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ebm-papst comments

Additional submitted attachment is included below.

June 16, 2017

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

Re: Docket No. 17-AAER-06 – Commercial and Industrial Fans & Blowers

Dear Mr. Galdamez:

ebm-papst Inc appreciates the opportunity to contribute to this rulemaking process.

Introduction

In 2015 ASRAC had appointed me as a CIFB working group voting member for the negotiations in Washington. My co-workers and I serve on numerous technical committees of the industry associations AMCA, AHRI, HVI, and more. My Ashrae involvement includes the technical committees "Fans", "Motors and Motor Controls", 'Electrical Systems", "SPC 222 Standard Method of Test for Electrical Power Drive Systems", and the 90.1 Mechanical Subcommittee.

Please let me refer to our American and to our global websites for a general overview of ebm-papst and of our products. Our customers are almost exclusively original equipment manufacturers (OEM) and distributors who sell to OEMs.

ecodesign directive EU 327/2011 for fans

ebm-papst has in-depth experience with EU 327 that first went into effect on 1/1/2013. This regulation uses the extended product approach. This is to say that in all cases the fan definition includes an electric motor and that the minimum energy performance standard (MEPS) is expressed in a wire-to-air manner. The physical fan test method is ISO 5801 which for all intents and purposes is the same as AMCA 210-2016 (aka Ashrae 51). The scope of EU 327 is very broad, starting at 125 W electrical input power and up. There are very few exceptions. I should emphasize that fans embedded in regulated products are still subject to the EU 327 fan regulation. The simplicity of EU 327 lies in the fact that just the fan's best-efficiency-point at maximum speed must meet a minimum efficiency grade. The efficiency grade requirement increased on 1/1/2015 from the initial levels. The first tier of EU 327 eliminated 350,000 fans from the ebm-papst annual sales and the second tier eliminated an additional 600,000 fans annually. Happily, ebm-papst is substituting all non-compliant fan models with better fans. The fan improvements stem from both better motor efficiency and aerodynamic enhancements. EU 327 yields substantial savings. We estimate that the substitution of just ebm-papst fans in Europe amounted to 175 GWh annual savings due to the first tier of EU 327 and to 300 GWh additional annual savings due to the second tier of EU 327.

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Critique of EU 327:

With many OEM product types as a whole being subject to regulation, “ecodesign” does require that substitute fans with sufficient peak efficiency are applied in an efficient manner. This prevents the investment in more efficient fans being offset by the use of lesser components elsewhere in the same product or by inferior product design. Equipment form factors have changed and footprints have grown to accommodate larger fans and to reduce air velocity in units. Typically, initial-cost increased. New safety and performance certifications have become necessary. In short, the burden on OEMs and other stakeholders during the transition was significant.

In many cases substitute fans are supplied with variable speed control because the EU 327 efficiency grade calculation applies a credit for it. Or substitute fans use variable speed permanent magnet motors for their high efficiency. Both options provide a higher value to the end customer than before the ecodesign. Control, monitoring, diagnostics, and - when load-matching is employed - part-load power savings and sound reduction are potential benefits.

EU 327 accommodates flexibly fans tested with discharge duct rated by total pressure and fans tested without discharge duct rated by static pressure. Given the fact that the applicable values of the minimum permissible efficiency grade account for the different setups, ebm-papst has never observed problems or abuse about this detail.

The efficiency grade metric in EU 327 eliminates fans from the market unconditionally. The metric provides no loop-holes.

ASRAC CIFB term sheet

I voted in favor of the overall term sheet and all its individual recommendations.

The ASRAC working group had agreed on the physical fan test method: The above mentioned AMCA 210-2016.
We laid the foundation for an innovative procedure for estimating electrical input power – even at part load - when only fan shaft power measurement values are available.

In terms of power, the lower scope limit (brake power 1 HP) was almost 4 times as high as the limit of EU 327 (125 W electrical power). The established fan categories differed widely from EU 327 and they spanned from plain fans (e.g. panel fans) to Power Roof Ventilators. Some fan types were outright exempt (e.g. crossflow fans) while other exemptions were justified by certain fan applications (e.g. air curtains, regulated HVAC/R equipment).

