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AMCA-Advocates Comments on Draft Staff Report

Additional submitted attachment is included below.

Air Movement and Control Association International
Appliance Standards Awareness Project
Northwest Energy Efficiency Alliance
Natural Resources Defense Council
American Council for an Energy-Efficient Economy
Pacific Gas and Electric Company
San Diego Gas and Electric
Southern California Edison

September 28, 2018

California Energy Commission
Docket Unit, MS-4
1516 Ninth Street
Sacramento, CA 95814-5512

RE: Docket No. 17-AAER-06: Commercial and Industrial Fans and Blowers

This letter constitutes the comments of the Air Movement and Control Association International (AMCA), Appliance Standards Awareness Project (ASAP), Northwest Energy Efficiency Alliance (NEEA), Natural Resources Defense Council (NRDC), American Council for an Energy-Efficient Economy (ACEEE), Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE) on the California Energy Commission's Draft Staff Report for commercial and industrial fans and blowers. These comments only address stand-alone fans. We appreciate the opportunity to provide input to the Commission.

Overview

We are pleased that for stand-alone fans the Draft Staff Report largely reflects the joint proposal submitted by AMCA and energy efficiency advocates in September 2017. In particular, we appreciate the Energy Commission's proposal to adopt our recommended approach of regulating fans at all manufacturer-declared duty points. This approach will drive not just more-efficient fan designs, but better fan selections, which will result in significantly greater savings for California. AMCA and efficiency advocates have continued to work together to try to assist the Energy Commission in developing standards for fans that can be successfully implemented, and we look forward to continuing to work with Energy Commission staff during future phases of this rulemaking.

Below we provide our recommendations on scope, definitions, test methods, standards, filing by manufacturers, marking, representations, and enforcement for stand-alone fans. In the Appendix we have provided our specific suggested edits to the proposed regulatory language.

Scope

We recommend excluding two additional fan types from the scope of coverage: safety fans and ceiling fans. Safety fans are fans designed for use in applications requiring extra safety measures, which both

reduce a fan's efficiency and significantly increase its cost. Excluding safety fans would be consistent with the ASRAC term sheet. Ceiling fans are already subject to DOE standards.[1]

Definitions

In the Appendix we have provided suggested edits and additions to the definitions in the Draft Staff Report. First, we are proposing definitions for terms that were previously undefined including "air curtain unit," "basic model," "radial housed unshrouded fan," and "shroud."

Of the proposed definitions, the most important is basic model. It is common in the fan industry for manufacturers to make various modifications to a basic fan design in order to meet a range of desired duty points, which can result in a huge number of individual fan designs. We have suggested a definition for "basic model" to attempt to describe catalogued fans that are offered for sale without any modification. In some cases, manufacturers offer a catalogued model that can be "configured." For example, an adjustable-pitch axial fan of a given size may be offered at 30 different blade pitches. Similarly, a centrifugal fan of a given size may be offered in small increments of impeller widths and impeller diameters (without changing the housing size). In order to try to limit the certification burden for manufacturers and avoid congesting the Modernized Appliance Efficiency Database System (MAEDbS), we are suggesting that all blade pitches of a certain size adjustable-pitch axial fan and all impeller widths and impeller diameters of a certain size centrifugal fan may be considered a single basic model.

Our suggested definition for "basic model" is:

"Basic model" of a commercial and industrial fan and blower means a catalogued product that is engineered and offered for sale with no modification necessary, typically consisting of a product and size; and, in addition:

(1) All blade pitches of a certain size adjustable-pitch axial fan may be considered a single basic model; and

(2) All impeller widths and impeller diameters of a certain size centrifugal fan may be considered a single basic model.

We have also added proposed definitions for additional terms that we believe should be defined including "dual-use fan," "erosion-resistant fan," "safety fan," "maximum rated air flow," "maximum rated pressure," and "maximum rated speed." Dual-use fans are fans that are used for general ventilation, but that can also operate at a higher speed for emergency use, such as smoke evacuation or stairwell pressurization. As described in the section on test methods, we are recommending that these fans be tested in their general ventilation mode. Erosion-resistant fans are used in applications such as cement manufacturing plants, foundries, and food processing. Erosion-resistant fans are standard fans that are then "armored" with features such as wear plates, deflector vanes, or thick coatings of erosion-resistant material in order to extend the useful life of the fan. These modifications significantly reduce

[1] New DOE standards for ceiling fans that will take effect on January 1, 2020 cover not just residential ceiling fans, but also high-speed small diameter and large-diameter ceiling fans, which are used in commercial and industrial applications.

the fan's efficiency while significantly increasing its cost. As described in the section on test methods, we are recommending that these fans be tested and rated prior to being modified for erosion resistance.

As described above, we are recommending that safety fans be excluded from the scope of coverage. Our suggested definition for "safety fan" is:

"Safety fan" means:

(1) A fan that is designed, marketed, and labeled to operate only at or above 482 degrees F (250 degrees C);
(2) A reversible axial fan in cylindrical housing that is designed and marketed for use in ducted tunnel ventilation and labeled as a fan that will reverse operations under emergency ventilation conditions;
(3) A fan bearing a UL or ETL 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 3000 FPM;
(5) A fan labeled as, and constructed in accordance with, AMCA type A or B spark resistant construction as defined in AMCA Standard 99-16;
(6) A fan designed and marketed for use in explosive atmospheres and tested and marked according to EN 13463-1:2001; or
(7) An electric-motor-driven Positive Pressure Ventilator as defined in AMCA Standard 240-15.

As described below in the section on filing by manufacturers, we are suggesting that maximum rated air flow, maximum rated pressure, and maximum rated speed be reported for each fan model to bound the compliant operating range. We are also suggesting that maximum rated speed in some cases be included on a fan's label. We believe that it will be useful to define these terms.

