi-split air conditioners and heat pumps that are subject to DOE's energy conservation standard at § 431.97(f); and

(4) In addition, the test procedure is only applicable to fan or blower duty points with the following characteristics, measured or calculated in accordance with the test procedure set forth in appendix A of this subpart:

(i)(A) Fan shaft input power equal to or greater than 1 horsepower; or

(B) Fan electrical input power equal to or greater than 0.89 kW; and

(ii)(A) Fan static air power equal to or less than 150 horsepower for fans using a static pressure basis fan energy index (''FEI'') in accordance with the required test configuration listed in table 7.1 of AMCA 214–21 (incorporated by reference, see § 431.173); or

(B) Fan total air power equal to or less than 150 horsepower for fans using a total pressure basis FEI in accordance with the required test configuration listed in table 7.1 of AMCA 214–21;

(b) *Scope for air circulating fans.* The test procedure in this section applies to all air circulating fans with input power greater than or equal to 125W at maximum speed.

(c) *Testing and calculations for fans and blowers other than air circulating fans.* Determine the FEI, the fan electrical input power (''FEP''), and fan shaft power (as applicable) at each duty point, as specified by the manufacturer, using the test procedure set forth in appendix A of this subpart.

(d) *Testing and calculations for air circulating fan.* Determine the FEI and the fan electrical input power (''FEP'') or the weighted-average FEI and weighted-average FEP as applicable, using the test procedure set forth in appendix B of this subpart.

■ 9. Add appendix A to subpart J of part 431 to read as follows:

Appendix A to Subpart J of Part 431—Uniform Test Method for the Measurement of Energy Consumption of Fans and Blowers Other Than Air Circulating Fans

After October 30, 2023, any representations made with respect to energy use or efficiency of fans and blowers subject to testing pursuant to § 431.174 must be made in accordance with this appendix. Any optional representations of fan energy index in the optional test configuration listed in table 7.1 of AMCA 214–21 ($FEI_{optional}$) must be accompanied by a representation of fan energy index in the required test configuration listed in table 7.1 of AMCA 214–21 (FEI).

0. Incorporation by Reference

In § 431.173, DOE incorporated by reference the entire standard for AMCA 210–16, AMCA 214–21, and ISO 5801:2017; however, only enumerated provisions of those documents are applicable as follows. In cases where there is a conflict, the language of this appendix takes precedence over those documents.

0.1 AMCA 210–16:

(a) Section 3, ''Definitions/Units of Measure/Symbols'';

(b) Section 4, ''Instruments and Methods of Measurement'' ;

(c) Section 5, ''Test Setups and Equipment'';

(d) Section 6, ''Observation and Conduct of Test'';

(e) Section 7, ''Calculations'' excluding Section 7.9.2, ''Conversion to other rotational speeds and air densities with compressible flow'' and Section 7.9.3, ''Conversion formulae for new densities and new rotational speeds'';

0.2. AMCA 214–21:

(a) Section 2, ''References (Normative),'' as referenced in section 2.2 of this appendix;

(b) Section 3, ''Definitions,'' as referenced in section 1 of this appendix;

(c) Section 4, ''Calculation of the FEI for a Single Duty Point,'' as referenced in section 2.6 of this appendix;

(d) Section 5, ''Reference Fan Electrical Power (FEP_{ref}),'' as referenced in section 2.6 of this appendix;

(e) Section 6.1, ''Wire-to-Air Testing at the Required Duty Point,'' as referenced in section 2.2 of this appendix;

(f) Section 6.2, ''Calculated Ratings Based on Wire-to-Air Testing,'' as referenced in section 2.2 of this appendix;

(g) Section 6.3, ''Bare Shaft Fans,'' as referenced in section 2.2 of this appendix;

(h) Section 6.4, ''Fans with Polyphase Regulated Motor'', excluding Section 6.4.1.4, ''Requirements for the VFD, if included'' and Section 6.4.2.4, ''Combined motor-VFD efficiency'' as referenced in section 2.2 of this appendix;

