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## AHRI Comments â€“ Title 20 Phase II Pre-Rulemaking â€“ Commercial and Industrial Fans & Blowers

*Additional submitted attachment is included below.*

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June 16, 2017

California Energy Commission
Docket Unit, MS-4
Re: Docket No. 17-AAER-06
1516 Ninth Street
Sacramento, California 95814-5512

Re: AHRI Comments – Title 20 Phase II Pre-Rulemaking – Commercial and Industrial Fans & Blowers *[Docket No. 17-AAER-06]*

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Dear CEC Staff:

These comments are submitted in response to the California Energy Commission (CEC) Phase II Pre-Rulemaking Invitation to Participate meeting held on May 11, 2017, regarding the proposal to establish minimum efficiency standards for commercial and industrial fans into California's Appliance Efficiency Standards in Title 20 of the California Code of Regulations, Sections 1601 through 1609.

AHRI is the trade association representing manufacturers of heating, cooling, water heating, and refrigeration equipment. More than 300 members strong, AHRI is an internationally recognized advocate for the industry, and develops standards for and certifies the performance of many of the products manufactured by our members. In North America, the annual output of the HVACR industry is worth more than $20 billion. In the United States alone, our members employ approximately 130,000 people, and support some 800,000 dealers, contractors, and technicians. In addition to its activities as a global standards developer, AHRI works closely with other global codes and standards developers as well as utilities to ensure their access to the latest technology and innovation from the HVACR and water heating industry.

## Background on the DOE Fans Rulemaking

AHRI represents 26 different types of products which use commercial and industrial fans, and manufacturers of fans, and was a member of the Department of Energy (DOE) Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) Commercial and Industrial Fans and Blowers Working Group to negotiate energy

conservation standards and test procedures for fans and blowers, held in 2015. Ultimately, AHRI voted against the final work product, the term sheet, as several key provisions were not included, the analysis contained fatal flaws, and the framework would not result in energy savings for all the included products. Despite AHRI's objections, the group did reach consensus on many issues and voted to approve the term sheet which is currently being developed into Notices of Proposed Rulemaking (NOPR) for energy conservation standards and test procedures for fans and blowers. As there is an active federal rulemaking underway, it is mystifying why California would devote considerable resources to develop its own regulation, which would only be preempted upon the completion of a federal standard.

The enormous complexity of the issues surrounding the regulation of fans is clear by looking at the history of the DOE rulemaking; which included a detailed framework document, three notices of data availability, three different metric proposals, an ASRAC working group consisting of 25 experts who met 16 times over the course of six months, only to yield a term sheet with significant holes and deficiencies. Based on many public statements, the DOE has been working diligently to turn the working group's term sheet into a viable regulation for these products. The time it is taking the federal government to develop the proposed rule is certainly commensurate with the intricacy of the issues. California embarking on its own, separate regulatory effort is detrimental to industry, confusing to consumers, and will not increase the efficiency of products into which fans are embedded.

The difficulties of a fans regulation begin at the very definition of the product – the working group discussed it at great length, and was unable to even agree upon a definition to exclude safety fans. The test procedure discussed at the working group, AMCA 210, is appropriate for stand-alone fans, but the ratings do not translate when the product is embedded into another piece of equipment. As the efficiency of fans embedded in HVACR and water heating equipment cannot be properly accounted for due to lack of an adequate test procedure, and the simple reason that the performance of embedded fans and stand-alone fans is inherently incomparable, AHRI urges CEC to exclude embedded fans from the scope of the regulation.

AHRI would like to stress that expanding the scope of proposed regulation to below one horsepower is not acceptable. The DOE ASRAC working group did agree on this issue.