We have suggested deleting two definitions for "axial power roof ventilator (PRV)" and "centrifugal power roof ventilator (PRV) exhaust." These two types of fans are both power roof/wall ventilators, which are separately defined; therefore, we do not believe that it is necessary to include these additional definitions.

We have also provided a few edits to some of the other proposed definitions. Most importantly, we have suggested edits to the definition for "commercial and industrial fan and blower." Our suggested revised definition is:

"Commercial and industrial fan and blower" means a rotary-bladed machine used to convert power to air power, with a specific work limited to 25 kJ/kg or less, consisting of an impeller, a shaft, bearings, and a structure or housing; and includes any transmissions, driver, and/or controls if integrated, assembled, or packaged by the manufacturer at the time of sale; and with rated shaft input power greater than or equal to 1 horsepower, or, for fans without a rated shaft input power, electrical input power greater than or equal to 1 kW, and fan airpower less than or equal to 150 horsepower.

It is important to include the phrase "with a specific work limited to 25 kJ/kg or less" to distinguish fans and blowers from air compressors. It is also important to include the phrase "consisting of an impeller, a shaft, bearings, and a structure or housing; and includes any transmissions, driver, and/or controls if integrated, assembled, or packaged by the manufacturer at the time of sale" to help define which components must be present for a fan to meet the definition of "fan and blower" and to clarify that a "fan" can include a transmission, driver, and/or controls if they are included by the manufacturer in the fan's rating. Finally, we have clarified that the 1 kW input power limit refers to electrical input power, not shaft power. (Fans rated in electrical input power are tested wire-to-air and thus do not have a measured shaft power.)

Test Methods

Pressure basis and installation type

For many fan categories, Table A.2 of AMCA 208 allows ratings based on either static pressure or total pressure. Similarly, in many cases the table allows more than one installation configuration for testing. However, for regulatory purposes, we recommend that the test method specify a single pressure basis (static or total) and installation type (e.g., free inlet, free outlet) for each fan category. This will ensure that all fans of a given category are tested and rated the same way. Table 1 shows our specific recommendations for pressure basis and installation type for each fan category.

For three fan categories (axial inline, centrifugal housed and centrifugal PRV supply, and centrifugal inline and inline mixed flow), we are recommending that either installation type D or type B be permitted for testing. Performance results for these two test configurations are identical because they both allow the use of an inlet bell during the test. As an example, configuration D allows the use of an inlet bell and/or short duct to simulate an inlet duct. Configuration B is described as a free inlet (non-ducted), but also allows for an inlet bell to be used during the test. Allowing either configuration to be used for these three fan categories will thus reduce the need for manufacturers to re-test products while having no impact on the test results. We also recommend that installation type D be used for any verification testing for these three fan categories.

Table 1. Recommended pressure basis and installation type for testing each fan category

Fan Category	Pressure Basis	Installation Type
Axial inline fans	Total	D or B
Axial panel fans	Static	A
Centrifugal housed fans and centrifugal PRV supply fans	Total	D or B
Centrifugal unhoused fans	Static	A
Centrifugal inline fans and inline mixed flow fans	Total	D or B
Radial housed fans	Total	D
Power roof/wall ventilators (excluding centrifugal PRV supply fans)	Static	A

Dual-use fans

For dual-use fans, we recommend that the test method specify that these fans be tested in their general ventilation mode.

Erosion-resistant fans

For erosion-resistant fans, we recommend that the test method specify that these fans be tested prior to being modified for erosion resistance.

Use of fan laws in developing ratings

It is common for a fan product line to consist of a wide range of diameters (i.e., "sizes"). Manufacturers commonly use the fan laws to develop ratings for larger-diameter fans based on test data of a geometrically-similar, smaller-diameter fan. (Geometrically-similar means that dimensional features of the two fans must be in proportion to their diameters.) This approach is conservative because efficiency increases with fan size, which is not taken into account when the fan laws are applied. Therefore, there is little incentive to use the fan laws to extrapolate performance for all representations. To limit test burden, we recommend that the test method include the option for manufacturers to use the fan laws to develop ratings. Specifically, we recommend that the fan laws, as defined in ANSI/AMCA 99-16, may be used to calculate the performance ratings of fans from tests of geometrically-similar fans tested at other speeds and/or smaller sizes.

Any verification testing could be done on any fan diameter including diameters for which the rating was developed using the fan laws.

Use of other calculation methods in developing ratings

Manufacturers also use other calculation methods to develop ratings for other types of product variations. For example, for axial fans, manufacturers commonly interpolate between pitch angles to develop performance data encompassing an entire range of available pitch angles. Manufacturers will also interpolate data between non-geometrically similar designs. However, these interpolations are not standardized. Instead, each manufacturer has developed their own method for conducting these interpolations based on their own fan designs. Therefore, it is not possible for the test method to specify how to do these additional types of calculations. Instead, we recommend that manufacturers be allowed to develop ratings using their own calculation methods. Allowing manufacturers to use calculation methods as an alternative to testing each and every variation in design will significantly reduce test burden.

For fan models for which the ratings are developed using calculation methods, the manufacturer's test report would consist of the underlying physical test data (to which the calculations were then applied) along with a description of how any calculations were done to develop the fan rating. Verification testing could be conducted on any model regardless of how the rating was developed.

Standards

We have one suggestion for the proposed regulatory language for standards to try to clarify that the standard applies to all fan duty points that are offered for sale. Specifically, we suggest the following language:

Commercial and Industrial Fans and Blowers. The FEI of commercial and industrial fans and blowers manufactured on or after January 1, 2020, shall be at least 1.0 or higher at all duty points offered for sale.

Filing by Manufacturers

In the Appendix we have provided specific suggested edits to the information that manufacturers would be required to report to the Energy Commission's MAEDbS. Table 2 shows the fields we recommend be included in the MAEDbS.

