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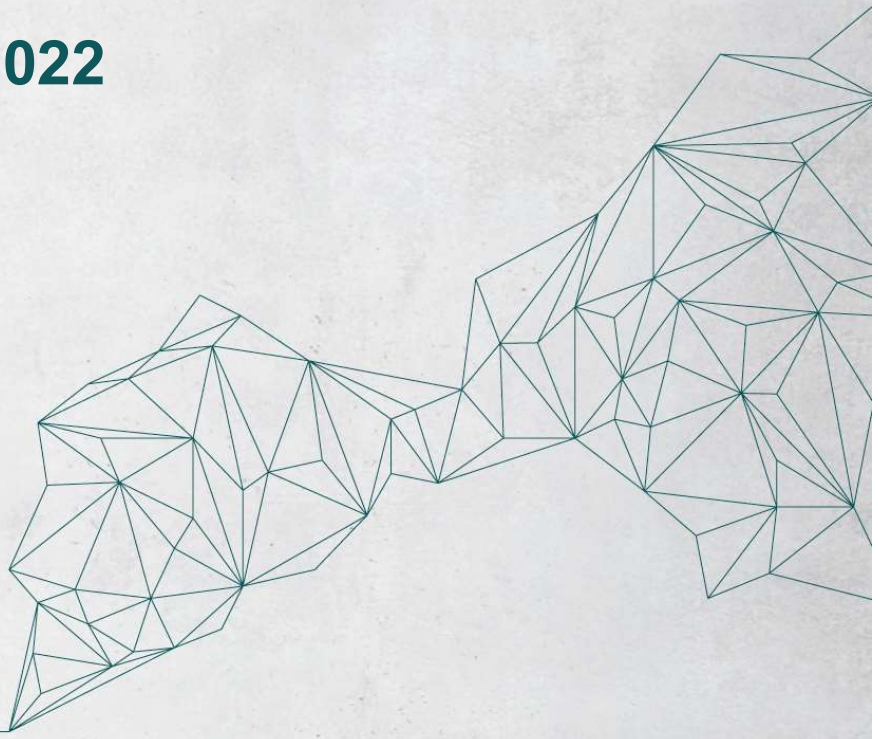


Fan ecodesign regulation and standards from an industry perspective

Geoff Lockwood
Chair of the Fan working group
European Ventilation Industry Association

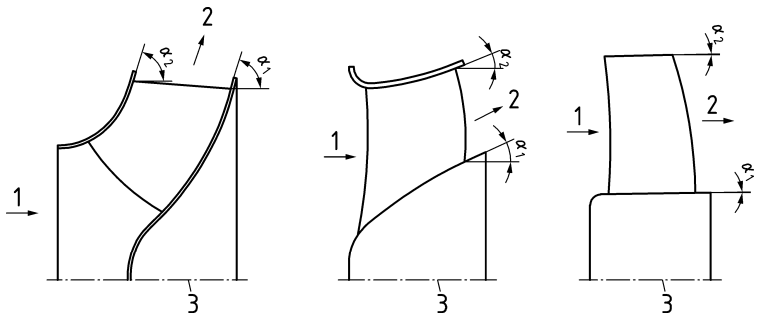
Current status

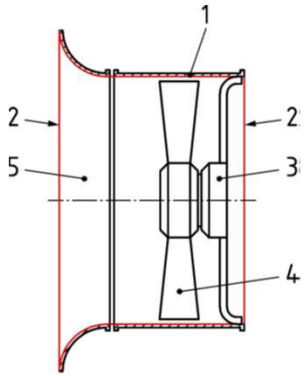
- Commission regulation 327/2011 - ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW
  - The requirements came into force 1st January 2013
  - A review of the regulation was started in 2014
  - A consultation forum was held on 30th April 2015
- CEN TC156 WG17 – fans – has produced a draft standard FprEN17166
- Several stakeholders have and are lobbying for an Energy Efficiency Index (EEI) for fans
- The Commission has restarted the review of 327/2011 and held another consultation forum on 1st April 2022

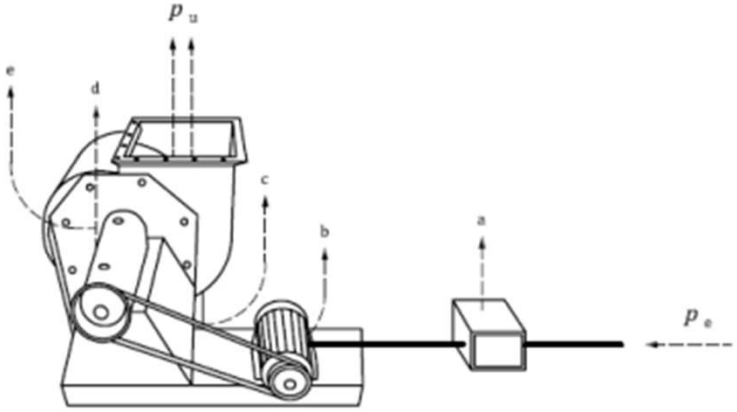
Revision of the European fan efficiency test standard