## ASHRAE Standard 90.1

It is important that CEC follows closely the activities of ASHRAE Project Committee 90.1 (SSPC 90.1), the cognizant committee for ANSI/ASHRAE/IES Standard 90.1 -- *Energy Standard for Buildings Except Low-Rise Residential Buildings*. SSPC 90.1 is aware of the progress of the metrics agreed upon by the DOE ASRAC working group, fan electrical input power (FEP) and the fan energy index (FEI) which is allowed for representation, and is waiting for the relevant AMCA draft standard, 208, to be completed. At that time, the ASHRAE fans technical committee, TC 5.1, will evaluate FEI and advise SSPC 90.1

on the appropriate efficiency metric to use in the standard. We recommend that CEC wait until ASHRAE SSPC 90.1 has completed its review of this fan efficiency metric and adopted a proposal on a new fan efficiency metric. Neither the industry nor consumers can handle separate regulatory efforts on a federal level, in California, and through ASHRAE. All relevant stakeholders can participate in the ASHRAE Standard 90.1 process and even California looks to this standard as a source of ideas to generate proposals for improving Title 20 and Title 24. These efforts need to be coordinated and harmonized to avoid confusion and duplicative efforts.

## Definition of a Fan, Scope of Rulemaking

To respond to a question the CEC posed during the May 11th meeting, California should not pursue a scope broader than the one negotiated by the DOE ASRAC WG. In fact, the scope California pursues should be significantly narrowed. At a minimum, it should preserve all DOE negotiated exclusions.

As mentioned previously, the ASRAC WG struggled with finding consensus on the very definition of a fan as this component does not, strictly speaking, consume power. It is only when the impeller is connected to a motor, and the assembly is mounted in a housing, that the "fan" uses power and can be tested. This definition becomes difficult when one considers that many motors are already regulated, and the housing of the fan can be built into another product, which may or may not be regulated. As there is no way to compare the performance of embedded to stand-alone fans, and no procedure exists to test embedded fans, AHRI strongly urges California to exclude all fans embedded in all types HVACR and water heating equipment from the scope of this regulation. This includes all replacement fans for HVACR and water heating products.

Additionally, forward curve (FC) centrifugal fans need to be preserved as a separate class. The DOE incorrectly proposed to group FC fans with airfoil, backward curved and backward inclined (BI) fans in a single product class. Forward curve fans are often not interchangeable with BI fans. These two fan types have different characteristics and there would be a significant impact on product utility by grouping FC fans with airfoil, backward curved and BI fans. When the fan type changes from FC to BI, the BI fan of the same capacity requires a much larger and stronger cabinet to support the increased weight, bearings, and vibration intensity, and to deal with the faster rotational speed. The stronger cabinet is necessary to attenuate the differing acoustical signature of the BI fan. Further, the housing on a BI fan is typically larger than the FC housing, so maintaining the same diameter does not equate to preserving a fan footprint of the same size. Larger fan and housings can increase overall product size. For some products, such as rooftop units, this can have a significant impact on replacement costs to consumers. Larger physical dimensions can require the use of costly roof curbs to transition between the existing roof opening and the larger equipment foot print which increases external static pressure and resultant fan energy usage. Data on cost and external static pressure penalties for conversion cubs was collected by DOE in the analysis for the 2016 Final Rule for the Energy Conservation Standards for Small, Large, and Very Large Commercial Package

Air Conditioning and Heating Equipment. Where used, the conversion curb is expected to add additional external static pressure of 0.2 in w.c. Cost estimates were developed as a function of capacity; 7.5 ton rooftop conversion curb cost of $1000, $1750 for 15.0 ton unit and $4000 for a 30 ton unit.[1]

The flaw in logic DOE employed in its analysis is the assumption that FC fans and BI fans are interchangeable. This is not correct. In addition to impacts on equipment size, the acoustical utility of FC fans cannot be ignored, especially when acoustical controls are specified in high performance building codes like ANSI/ASHRAE Standard 189.1. Acoustical performance is also critical and regulated in some jurisdictions for classrooms as numerous studies have shown the impact of sound in the learning environment, especially in English Second Language situations where comprehension challenges are even greater. Furthermore, FC fans offer similar or better efficiencies when applied in the proper range of operating conditions, typically lower pressure uses often found in HVACR applications (pressures can be increased to have "better efficiency" situations but at higher energy use).