We are suggesting a number of edits to the basic information to be reported about each fan model. We have added the reporting of the fan manufacturer, model, and diameter. For fan type, we have added additional permissible answers to try to encompass the complete set of fan types that would be included in the scope of coverage. We have also deleted "embedded fan" from the list of permissible answers because we believe that the fan type should describe the fan itself. We have deleted the reporting of impeller type because that information appears to be unnecessary. We have also deleted the reporting of motor, transmission, and controller efficiency since the efficiency of those components is not fixed, but rather varies with fan duty point. We have added reporting of motor and controller model numbers and suggested that the reporting of motor and controller manufacturers and model numbers be required only if applicable since fans are not always sold with motors and/or controllers. We have also suggested that the reporting of transmission type be changed to a question about whether the transmission is direct-drive.

Table 2 also includes our proposed simplified approach for reporting information about a fan's compliant operating range. Our proposed approach would significantly reduce the number of data points required to be reported for each model. We have suggested reporting the maximum rated speed (RPM), maximum rated air flow (CFM), and maximum rated pressure (in. wg). This information will allow the Energy Commission to verify that manufacturers are not advertising fans for sale at duty points with speeds, air flows, and/or pressures that are greater than the maximum reported values. Our proposed approach also includes reporting of information at the fan duty point that represents the maximum fan energy index (FEI) at the maximum rated speed. This information would include air flow (CFM), pressure (in. wg), fan shaft power (HP),[2] fan electrical power (FEP) (kW), and FEI.

[2] Fan shaft power would not be reported for fans tested wire-to-air.

Table 2. Recommended fields for MAEDbS reporting

Required Information	Permissible Answers
…	…
Manufacturer	
Product Line	
Model	
Fan type	Centrifugal Housed and Centrifugal PRV Supply, Centrifugal Unhoused, Axial Inline, Centrifugal Inline and Inline Mixed-Flow, Power Roof/Wall Ventilators (excluding Centrifugal PRV Supply), Axial Panel, Radial Housed
Fan impeller diameter (in.)	
Motor Manufacturer (if fan is certified with a motor)	
Motor model number (if fan is certified with a motor)	
Direct-Drive Transmission	Yes, No
Controller Manufacturer (if fan is certified with a controller)	
Controller model number (if fan is certified with a controller)	
Max rated speed (RPM)	
Max rated air flow (CFM)	
Max rated pressure (in. wg)	
Max FEI at max rated speed	
Air flow at max FEI at max rated speed (CFM)	
Pressure at max FEI at max rated speed (in. wg)	
Fan shaft power at max FEI at max rated speed (HP) (unless fan is tested wire-to-air)	
FEP at max FEI at max rated speed (kW)	

Figure 1 illustrates our proposed approach for reporting information about a fan's compliant operating range.[3]

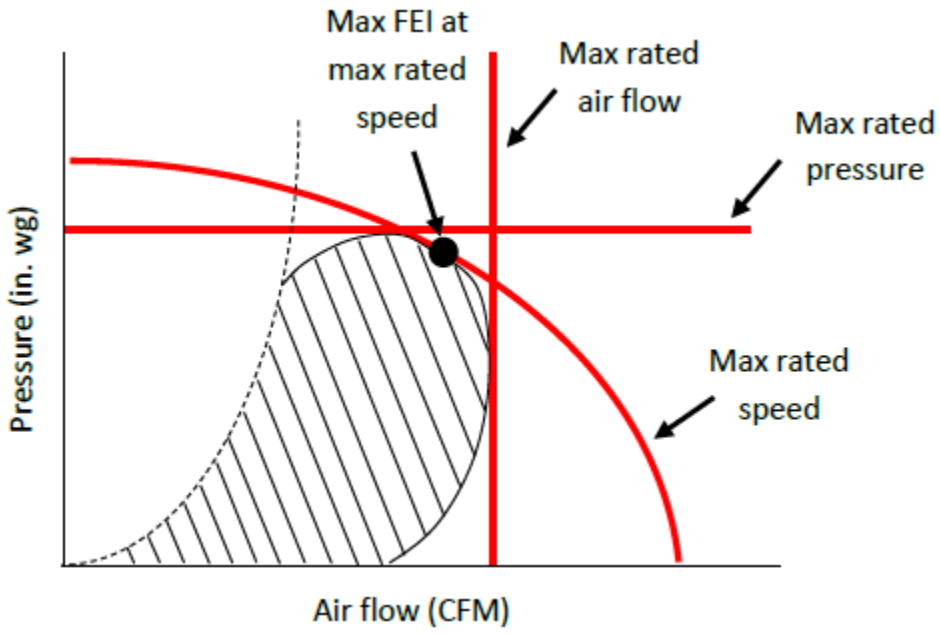

Figure 1. Proposed approach for reporting information about a fan's compliant operating range

As described above, for adjustable-pitch axial fans we are suggesting that all blade pitches of a certain size fan may be considered a single "basic model." As shown in Figure 2, the operating range for an adjustable-pitch axial fan consists of a series of fan curves, each at a different blade pitch at a given speed. The compliant operating range for these fans would be bounded by the maximum rated air flow and the maximum rated pressure. The maximum FEI at the maximum rated speed would generally be at an intermediate blade pitch. (Note that each fan curve in Figure 2 is at the same speed, which is equivalent to the maximum rated speed.)

[3] We note that for a fan driven by a motor with high slip, the motor speed along a given pressure curve will not be constant.