FprEN 17166 fans – procedures and methods to determine the efficiency for the electrical power input of 125 W up to 500 kW

- clarify the boundaries of the fan
- define all elements of a fan
- define the transition between centrifugal, mixed flow and axial fans





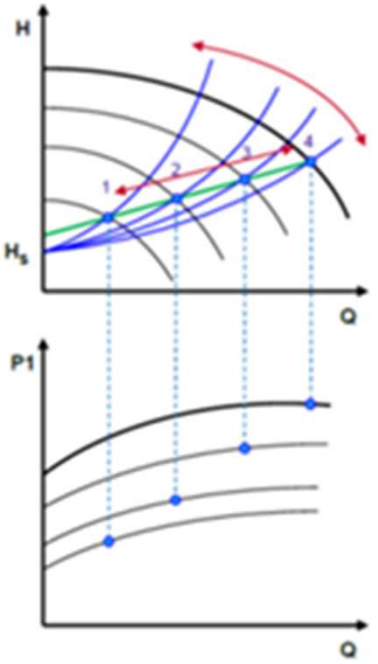


An Energy Efficiency Index (EEI)?

- European Commission consultant – working document explanatory notes – review of regulation 327/2011
- IEC 61800-9-1:2017 – Adjustable speed electrical power drive systems – Part 9-1: Ecodesign for power drive systems, motor starters, power electronics and their driven applications – General requirements for setting energy efficiency standards for power driven equipment using the extended product approach (EPA) and semi analytic model (SAM)
- Stakeholders stating an Energy Efficiency Index (EEI) is required to define the efficiency of an Extended Product and an Extended Product Approach

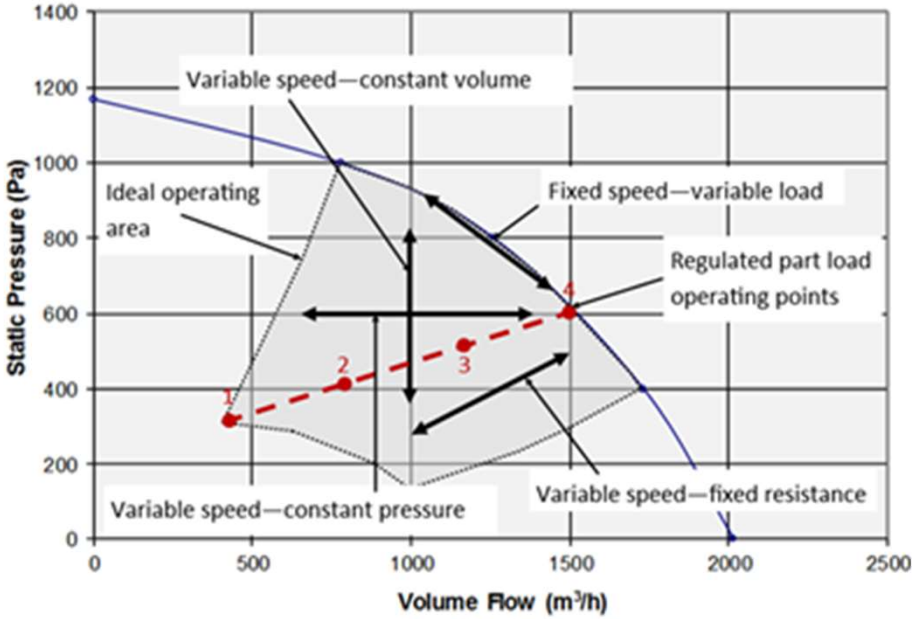
Energy Efficiency Index (EEI)

- Extended product
- System efficiency metric
- Partial-load
- Extended product approach
- Energy Efficiency Index - EEI – the ratio between the power input weighted by a load profile and reference power



Energy Efficiency Index (EEI)

- An EEI does not describe the full partial-load operating characteristic of a fan
- One fan can be used in many applications and in many modes;
  - Fixed speed
  - Variable speed - constant volume
  - Variable speed - constant pressure
  - Variable speed – variable volume versus pressure



The fan industries response

- European Ventilation Industry Association (EVIA) – Problem statement – fan efficiency

Conclusions –

- An EEI is not appropriate
- Define partial-load
- Adopt the same approach as the new motor regulation – set of data points across the operating range of the motor