## Regulated Products Should be Excluded

Many systems that include commercial and industrial fans and blowers are already subject to DOE's energy conservation standards. Additionally, the energy efficiencies of these systems are determined through product performance rating standards and method of testing standards. Product categories enforced by the federal government are subject to federal standards and are preempted from state regulation. This includes the entire piece of equipment, including all components. Should California proceed with a fans rulemaking, *all* fans in *all* federally regulated products must be clearly and completely excluded. See Appendix A for a list of federally regulated products to exempt from the scope of this fans rulemaking.

Recommendation 8 of the DOE term sheet states, "Testing of embedded fans will be performed outside of the equipment in a standalone fan testable configuration. If necessary, 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 will be used to complete the fan testable configuration." Due to system effect, this testing strategy will not yield fan ratings that are meaningful when the fan is integrated into a piece of HVACR or water heating equipment. This principle applies to both regulated and non-regulated equipment. Further, the federal definition of "energy use" also clearly states that efficiency must be measured at the "point of use." 42 U.S.C. 6291(4) and 42 U.S.C. 6311 (4). Thus, because one metric should account for energy use at the point of use, it is therefore impossible, by definition, to test a fan separately/outside of the covered product. The proposed metric will not be measuring the efficiency as it operates within the covered product at *the point of use* if tested outside the system in which it operates.

[1] 81 Fed. Reg. at Page 2661 and 2476 (January 15, 2016) and Docket No. EERE-2013-BT-STD-0007-0085 (May 11-12, 2015) and Docket No. EERE-2013-BT-STD-0007-0089 (May 20-21, 2015)

For the same reasons, California also should exempt products it regulates under Title 20 Title 24. Refer to 20 CCR § 1606 Table X and Title 24 Table 110.2-A through Table 110.2-K for the lists of products regulated by the state of California which should be exempt from the scope of this fans rulemaking.

Additionally, regulations affecting fans used in combustion systems for furnaces, water heaters and boilers could have a variety of negative consequences. Pre-mix combustion air blowers are an essential part of all high efficiency combustion products. Limiting the range of operation or selection of combustion blowers could eliminate many of the highest efficiency heating products available. Limiting the range of operation of existing blowers will reduce or eliminate turndown ratio which has been a valuable energy saving feature for heating products.

Changes affecting fan operating ranges will not only directly affect combustion products, but indirectly affect them as well. Exhaust fans that are necessary for many modern vent installations require specialty fans that automatically adjust to match draft conditions. Limiting the operational range of exhaust fans could increase the potential for carbon monoxide poisoning, limit installation options and negatively affect efficiency.

## Tradeoffs for Equipment with Embedded Fans

Manufacturers optimize the efficiency of their products by making trade-offs between various options taking into consideration the energy conservation standards for the complete product and the performance required by consumers. Imposing efficiency standards on components narrows the manufacturer's choices to optimize complete and complex products. It can lead to an overall higher cost without providing any energy saving. This undermines the very principle of the life cycle cost analysis of complete products that regulatory agencies perform to prove that an efficiency standard is technologically feasible and economically justified.

The clear majority of fans in AHRI products are already regulated in California through Title 24 minimum efficiency tables that are comparable to the ASHRAE Standard 90.1 efficiency levels. This is an effective way to regulate products. One aspect of a consumer's purchase decision regarding HVAC products is based on overall product efficiency. By setting minimum standards based on ASHRAE Standard 90.1 for non-Federally regulated equipment, the consumer can choose from the entire range of efficiency options. Fan optimization is only one facet to overall product energy efficiency performance. There is no evidence that component regulation will save energy in equipment with system level efficiency requirements but there are reasons to believe that consumer cost will increase because manufacturers cannot employ all optimization options and must recover additional redesign costs.

Regulating fans incorporated into OEM products will represent a significant burden to OEM's as well as an enforcement burden as additional testing at the component level

would be required. Adding such testing obligations will hamper effective compliance and enforcement. There is no option to test embedded fans and have a rating comparable to stand alone fans.