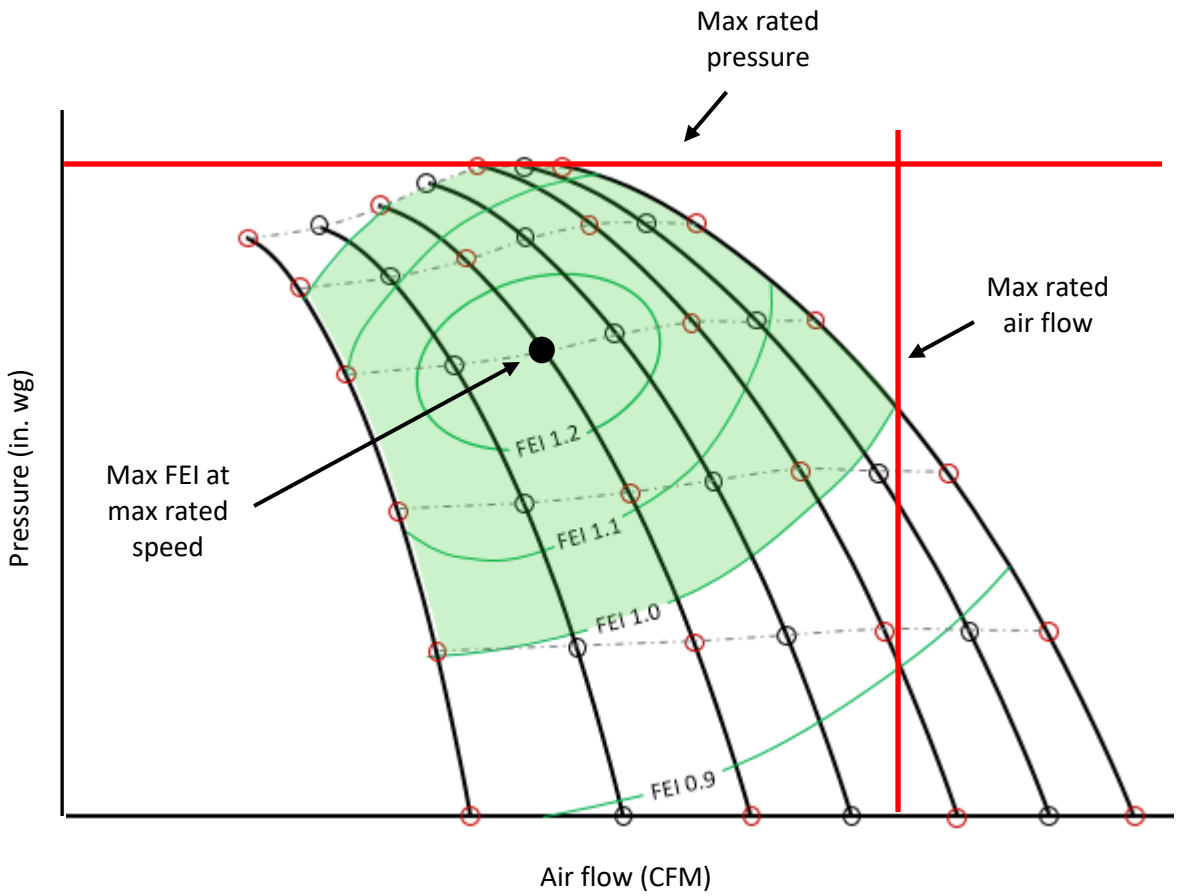

Figure 2. Proposed approach for reporting information about a fan's compliant operating range for adjustable-pitch axial fans

We have also suggested that all impeller widths and impeller diameters of a certain size centrifugal fan may be considered a single "basic model." For these fans, we recommend that the model sized at 100% impeller width and 100% impeller diameter be reported to the MAEDbS.

Finally, there are also custom fans that are engineered-to-order on a per-application basis. Custom fans can be engineered to literally any size resulting in an infinite number of combinations of available product configurations. Custom fans would not meet our recommended definition of "basic model" since they are not "a catalogued product that is engineered and offered for sale with no modification necessary." We recommend that each individual custom fan not be required to be reported to the MAEDbS. However, there may be a way for performance data for "prototypes" of custom fans to be reported, and we look forward to working with Energy Commission staff on any details related to custom fans.

Marking

If possible, we recommend that the Energy Commission allow manufacturers the option of providing the marking either in tabular format or any barcode of a published format (e.g., a QR code).[4] We believe that these options will give manufacturers greater flexibility while still allowing a code official, for example, to easily access the marking information.

In the Appendix we have provided a few edits to the proposed marking requirements for stand-alone fans. Table 3 shows our suggested marking requirements for stand-alone fans when the design point is known. We have suggested that either the serial number or the date manufactured should be included on the label, but it is not necessary for both items to be included. (This is also consistent with the ASRAC term sheet.) We believe that it is important to specify whether the design pressure is in terms of static pressure or total pressure. We also recommend that the label include a link to a fan's complete performance map so that a contractor or end-user can have easy access to information about the fan's compliant operating range.

Table 3. Recommended marking requirements for stand-alone fans when the design point is known

Manufacturer Name, Brand Name, or Brand Code
Model number
Serial number or date manufactured
Design air flow (CFM)
Design pressure (static or total, in. wg)
FEI at design point
Design speed (RPM)
Public internet link to complete performance map

For stand-alone fans when the design point is unknown, we recommend that in addition to the basic information about the fan model (manufacturer, model number, serial number or date manufactured), the marking include the maximum rated speed and a link to the complete performance map, as shown in Table 4. We believe that a link to a complete performance map of the fan is a more feasible way of providing information about the compliant operating range than a list of compliant pressures and air flows. In addition, a link to the performance map would provide better information since compliant pressures are only compliant at certain air flows, and vice versa.

[4] Commercial and industrial pumps are increasingly being marked with QR codes to allow for easy access of Pump Energy Index (PEI) and other product information.