The proposed energy efficiency metric (FEI for Fan Energy Index, previously introduced as PBER for Performance Based Efficiency Ratio) is very enticing due to its potential for driving the market towards optimum fan selections. Stakeholders pronounced that the fan energy savings through improved selections from an existing portfolio of fan models would far exceed savings if fans were redesigned.

Critique of ASRAC CIFB term sheet:

ebm-papst is concerned about the proper use of the Fan Energy Index FEI. Nefarious declarations of favorable fan selection points will prevent complete removal of inferior fans from the market and will jeopardize the shift to truly energy-conscious fan selections.

Determination of the duty point of an embedded fan for the purpose of using the FEI is subject to ongoing debates in the fan industry. Fan inlet system effect and fan outlet system effect distort the "fan only" test results. We discussed the paradox that in terms of the FEI a fan embedded in an air handler would benefit from increasing AHU-internal losses. This proves the need for expertise and the risk of unintended consequences. ebm-papst Inc. now concludes that fans embedded in equipment that meets overall efficiency at the technical state-of-the-art level should remain exempt from fan regulation.

The Fan Energy Index relies on realistic representation of fan electrical input power throughout a fan's complete advertised performance envelope.

- Direct measurement of electrical input power during an AMCA 210-2016 test for all published fan operating points provides the best basis for FEI.
- However in many cases only the impeller brake power values are known for legacy reasons, due to the design or the size of the fans, or due to the fans' supply chain. Then the measured brake power requires mathematical extension to electrical input power through the application of loss models for the mechanical and electrical fan drive components. The ASARC term sheet proposed conservative models for fan drive components for part-load operation, which then permitted mapping of the fan energy performance through the fan's entire operating envelope. ebm-papst emphasizes that less rigorous loss models or unsubstantiated component-manufacturers' claims will undermine the FEI metric.

As with any other machine, fans are subject to serial production tolerances. Airflow, fan pressure, and electrical input power vary from piece to piece. ebm-papst proposes to adopt from AMCA guideline 211 the check test tolerance limits for performance combined with input power.

The terms "commercial" and "industrial" in the title are irrelevant because the same fan model can be employed in vastly different applications. Example: A certain 14-in. panel fan model is used as a whole-house fan in a single-family home and in a commercial blast freezer.

ebm-papst recommendations for CEC T20

1. Remove the terms "commercial" and "industrial" from the title.
2. As physical fan test methods, adopt AMCA 210, AMCA 230, AMCA 250, AMCA 260, ISO 5801, and ISO 13350 according to fan type and each test standard's scope.
3. Have all fans that were tested according to AMCA 210 / ISO 5801 rated based on the presence or absence of an outlet duct during the air performance test: Total pressure for ducted tests but static pressure for fans tested without outlet ducts.
4. As an optional mathematical extension from a measured brake power value to an estimated electrical power, employ a method that is at least as rigorous as AMCA 207.
5. As rating method for the purpose of establishing catalog ratings and check test tolerances adopt the limits from AMCA guideline 211.

6. Establish the distinction between standalone fans and embedded fans. Proposals:
   6.1. Standalone fan
   A complete fan unit that is (a) designed for field installation in commercial or industrial field settings, that is (b) designed for field installation in a residence subject to building code inspection, or that (c) carries a comprehensive safety agency approval indicating its suitability for installation and operation by untrained persons. Standalone 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 fans, inline fans, ceiling fans, jet tunnel fans, and induced flow fans as part of a laboratory exhaust.
   6.2. Embedded fan
   A fan whose purpose exceeds or is different than that of a standalone fan. It is firmly attached to or entirely integrated in an appliance or a surrounding piece of equipment, each of which is regulated for minimum energy performance in many cases. Comprehensive safety agency approvals of an embedded fan are conditional on the product in which this fan is embedded. Examples of embedded fans include supply fans in air handling units, plenum fans in central station air handlers, condenser fans in heat rejection equipment, tangential blowers in air curtain units, and induced or forced draft combustion blowers in boilers or furnaces.
7. Establish the energy performance standard for standalone fans in the form of FEI. All fan operating point documentations (i.e. flow and pressure) shall be accompanied by the associated FEI values and fan electrical power values. Fan performance below a reasonable FEI value shall be masked to prevent intentional selection of energy-wasting fans.
8. Exempt outright equipment that is thoroughly regulated for overall energy performance.
9. Collaborate with OEMs for cost and benefits analyses on any opportunities where fan energy could be saved through a new or stricter equipment regulation or through a regulation of embedded fans. Weigh the simplicity and savings potential of a fan peak efficiency regulation against the savings potential and the enforceability of an embedded fan's FEI map.