The Commission should consider the positive impact part load metrics, such as IEER, have in driving use of variable speed fans in a growing percentage of variable air volume (VAV) products. The energy savings from use of variable speed fans to reduce air flow can have a larger impact on energy savings than changing fan efficiency. By implementing a component regulation on the fan, there is little incentive to improve the overall efficiency metric of the products. There are estimates of VAV share of rooftop market documented in the DOE CUAC and CWAF technical support document. The share of VAV increases as unit capacity increases. 2014 estimates show the share of VAV systems in rooftops at 6% for 7.5 tons, 9.2% for 15 tons and 34.7% for 30 tons. The share of VAV units will continue to grow with requirements for staged airflow in ASHRAE Standard 90.1 and California Title 24. While not included in DOE analysis, the VAV share is even higher in rooftops greater than 65 ton.

## Unintended Consequences of Regulating Equipment with Embedded Fans

Regulation of return fans (RAF) and exhaust fans (EAF) requires special consideration. These fans are often required to properly control building pressure. Poor building pressure control causes many problems including wasted energy. RAFs and EAFs must handle approximately the same air flow as the supply fan (SAF) but at a much lower external static pressure. Therefore, RAFs and EAFs cannot be selected at the same efficiency as the SAF unless they are much larger diameter with a larger footprint, which conflicts with the space constraints in the air handler. At the end of the day, RAFs and EAFs consume all the available space in the air handler such that any fan change likely requires a larger cabinet.

Replacement fans in HVACR and water heating equipment also warrant a scope exemption. There would be significant safety issues if one tried to replace a fan in a product with seismic certification, or just as importantly, gas or electric heat with a different fan. This would void all safety listings based on safety standards and the warranty.

Based on a DOE-funded study, the energy consumption of fans in heat rejection equipment (cooling towers, air-cooled chillers, and a portion of the condenser fans) is relatively modest because (1) their power input per ton of cooling is very low and (2) central systems with which they are used represent less than one third of commercial building floor space. Some of this equipment also has very low utilization values due to its operating characteristics – it is used at full power very infrequently and is used with variable speed devices in nearly all cases in the US due to Title 24 (CA) and ASHRAE 90.1/IECC (rest of US).[2] It is inappropriate to include fans in products that lack the

[2] Energy Consumption Characteristics of Commercial Building HVAC Systems Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Arthur D. Little Reference No. 33745-00, October 1999, http://apps1.eere.energy.gov/buildings/publications/pdfs/commercial_initiative/hvac_volume2_final_report.pdf

potential for energy savings in the scope of this rulemaking. More relevant energy efficiency metrics, such as kW/ton or gpm/hp, are widely used to express the energy use for much of this equipment. Additionally, there exists the potential for unintended increases in system energy use to accommodate a fan efficiency standard which drive fans to be larger and operate at slower speeds. The design challenges and costs associated with accommodating larger, slower, or different types of fans need to be properly included in CEC's analysis. The utility burdens of imposing separate fan efficiency regulations are likely extreme for these heat rejection devices.

Separate regulation of fans as a component will likely introduce utility issues for heat rejection equipment. Heat rejection products are frequently installed outdoors and subjected to severe service conditions including heat; humidity; solar impacts such as thermal expansion of fan and housing materials; and material degradation from UV radiation; wind impacts; and in some cases, seismic impacts. These installation factors frequently require fans to be installed with a high tip clearance which reduces peak efficiency potential, but is necessary for proper and safe operation. Fans used for these applications are often custom designed for the application and are limited in peak efficiency in order to meet the physical demands for severe service application.

Heat rejection products are space constrained, especially for shipment size restrictions. Accommodating larger, slower, compliant fans in the same equipment footprint will lead to a reduction in heat transfer surface and could increase actual net energy consumption, negating the intent of the rulemaking. Heat rejection equipment faces similar fan-testing issues as most fan housings are an integral part of the cabinet.