Table 4. Recommended marking requirements for stand-alone fans when the design point is unknown

Manufacturer Name, Brand Name, or Brand Code
Model number
Serial number or date manufactured
Maximum rated speed (RPM)
Public internet link to complete performance map

Fan Performance Representations

We urge the Energy Commission as part of this rulemaking to establish requirements regarding fan performance representations (e.g., marketing materials, sales literature, technical project documentations, selection software) since the majority of the savings from the proposed standards will come from improved fan selections. Fan suppliers (e.g., manufacturers, distributors) typically provide information about a fan's operating range in catalogs or other marketing materials. Many fan suppliers also have selection software, which allows a user to input a design flow and pressure, and the software returns a list of potential selections. Today, the operating points shown in catalogs and the fan selections returned by software are typically limited only by the surge region and the fan's maximum speed (which is dependent on the structural integrity of the fan impeller). However, under the Energy Commission's proposed standards, the compliant operating range of a given fan will likely be smaller than the currently-advertised operating range. In order for the proposed standards to be effectively implemented, it is important that there be requirements regarding all fan performance representations in order to help ensure that purchasers are selecting fans that meet the standard at the design point.

For all fan performance representations, we recommend that a supplier must clearly distinguish performance that meets the California standards and performance that does not.

Enforcement

We encourage the Energy Commission to clarify at what point in the supply chain enforcement would take place. For example, there could be a situation where a fan manufacturer sells a fan to an OEM in California who then embeds that fan in a piece of equipment that is exempted by the fan standards. Our understanding is that the intent is not to require that the stand-alone fan in that scenario be certified, but it would be helpful to have additional clarification. We also encourage the Energy Commission to consider the role that Title 24 could play in enforcement efforts.

Thank you for considering these comments.

APPENDIX: Suggested Edits to the Proposed Regulatory Language

CHAPTER 10:
Proposed Regulatory Language

The proposed changes to the Title 20 standards are provided below. Changes to the standards are marked with underline for new language relevant to commercial and industrial fans and blowers and ~~strike-out~~ to delete existing language. Three dots or "…" represent the substance of the regulations that exists between the proposed language and current language.

The proposed regulations will:

1. Expand the scope of the regulations to include commercial and industrial fans and blowers.
2. Define the test methods to measure the efficiency of commercial and industrial fans and blowers.
3. Establish a minimum Fan Energy Index (FEI) of 1.0 for commercial and industrial fans and blowers.
4. Establish manufacturer data submittal requirements for the certification of commercial and industrial fans and blowers.
5. Establish marking requirements for commercial and industrial fans and blowers.

The efficiency standards for commercial and industrial fans and blowers would apply to fans manufactured on or after January 1, 2020, or at least one year from the adoption of this regulation.

Section 1601. Scope

…

(d) Spot air conditioners, evaporative coolers, residential furnaces, ceiling fans, ceiling fan light kits, whole house fans, residential exhaust fans, ~~and~~ dehumidifiers, and commercial and industrial fans and blowers.

1) Commercial and industrial fans and blowers do not include:

   a) Radial housed unshrouded fans with diameter less than 30 inches and~~or~~ a blade width of less than 3 inches;

   b) Safety fans;

   c) Ceiling fans;

   ~~a)~~d) Circulating fans;

   ~~b)~~e) Induced flow fans;

   ~~c)~~f) Jet fans;

~~d)~~g) Cross-flow fans;

~~e)~~h) Fans embedded in central air conditioners and central air-conditioning heat pumps as defined at 10 CFR 430.2;

~~f~~i) Small commercial packaged air-conditioning and heating equipment as defined at 10 CFR 431.92 with cooling capacity less than 65,000 Btu/h.

~~g~~j) Furnaces as defined at 10 CFR 430.2;

~~h~~k) Transport refrigeration and fans exclusively powered by internal combustion engines;

~~i~~l) Vacuums;

~~j~~m) Heat rejection equipment;

~~k~~n) Air curtain units;

~~l~~o) Supply and condenser fans in air-cooled commercial package air-conditioning and heating equipment as defined at 10 CFR 431.92 with cooling capacity greater than or equal to 65,000 Btu/h and less than 760,000 Btu/h;

~~m~~p) Fans in water-cooled and evaporative-cooled commercial package air conditioning and heating equipment as defined at 10 CFR 431.92 with cooling capacity less than 760,000 Btu/h;

~~n~~q) Fans in water-source heat pumps as defined at 10 CFR 431.92 with cooling capacity less than 135,000 Btu/h;

~~o~~r) Fans in single-package vertical air conditioners and single-package vertical heat pumps as defined at 10 CFR 431.92 with cooling capacity less than 240,000 Btu/h;

~~p~~s) Fans in packaged terminal air conditioners and packaged terminal heat pumps as defined at 10 CFR 431.92 with cooling capacity less than 760,000 Btu/h; or

~~q~~t) Fans in variable refrigerant flow multisplit air conditioners and variable refrigerant flow multisplit heat pumps as defined at 10 CFR 431.92 with cooling capacity less than 760,000 Btu/h.

Section 1602. Definitions

…

(d) Spot Air Conditioners, Evaporative Coolers, Ceiling fans, Ceiling Fan Light Kits, Whole House Fans, Residential Exhaust Fans, ~~and~~ Dehumidifiers, and Commercial and Industrial Fans and Blowers.

…

"Air Curtain unit" means 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.

"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.

"Axial-panel fan" means a fan with an axial impeller mounted in a short housing 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.

~~"Axial power roof ventilator (PRV) means a fan with an axial impeller and a cylindrical housing as well as a housing to prevent precipitation from entering the building with or without turning vanes used to exhaust air from a building. Inlets and outlets can optionally be ducted.~~

…

"Basic model" of a commercial and industrial fan and blower means a catalogued product that is engineered and offered for sale with no modification necessary, typically consisting of a product and size; and, in addition:

(1) All blade pitches of a certain size adjustable-pitch axial fan may be considered a single basic model; and

(2) All impeller widths and impeller diameters of a certain size centrifugal fan may be considered a single basic model.