(i) Section 7, ''Testing,'' as referenced in sections 2.2 and 2.3 of this appendix;

(j) Section 8, ''Rating Development'', excluding Section 8.2.2, ''Separate Fan and Motor Tests'' and Section 8.3, ''Appurtenances'' as referenced in section 2.2 of this appendix;

(k) Annex D, ''Motor Performance Constants (Normative),'' as referenced in section 2.2 of this appendix;

(l) Annex E, ''Calculation Methods for Fans Tested Shaft-to-Air,'' as referenced in section 2.2 of this appendix;

(m) Annex G, ''Wire-to-Air Measurement—Calculation to Other Speeds and Densities (Normative),'' as referenced in section 2.2 of this appendix;

(n) Annex J, ''Other data and calculations to be retained,'' as referenced in section 2.2 of this appendix; and

(o) Annex K, ''Proportionality and Dimensional Requirements (Normative),'' as referenced in section 2.2 of this appendix.

0.3. ISO 5801:2017:

(a) Section 3, ''Terms and Definitions'';

(b) Section 4, ''Symbols, Abbreviated Terms and Subscripts'';

(c) Section 5, ''General'';

(d) Section 6, ''Test Configurations'';

(e) Section 7, ''Carrying out the Test'';

(f) Section 8, ''Airways for Duct Configuration'';

(g) Section 9, ''Standardized Test Chambers'';

(h) Section 10, ''Various Component Parts for a Laboratory Setup'';

(i) Section 11, ''Standard Test Configurations'';

(j) Section 12, ''Measurements'';

(k) Section 13, ''Reference Conditions'';

(l) Section 15, ''Calculations'';

(m) Section 16, ''Fan Characteristic Curves''; and

(n) Section 17, ''Uncertainty Analysis''.

1. Definitions

The definitions applicable to this appendix are defined in § 431.172 and in section 3, ''Definitions,'' of AMCA 214–21. In cases where there is a conflict, the definitions in § 431.172 take precedence over AMCA 214–21.

2. Test Procedure for Fans and Blowers Other Than Air Circulating Fans

2.1. General.

This section describes the test procedure for fans and blowers other than air circulating fans. In cases where there is a conflict, the provisions in this appendix take precedence over AMCA 214–21. Where AMCA 214–21 refers to Annex A, ''Polyphase Regulated Motor Efficiencies (Normative),'' of AMCA 214–21, Table 5 of § 431.25 must be used instead.

2.2. Testing

2.2.1. General.

The fan electrical input power (FEP_{act}) in kilowatts must be determined at every duty point specified by the manufacturer in accordance with one of the test methods listed in Table 1, and the following sections of AMCA 214–21: Section 2, ''References (Normative)''; Section 7, ''Testing,'' including the referenced provisions to AMCA 210–16 and ISO 5801:2017 as listed in sections 2.2.2 and 2.2.3 of this appendix; Section 8.1, ''Laboratory Measurement Only'' (as applicable); and Annex J, ''Other data and calculations to be retained.''