In the attached is my effort to answer as many of the presented questions as I can. Please feel free to contact me in case I can assist you any further at all.

Best regards

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Engineering

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The Energy Commission is seeking:

1. A complete set of market data for each appliance type.

This market data should cover every model available in the California market and include: brand name, model number, product sub-type (or category), energy/water use performance metrics, non-energy/water use product characteristics, product lifetime, retail price, and number of California sales/shipments for years 2017-2019 (or other years). Energy and water use metrics may include kWh/yr, kW draw-per-mode, lumens-per-watt, gallons-per-minute flow, gallons-per-flush, and so on. Nonenergy/water use product characteristics may include color temperature, capacity, resolution, rated horsepower, and so on. This data will provide the Energy Commission with a snapshot of the market for each appliance type identified in this invitation.

Unfortunately, ebm-papst does not have these answers:
Our OEM and distribution customers are supplying our fans into a countless variety of equipment and appliances. Many of our fan models are used in radically different end-products that are occasionally even made by the very same OEM. We are shipping out of our factory in Connecticut to customers in California. But California-made equipment is often used in other regions and OEMs from other regions supply equipment with embedded ebm-papst products into California.
We therefore have hardly any visibility of power use or annualized energy use due to ebm-papst in California. The maximum rpm of our range of fans with integrated electronically commutated motors are customer-programmable. Therefore, even the question of rated horsepower becomes moot.

2. Information on the following for each appliance under consideration:

- Product Definition and Scope

Extended products

Ventilation units as opposed to fans
Fans embedded in regulated equipment
Fans embedded in non-regulated equipment
Standalone fans

Power range

- Existing Test Procedures and Test Procedures Under Development

AMCA 210, AMCA 230, AMCA 250, AMCA 260, ISO 5801, and ISO 13350

- Sources of Test Data

Fan manufacturer's own laboratory test data.

The plausibility of performance representations for fans that are embedded by OEMs are every time validated when the fan suppliers' OEM customers conduct performance tests of the overall units.

- Existing Standards and Standards under Development

Existing ecodesign directives:

- EU 327/2011 for fans with ≥125 watts input
- EU 1253/2014 Ventilation units with ≥30 watts
  http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014R1253

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- Operations, Functions and Modes

The implementation of Greentech EC motors provides a plethora of operating modes, functions, and modes. The larger the EC motors the more comprehensive are typically the available.

See brochure "GreenTech EC technology: Commutate electronically, benefit economically" at
http://www.ebmpapst.com/media/content/info-center/downloads_10/brochures/ebm-papst_GreenTech-EC-Technology_en.pdf

- Energy-saving Technologies, Components and Features

http://www.ebmpapst.com/en/products/product-news/product_news.html

- Installed Base Characteristics

On/off operation is very common

In multi-fan applications, fan motors are switched on/off in stages for capacity control.

Inefficient but simple triac fan motor speed control is used up to maybe 750 W motor power.

After market variable frequency drives are common with fans above 1 HP.

The market share of EC fan motors keeps increasing.

Belt drives remain popular for low-speed high-torque fans.

- Product Development Trends

EC fan motors are max tech presently.
http://www.ebmpapst.com/en/products/centrifugal-fans/radipac/radipac_new_dimensions/radipac_new_dimensions.php

Airside improvements still provide very high improvement potential: Diffusers, guide vanes.
http://axiblade.en.ebmpapst.com/_gfx/three60/ebm_papst_Axiblade_360Grad_Panorama.html

Advanced electronic fan catalogs (fan selection software) assist with selecting the most suitable fan size, fan type, and fan quantity (in case of fan arrays) even when considering annual bin hours.
http://www.ebmpapst.com/en/products/product_search/ebm_papst_fanscout/fanscout.html

Low sound is as important as low power.
http://www.ebmpapst.com/en/products/product-news/flowgrid/flowgrid.html