"Centrifugal housed fan" means a fan with a centrifugal 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.

"Centrifugal inline fan" means a fan with a centrifugal 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.

~~"Centrifugal power roof ventilator (PRV) exhaust" means a PRV with a centrifugal impeller that exhausts air from a building. Inlets are typically ducted, but outlets are not ducted.~~

"Centrifugal power roof ventilator (PRV) supply fan" means a PRV with a centrifugal impeller that supplies air to a building. Inlets are not ducted and outlets are typically ducted.

"Centrifugal unhoused fan" means a fan with a centrifugal impeller in which airflow enters through a panel and discharges into free space. ~~Inlets and o~~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.

"Circulating fan" means 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, designed to be used for the general circulation of air.

…

"Commercial and industrial fan and blower" means a rotary-bladed machine used to convert power to air power, with a specific work limited to 25 kJ/kg or less, consisting of an impeller, a shaft, bearings, and a structure or housing; and includes any transmissions, driver, and/or controls if integrated, assembled, or packaged by the manufacturer at the time of sale; and with rated shaft input power greater than or equal to 1 horsepower, or, for fans without a rated shaft input power, electrical input power greater than or equal to 1 kW, and fan airpower less than or equal to 150 horsepower~~with a brake horsepower greater than or equal to either 1 kW or 1 horsepower, and an air horsepower less than or equal to 150~~.

“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.

…

“Dual-use fan” means a fan having two operating modes as to serve long-term ventilation purposes as well as short-time emergency duty at higher speed for fire or smoke extraction.

“Embedded fan” means a fan that is set or fixed firmly inside or attached to a surrounding piece of equipment whose purpose exceeds that of a fan or is different than that of a stand-alone fan. This equipment may have safety or energy efficiency requirements of its own. Examples of embedded fans include supply fans in air-handling

units, condenser fans in heat rejection equipment, tangential blowers in air curtain units, and induced or forced draft combustion blowers in boilers or furnaces.

…

"Erosion-resistant fan" means a fan designed with features intended to reduce erosion by particles or liquids passing through the fan, thereby extending its useful life. Such features may include wear plates, deflector vanes, and/or thick coatings of erosion resistant material, and will reduce the efficiency of the fan.

"Fan air power" means the fan output power as determined in accordance with the test procedure specified in Table D-1 of Section 1604(d).

"Fan Energy Index or FEI" means the ratio of a reference fan electrical input power over actual fan electrical input power as calculated under the test method in Section 1604(d).

"Fan Electrical Power or FEP" means the fan electrical power associated with a given fan duty point, in terms of airflow and pressure, as calculated under the test method in Section 1604(d).

…

"Induced-flow fan" means a housed fan with a nozzle and windband whose outlet airflow is greater than the inlet airflow due to induced airflow. All the flow entering the inlet will exit through the nozzle. The flow exiting the windband will include the nozzle flow plus the induced flow.

"Inline mixed-flow fan" means a fan with a 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.

"Jet fan" means a fan used for producing a high-velocity flow of air in a space. The typical function is to add momentum to the air within a tunnel. Inlets and outlets are not ducted.

…

"Maximum rated air flow" means the manufacturer-declared maximum air flow (in CFM) at which at least one duty point is compliant.

"Maximum rated pressure" means the manufacturer-declared maximum pressure (in in. wg) at which at least one duty point is compliant.

"Maximum rated speed" means the manufacturer-declared maximum operating speed (in RPM) at which at least one duty point is compliant.

"Power roof/wall ventilator (PRV)" means a fan with an internal driver and a housing to prevent precipitation from entering the building and with a base designed to fit, usually by means of a roof curb, over a roof or wall opening.

…

"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 unshrouded fan" means a radial housed fan where the impeller does not contain a shroud.

"Safety fan" means:

(1) A fan that is designed, marketed, and labeled to operate only at or above 482 degrees F (250 degrees C);

(2) A reversible axial fan in cylindrical housing that is designed and marketed for use in ducted tunnel ventilation and labeled as a fan that will reverse operations under emergency ventilation conditions;

(3) A fan bearing a UL or ETL 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 3000 FPM;

(5) A fan labeled as, and constructed in accordance with, AMCA type A or B spark resistant construction as defined in AMCA Standard 99-16;

(6) A fan designed and marketed for use in explosive atmospheres and tested and marked according to EN 13463-1:2001; or

(7) An electric-motor-driven Positive Pressure Ventilator as defined in AMCA Standard 240-15.

"Shroud" means a plate located on the front side of an impeller used to aerodynamically increase fan efficiency.

…

"Stand-alone fan" means a fan in at least a minimum testable configuration, as defined in Section 4.1 of AMCA 208, including any motor, transmission, or motor controller if included in the rated fan, as well as any attachments included in the rated fan, excluding the impact of any surrounding equipment whose purpose exceeds or is different than that of the fan. Stand-alone fans do not include provisions for air conditioning, air filtration, air mixing, air treatment, or heating. Examples include power

roof ventilators, side-wall exhaust fans, ~~whole-house~~plenum fans, inline fans, ~~ceiling-~~ centrifugal supply fans, ~~jettunnel fans,~~ and ~~induced-flow~~ laboratory exhaust fans.

…

Section 1604. Test Methods

…

(d) Spot Air Conditioners, Evaporative Coolers, Ceiling Fans, Ceiling Fan Light Kits, Whole House Fans, Residential Exhaust Fans, ~~and~~ Dehumidifiers, and Commercial and Industrial Fans and Blowers.