TABLE 1 TO APPENDIX A TO SUBPART J OF PART 431

Driver	Motor controller present?	Transmission configuration?	Test method	Applicable section(s) of AMCA 214–21
Electric motor	Yes or No	Any	Wire-to-air	6.1 "Wire-to-Air Testing at the Required Duty Point".
Electric motor	Yes or No	Any	Calculation based on Wire-to-air testing.	6.2 "Calculated Ratings Based on Wire to Air Testing" (references Section 8.2.3, "Calculation to other speeds and densities for wire-to-air testing," and Annex G, "Wire-to-Air Measurement—Calculation to Other Speeds and Densities (Normative)").
Regulated polyphase motor	No	Direct drive, V-belt drive, flexible coupling or synchronous belt drive.	Shaft-to-air	6.4 "Fans with Polyphase Regulated Motors," (references Annex D, "Motor Performance Constants (Normative)") *.
None or non-electric	No	None	Shaft-to-air	Section 6.3, "Bare Shaft Fans".
Regulated polyphase motor	No	Direct drive, V-belt drive, flexible coupling or synchronous belt drive.	Calculation based on Shaft-to-air testing.	Section 8.2.1, "Fan laws and other calculation methods for shaft-to-air testing" (references Annex D, "Motor Performance Constants (Normative)," Annex E, "Calculation Methods for Fans Tested Shaft-to-Air," and Annex K, "Proportionality and Dimensional Requirements (Normative)").
None or non-electric	No	None	Calculation based on Shaft-to-air testing.	Section 8.2.1, "Fan laws and other calculation methods for shaft-to-air testing" (references Annex E, "Calculation Methods for Fans Tested Shaft-to-Air," and Annex K, "Proportionality and Dimensional Requirements (Normative)").

* Excluding Section 6.4.1.4, "Requirements for the VFD, if included" and Section 6.4.2.4, "Combined motor-VFD efficiency."

Testing must be performed in accordance with the required test configuration listed in table 7.1 of AMCA 214–21. The following values must be determined in accordance with this appendix at each duty point specified by the manufacturer: fan airflow in cubic feet per minute; fan air density; fan total pressure in inches of water gauge for fans using a total pressure basis FEI in accordance with Table 7.1 of AMCA 214–21; fan static pressure in inches of water gauge for fans using a static pressure basis FEI in atcordance with table 7.1 of AMCA 214–21; fan speed in revolutions per minute; and fan shaft input power in horsepower for fans tested in accordance with sections 6.3, 6.4 or 6.5 of AMCA 214–21.

In addition, if applying the equations in Section E.2 of Annex E of AMCA 214–21 for compressible flows, the compressibility coefficients must be included in the equations as applicable.

All measurements must be recorded at the resolution of the test instrumentation and calculations must be rounded to the number of significant digits present at the resolution of the test instrumentation.

In cases where there is a conflict, the provisions in AMCA 214–21 take precedence over AMCA 210–16 and ISO 5801:2017. In addition, the provisions in this appendix apply.

2.2.2 Power Roof Ventilators

Centrifugal Power Roof Ventilators that are both supply and exhaust must be tested in both supply and exhaust configurations as listed in table 7.1 of AMCA 214–21.

2.2.3 Embedded Fans

Embedded fans that are not manufactured in a standalone configuration must be tested in a standalone configuration. If some components of the bare shaft fan are not removable without causing irreversible damage to the equipment into which the fan is embedded, testing must be performed using additional fan components, except for the fan impeller, that are geometrically identical to that of the fan embedded inside the larger piece of equipment for testing.

2.3. Power Supply

Any wire-to-air testing must be conducted at the supply frequency, phase, and voltages specified in this section. The frequency and voltage must be selected in accordance with section 7.8. of AMCA 214–21. Fans and blowers rated for operation for single- or multi-phase power supply must be tested with single- or multi-phase electricity, respectively. Fans and blowers, capable of operating with single- and multi-phase power supply, must be tested using multi-phase electricity.

2.4. Stability Conditions.

The following conditions must be met to establish system stability prior to collecting test data:

(a) Barometric pressure, dry bulb temperature and wet bulb temperature in the general test area must be captured at least every five seconds after the run-in period is completed and the ambient air density calculated from these values shall not vary by more than ±1 percent during verification of fan speed and fan input power stability.

(b) After the fan has been run-in, record the fan speed in rpm and the input power (in pound-force, pound-force-in, or watts) at least every 5 seconds for at least three 60-second intervals. Readings shall be made simultaneously. Repeat these measurements over 60-second intervals until:

(1) The average fan speed from the last 60-second interval varies by less than the absolute value of 1 percent or 1 rpm, whichever is greater, when compared to the average fan speed measured during the previous 60-second test interval;

(2) The average input power from the last 60-second interval varies by less than the absolute value of 1 percent, whichever is greater, compared to the average input power measured during the previous 60-second test interval; and

(3) The slopes calculated from the individual data collected for fan speed and input power during at least three 60-second sampling intervals include both positive and negative values (*e.g.,* two positive and one negative slope value or one positive and two negative slope values). If three positive or three negative slopes are determined in succession, additional sampling intervals are required until slopes from three successive sampling intervals include both positive and negative values.