AHRI urges CEC to exclude all fans used in all heat rejection products, including air-cooled products, evaporatively-cooled products, and hybrid products from the CEC fan efficiency rulemaking

Transportation refrigeration fans should also be out of scope for a California rulemaking. Not only are all transport refrigeration fans embedded fans or blowers, they are mobile and, as such, there are interstate issues that would make this a federal issue and potentially international issue with marine applications. The energy savings was found to be de mimimis at a national level and would be even smaller at a state level. Increases in fan efficiency may not be technically achievable in the same footprint. Increases in footprint may drastically impact vehicle fuel efficiency and negate any small energy efficiency gains. AHRI urges CEC to exclude all transport refrigeration fans from the scope of the rulemaking.

## **Metric**

It is unclear if CEC requested feedback on residential furnace fan metric (FER), which gives annual power consumption, or a previously proposed fans metric (first or second NODA). In the first (December 2014) and second (May 2015) NODA's DOE proposed the name of the metric to be FER, Fan Energy Rating, along with the Fan Efficiency Index,

FEI. The ASRAC Working Group proposed changing the name of the metric from FER to FEP (Fan electric input power) to avoid confusion with the residential furnace fan FER metric. If CEC is in fact considering a residential FER-type watt/cfm rating at a given set of conditions, this may be a more desirable approach than the range of operating conditions FEP/FEI conformance requires. CEC should make clear its request and give stakeholders another opportunity to comment.

## Enforcement of Application-based Metrics is Nearly Impossible under Title 20

AHRI also urges CEC to consider the complexity of regulating a product with ratings that comply within a range of operating points or bubble. At the core, the regulation of an operating map must be by software program, which would be immensely difficult to enforce. The downfall of an application regulation is that virtually every fan is both compliant and non-compliant depending on the application. Therefore, the traditional enforcement scheme based on the fan model number simply will not work. California's product database that displays compliant models would not be helpful.

It is unclear who would be responsible for compliance with an application-based metric. It is also unclear how CEC would know if the fan, at the selected point, with optional features and ductwork which was installed differently than designed, is operating within the allowable compliance bubble. For commercial equipment, this is further complicated by the modes of operation and practically infinite variety of configurations for some equipment types. Compliance for an application-based and as-built selection cannot rest with the manufacturer. Should it be the designer? The builder? The owner? Lastly, how would the performance of the fan be verified? AHRI urges California to consider the difficult and problematic compliance aspect of an application-based metric.

## Summary

In summary, regulating fans and blowers embedded in commercial HVACR and water heating equipment simply does not make sense from a technically or regulatory stand point. Regulation of commercial and industrial fans and blowers is impractical because the standalone performance is different from the fan or blower performance within a system. Further, CEC should not duplicate federal regulations currently under development. However, should CEC decide to proceed, it should propose a limited, more meaningful scope and definition of fan, to enable requirements for which compliance can be applied and performance measured. The regulation should clearly exempt fans embedded in equipment regulated by the federal government and the State of California. The focus should be upon the types of stand-alone fans that are testable as applied and which constitute the majority of the energy consumption in buildings. Lastly, CEC should be aware that the analysis conducted by DOE contains significant issues that need to be corrected.

AHRI appreciates the opportunity to provide these comments. If you have any questions regarding this submission, please do not hesitate to contact me.

Sincerely,

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Appendix A - Federally Regulated Products AHRI Represents

Commercial Products:

- Automatic commercial automatic ice makers
- Commercial hot water supply boilers
- Commercial package air-conditioning and heating equipment (including variable refrigerant flow systems)
- Commercial packaged boilers
- Commercial refrigerator, freezer, and refrigerator-freezer
- Commercial warm air furnaces
- Commercial water heaters
- Commercial unfired hot water storage tanks
- Commercial unit heaters
- Computer Room Air Conditioners
- Packaged terminal air conditioners
- Packaged terminal heat pumps
- Single package vertical units
- Refrigeration Systems for walk-in coolers
- Refrigeration Systems for walk-in freezers

Consumer Products

- Residential boilers
- Residential central air conditioners
- Residential central heat pumps
- Residential furnaces
- Residential furnace fans
- Residential pool heaters
- Residential water heater
- Small duct high velocity system
- Space constrained products