The test methods for spot air conditioners, evaporative coolers, ceiling fans, ceiling fan light kits, whole house fans, residential exhaust fans, ~~and~~ dehumidifiers, and commercial and industrial fans and blowers are shown in Table D-1.

Table D-1

Spot Air Conditioners, Ceiling Fan, Ceiling Fan Light Kit, Evaporative Cooler, Whole House Fan, Residential Exhaust Fan, Commercial and Industrial Fans and Blowers, and Dehumidifier Test Methods

Appliance	Test Method
Spot Air Conditioners	ANSI/ASHRAE 128-2001
Ceiling Fans, Except Low-Profile Ceiling Fans	10 C.F.R. section 430.23(w) (Appendix U to Subpart B of part 430)
Ceiling Fan Light Kits	10 C.F.R section 430.23(x) (Appendix V to Subpart B of part 430)
Evaporative Coolers	ANSI/ASHRAE 133-2008 for packaged direct evaporative coolers and packaged indirect/direct evaporative coolers; ANSI/ASHRAE 143-2007 for packaged indirect evaporative coolers
Whole House Fans	HVI-916, tested with manufacturer-provided louvers in place (2009)
Dehumidifiers	10 C.F.R. section 430.23(z) (Appendix X to Subpart B of part 430, active mode portion only)
Residential Exhaust Fans	HVI-916 (2009)
Residential Furnace Fans	10 C.F.R. section 430.23(cc) (Appendix AA to Subpart B of part 430)
Commercial and Industrial Fans and Blowers	ANSI/AMCA Standard 208-18 Calculation of the Fan Energy Index

Each fan category shall be tested according to the pressure basis and installation type outlined in the following table:

Fan Category	Pressure Basis	Installation Type
Axial inline fans	Total	D or B
Axial panel fans	Static	A
Centrifugal housed fans and centrifugal PRV supply fans	Total	D or B
Centrifugal unhoused fans	Static	A
Centrifugal inline fans and inline mixed flow fans	Total	D or B
Radial housed fans	Total	D

Power roof/wall ventilators (excluding centrifugal PRV supply fans)	Static	A

Dual-use fans shall be tested in their long-term, non-emergency ventilation mode.

Erosion-resistant fans shall be tested prior to being modified for erosion resistance.

The fan laws, as defined in ANSI/AMCA 99-16, may be used to calculate the performance ratings of fans from tests of geometrically-similar fans tested at other speeds and/or smaller sizes.

Section 1605.1. Federal and State Standards for Federally Regulated Appliances

…

(d) Spot Air Conditioners, Evaporative Coolers, Ceiling Fans, Ceiling Fan Light Kits, Whole House Fans, Residential Exhaust Fans, ~~and~~ Dehumidifiers, and Commercial and Industrial Fans and Blowers.

…

(4) See Section 1605.3(d) for energy efficiency standards for commercial and industrial fans and blowers.

(5) There are no energy efficiency standards or energy design standards for spot air conditioners, evaporative coolers, whole house fans, or residential exhaust fans. There are no efficiency standards for ceiling fans and ceiling fan light kits.

…

Section 1605.2. State Standards for Federally Regulated Appliances.

…

(d) Spot Air Conditioners, Evaporative Coolers, Ceiling Fans, Ceiling Fan Light Kits, Whole House Fans, Residential Exhaust Fans, ~~and~~ Dehumidifiers, and Commercial and Industrial Fans and Blowers.

…

(3) See Section 1605.3(d) for energy efficiency standards for commercial and industrial fans and blowers.

(4) There are no energy efficiency standards or energy design standards for spot air conditioners, evaporative coolers, whole house fans, or residential exhaust fans. There are no efficiency standards for ceiling fans and ceiling fan light kits.

…

Section 1605.3. State Standards for Non-Federally-Regulated Appliances

…

(d) Spot Air Conditioners, Evaporative Coolers, Ceiling Fans, Ceiling Fan Light Kits, Whole House Fans, Residential Exhaust Fans, ~~and~~ Dehumidifiers, and Commercial and Industrial Fans and Blowers.

(1) See Section 1605.1(d) for energy design standards for ceiling fans and ceiling fan light kits.

(2) See Section 1605.1(d) for energy efficiency standards for dehumidifiers.

(3) Commercial and Industrial Fans and Blowers. The FEI of commercial and industrial fans and blowers manufactured on or after January 1, 2020, shall be at least 1.0 or higher at all duty points offered for sale.

(4) There are no energy efficiency standards or energy design standards for spot air conditioners, evaporative coolers, whole house fans, or residential exhaust fans. There are no efficiency standards for ceiling fans and ceiling fan light kits.

Section 1606. Filing by Manufacturers; Listing of Appliances in Database.

(a) Filing of Statements

{Skipping (a)(1)-(3) and sections A-C of Table X}

	Appliance	Required Information	Permissible Answers
…	…	…	…
D		Manufacturer	
	Commercial and Industrial Fans and Blowers	Product Line	
		Model	
		Fan type	Centrifugal Housed and Centrifugal PRV Supply, Centrifugal Unhoused, Axial Inline, Centrifugal Inline and Inline Mixed-Flow, Power Roof/Wall Ventilators (excluding PRV Supply), Axial Panel, Radial Housed~~Embedded~~ ~~Fan~~
		~~Impeller type~~Fan impeller diameter (in.)	
		Motor Manufacturer (if fan is certified with a motor)	
		Motor ~~Efficiency~~model number (if fan is certified with a motor)	
		Direct-Drive Transmission	~~Belt-Drive or Direct-Drive~~Yes, No
		~~Transmission Efficiency~~	
		Controller Manufacturer (if fan is certified with a controller)	
		Controller ~~Efficiency~~model number (if fan is certified with a controller)	
		Max rated speed (RPM)	
		Max rated air flow (CFM)	
		Max rated pressure (in. wg)	
		Max FEI at max rated speed	
		Air flow at max FEI at max rated speed (CFM)	