2.5. Sampling Intervals for Testing.

A test measurement must meet the following conditions:

(a) The sampling interval over which average test values are determined shall not exceed 60 seconds;

(b) The average fan speed from the most recent 60-second interval varies by less than the absolute value of 1 percent or 1 rpm, whichever is greater, when compared to the average fan speed measured during the previous 60-second test interval; and

(c) the average input power from the last 60-second interval by reaction dynamometer, torque meter or calibrated motor must be ±4 percent, or the average input power by electrical meter must be ±2 percent of the mean or 1 watt, whichever is greater, compared to the average input power measured during the previous 60-second test interval.

2.6. FEI calculation

The FEI must be determined at every duty point in accordance with Section 4, ''Calculation of the FEI for a single duty point,'' and Section 5, ''Reference Fan Electrical Power (FEP_{ref})'' of AMCA 214–21. In addition, the FEI must be rounded to the nearest hundredths place; FEP must be rounded to three significant figures; and all measurements must be recorded at the resolution of the test instrument.

■ 10. Add appendix B to subpart J of part 431 to read as follows:

Appendix B to Subpart J of Part 431—Uniform Test Method for the Measurement of Energy Consumption of Air Circulating Fans

After October 30, 2023, any representations made with respect to energy use or efficiency of air circulating fans subject to testing pursuant to § 431.174 must be made in accordance with this appendix. Any optional representations of air circulating fan efficacy at speeds less than the air circulating fan's maximum speed must be accompanied by a representation of the air circulating fan efficacy at maximum speed.

0. Incorporation by Reference

In § 431.173, DOE incorporated by reference the entire standard for AMCA 230–23; however, only enumerated provisions of those documents are applicable as follows. In cases where there is a conflict, the language of this appendix takes precedence over those documents.

0.1 AMCA 230–23:

(a) Section 4, ''Definitions/Units of Measurement/Symbols,'' as referenced in section 1 and 2.2.2 of this appendix;

(b) Section 5, ''Instruments and Methods of Measurement,'' as referenced in section 2.2.2 of this appendix;

(c) Section 6, ''Equipment and Setup,'' as referenced in section 2.2.2 of this appendix;

(d) Section 7, ''Observations and Conduct of Test,'' as referenced in section 2.2.2 of this appendix;

(e) Section 8, ''Calculations,'' as referenced in section 2.2.2 of this appendix; and

(f) Section 9, ''Report and Results of Test,'' as referenced in section 2.2.2 of this appendix.

1. Definitions

The definitions applicable to this appendix are defined in § 431.172 and in Section 4, ''Definitions/Units of Measurement/Symbols,'' of AMCA 230–23. In cases where there is a conflict, the definitions in § 431.172 take precedence over AMCA 230–23.

2. Test Procedure for Air Circulating Fans

2.1. General

This section describes the test procedure for air circulating fans.

2.2. Testing

2.2.1. General

The air circulating fan efficacy (Eff_{circ}) in cubic feet per minute (''CFM'') per watt (''W'') (''CFM/W'') at maximum speed must be determined in accordance with the applicable sections of AMCA 230–23 as listed in section 2.2.2 of this appendix. In addition, testing must be conducted in accordance with the provisions in sections 2.3 through 2.5 of this appendix. Optional testing speeds lower than maximum speed is permitted. Speeds less than maximum speeds must be expressed at a percentage of maximum speed (*e.g.,* 50 percent) and the air circulating fan efficacy at lower speed must include the speed percentage in its subscript (*e.g.,* $Eff_{circ,50}$).