Pressure at max FEI at max rated speed (in. wg)	
Fan shaft power at max FEI at max rated speed (HP) (unless fan is tested wire-to-air)	
FEP at max FEI at max rated speed (kW)	
~~Pressure 1 (P1) (in. wg)~~	
~~Min Air flow at P1 (cfm)~~	
~~Max Air flow at P1 (cfm)~~	
~~Air Density at P1 (lbm/cf)~~	
~~Min FEP actual at P1 (kW)~~	
~~Max FEP actual at P1 (kW)~~	
~~Min fan shaft power at P1 (HP)~~	
~~Max fan shaft power atP1 (HP)~~	
~~Min FEP ref at P1 (kW)~~	
~~Max FEP ref at P1 (kW)~~	
~~FEI at min air flow at P1~~	
~~FEI at max air flow at P1~~	
~~Pressure 2 (P2) (in.wg)~~	
~~Min Air flow at P2 (ft^3 per min)~~	
~~Max Air flow at P2 (ft^3 per min)~~	
~~Air Density at P2 (lbm/ft^3)~~	
~~Min FEP actual at P2 (kW)~~	
~~Max FEP actual at P2 (kW)~~	
~~Min fan shaft power at P2 (HP)~~	
~~Max fan shaft power at P2 (HP)~~	
~~Min FEP ref at P2 (kW)~~	
~~Max FEP ref at P2 (kW)~~	
~~FEI at min air flow at P2~~	
~~FEI at max air flow at P2~~	
~~Pressure 3 (P3) (in.wg)~~	
~~Min Air flow at P3 (ft^3 per min)~~	
~~Max Air flow at P3 (ft^3 per min)~~	
~~Air Density at P3 (Lbm/ft^3)~~	
~~Min FEP actual at P3 (kW)~~	
~~Max FEP actual at P3 (kW)~~	

~~Min fan shaft power at P3 (HP)~~	
~~Max fan shaft power at P3 (HP)~~	
~~Min FEP ref at P3 (kW)~~	
~~Max FEP ref at P3 (kW)~~	
~~FEI at min air flow at P3~~	
~~FEI at max air flow at P3~~	
~~Pressure 4 (P4) (in.wg)~~	
~~Min Air flow at P4 (ft^3 per min)~~	
~~Max Air flow at P4 (ft^3 per min)~~	
~~Air Density at P4 (Lbm/ft^3)~~	
~~Min FEP actual at P4 (kW)~~	
~~Max FEP actual at P4 (kW)~~	
~~Min fan shaft power at P4 (HP)~~	
~~Max fan shaft power at P4 (HP)~~	
~~Min FEP ref at P4 (kW)~~	
~~Max FEP ref at P4 (kW)~~	
~~FEI at min air flow at P4~~	
~~FEI at max air flow at P4~~	
~~Pressure 5 (P5) (in.wg)~~	
~~Min Air flow at P5 (ft^3 per min)~~	

	~~Max Air flow at P5 (ft^3 per min)~~	
	~~Air Density at P5 (Lbm/ft^3)~~	
	~~Min FEP actual at P5 (kW)~~	
	~~Max FEP actual at P5 (kW)~~	
	~~Min fan shaft power at P5 (HP)~~	
	~~Max fan shaft power at P5 (HP)~~	
	~~Min FEP ref at P5 (kW)~~	
	~~Max FEP ref at P5 (kW)~~	
	~~FEI at min air flow at P5~~	
	~~FEI at max air flow at P5~~	
	~~Pressure 6 (P6) (in. wg)~~	
	~~Min Air flow at P6 (ft^3 per min)~~	
	~~Max Air flow at P6 (ft^3 per min)~~	
	~~Air Density at P6 (Lbm/ft^3)~~	
	~~Min FEP actual at P6 (kW)~~	
	~~Max FEP actual at P6 (kW)~~	
	~~Min fan shaft power at P6 (HP)~~	
	~~Max fan shaft power at P6 (HP)~~	
	~~Min FEP ref at P6 (kW)~~	
	~~Max FEP ref at P6 (kW)~~	
	~~FEI at min air flow at P6~~	
	~~FEI at max air flow at P6~~	
	~~Maximum rated speed (RPM)~~	

…

Section 1607. Marking of Appliances

…

(d) Energy Performance Information.

…

(14) Commercial and Industrial Fans and Blowers. Each commercial and industrial fan and blower shall be marked with a legible and permanently fixed label, which may be in tabular form (as shown below), or any barcode of a published format:

(A)For stand-alone fans ~~designed to a specific operating point~~for which the design point is known, the fan shall be marked with the following information:

Manufacturer Name, Brand Name, or Brand Code
Model number
Serial number ~~and~~ or date manufactured
Design air flow (CFM)
Design pressure (static or total, in. wg)
FEI at design point
Design speed~~ed~~ (RPM)
~~Ducted or unducted~~Public internet link to complete performance map

(B)For stand-alone fans ~~designed~~ for which the~~with~~ design point is u~~U~~nknown, the marking shall include:

Manufacturer Name, Brand Name, or Brand Code
Model number
Serial number ~~and~~ or date manufactured
~~List of pressures fan is compliant under (in. wg)~~
~~List of volumetric flowrate (ft^3/min)~~
~~Static or total pressure~~
Maximum rated speed (RPM)
~~Ducted or unducted~~Public internet link to complete performance map

(C)For embedded, the marking shall be on the exterior of the unit the fan is embedded into and shall include the following information:

Model Number
Serial number and date manufactured
Design flow (CFM) and Operating speed (RPM)
FEI at design point
Total pressure at design point (in. wg)