All measurements must be recorded at the resolution of the test instrumentation and calculations must be rounded to the number of significant digits of the resolution of the test instrumentation.

2.2.2. AMCA 230–23, Applicable Sections.

The following sections of AMCA 230–23 are applicable: Section 4, ''Definitions/Unit of Measurement/Symbols''; Section 5, ''Instruments and Methods of Measurement''; Section 6, ''Instruments and Methods of Measurement''; Section 7, ''Observations and Conduct of Test''; Section 8, ''Calculations''; and Section 9, ''Report and Results of Test.''

2.3. Air circulating fans without motors

Air circulating fans distributed in commerce without an electric motor must be tested using an electric motor as recommended in the manufacturer's catalogs or distributed in commerce with the air circulating fan. If more than one motor is available in manufacturer's catalogs or distributed in commerce with the air circulating fan, testing must be conducted using the least efficient motor capable of running the fan at the fan's maximum allowable speed.

2.4. Power Supply.

The test must be conducted at the frequency, phase, and voltages specified in this section.

2.4.1. Frequency.

Air circulating fans rated for operation with only 60 Hz power supply must be tested with 60 Hz electricity. Air circulating fans capable of operating with 50 Hz and 60 Hz electricity must be tested with 60 Hz electricity.

2.4.2. Phase.

Air circulating fans rated for operation for single- or multi-phase power supply must be tested with single- or multi-phase power electricity, respectively. Air circulating fans, capable of operating with single- and multi-phase power supply, must be tested using multi-phase electricity.

2.4.3. Voltage.

Select the supply voltage as follows:

(a) For air circulating fans tested with single-phase electricity, the supply voltage must be:

(1) 120 V if the air circulating fan's minimum rated voltage is 120 V or the lowest rated voltage range contains 120 V,

(2) 240 V if the air circulating fan's minimum rated voltage is 240 V or the lowest rated voltage range contains 240 V, or

(3) The air circulating fan's minimum rated voltage (if a voltage range is not given) or the mean of the lowest rated voltage range, in all other cases.

(b) For air circulating fans tested with multi-phase electricity, the supply voltage must be

(1) 240 V if the air circulating fan's minimum rated voltage is 240 V or the lowest rated voltage range contains 240 V, or

(2) The air circulating fan's minimum rated voltage (if a voltage range is not given) or the mean of the lowest rated voltage range, in all other cases.

2.5. Stability Conditions.

In addition to the test requirements specified in sections 7.1 and 7.3 of AMCA 230–23, the following conditions must be met to establish system stability prior to collecting test data:

(a) Test voltage shall be captured at least every five seconds and shall not vary by more than +/−1 percent during each test. Barometric pressure, dry bulb temperature and wet bulb temperature in the general test area for calculation of air density must be captured at least every five seconds and the calculated ambient air density shall not vary by more than +/−1 percent during each test.

(b) After a run-in time of at least 15 minutes, record the fan speed in rpm, the input power in watts, and load differential in pound-force for at least 3 120-second intervals. Repeat these measurements over additional 120-second intervals until:

(1) The average fan speed of the last 120-second interval varies by less than the absolute value of 1 percent or 1 rpm, whichever is greater, when compared to the average fan speed measured during the previous 120-second test interval;

(2) The average input power of the last 120-second interval varies by less than the absolute value of 1 percent or 1 watt, whichever is greater, compared to the average input power measured during the previous 120-second test interval;

(3) The average load differential of the last 120-second interval varies by less than the absolute value of 1 percent, whichever is greater, compared to the average load differential during the previous 120-second test interval; and

(4) The slopes calculated from the individual data collected for fan speed, input power, and load differential during at least three 120-second intervals include both positive and negative values (*e.g.,* two positive and one negative value or one positive and two negative values). If three positive or three negative slopes are determined in succession, additional sampling intervals are required until slopes from three successive intervals include both positive and negative values.

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