The fan industries response

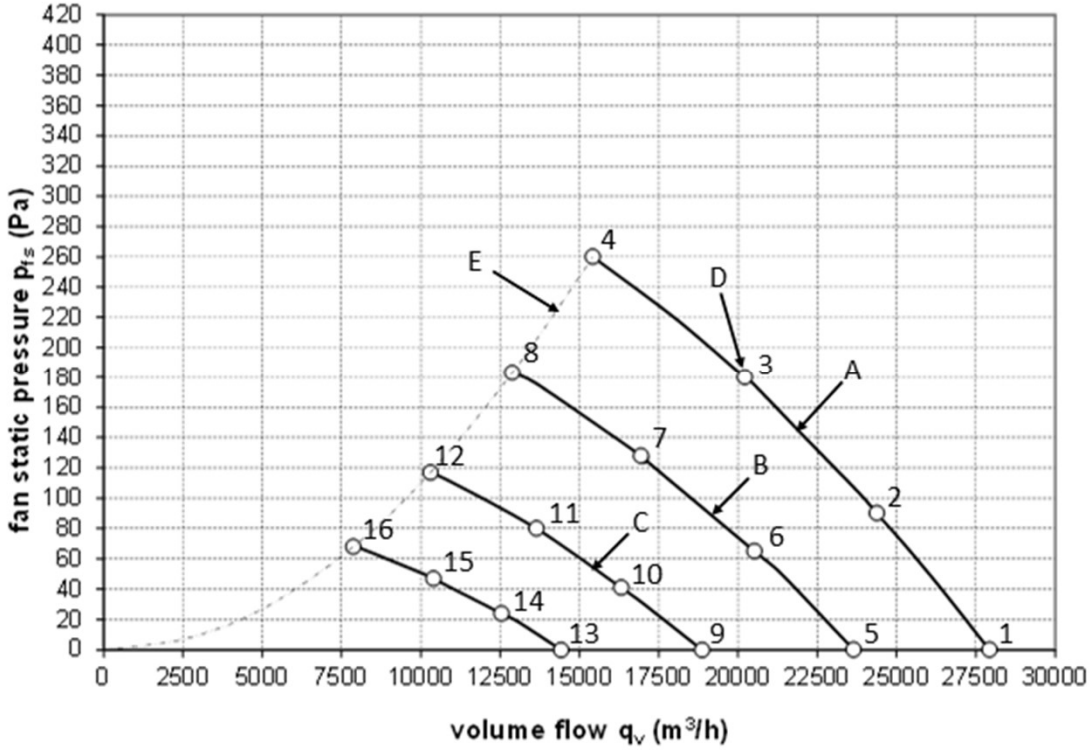
Commission standardisation request (Sreq)

Proposals –

- Update FprEN17166
- New definitions
  - Series produced fans
  - Custom fans
  - Partial load
- Information requirement at partial-load
- Calculation methodology
- Jet Fans
- Circulating fans

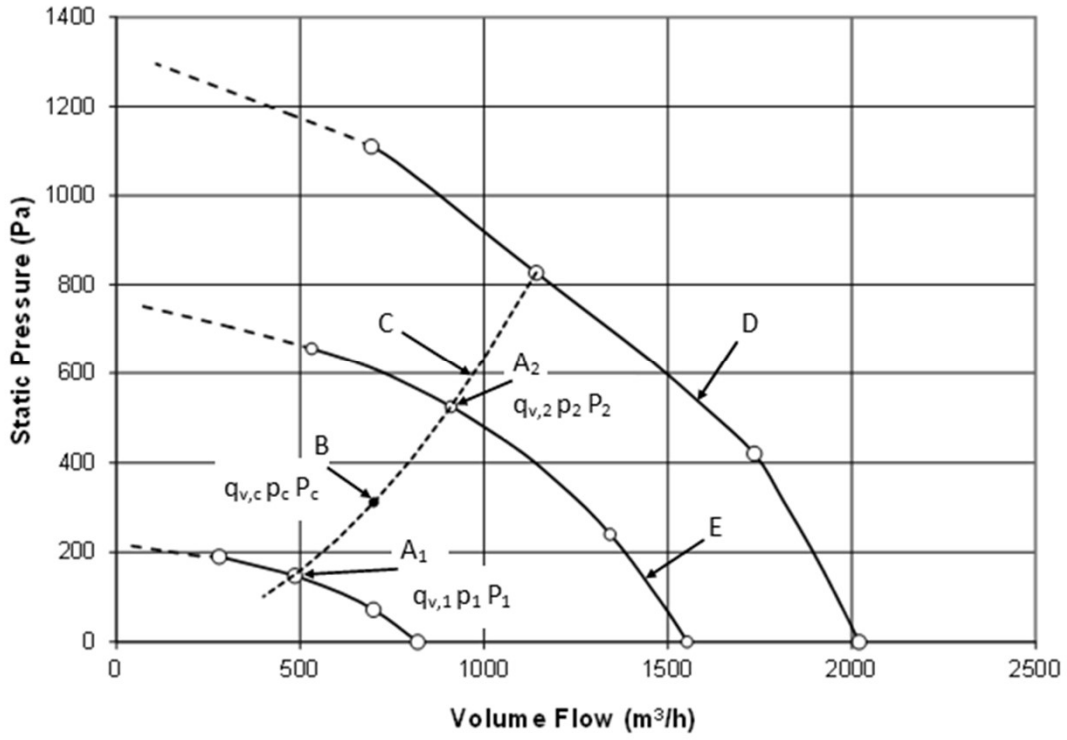
Additional data at partial load operating points

- The proposal is already provided by many in the fan industry – it is just not regulated
- Provide a sufficient number of operating points and relevant data at those points to determine the losses anywhere within operating characteristic of the fan
- Fan characteristics at;
  - the inherent speed
  - the minimum recommended speed
  - a speed between the two



Additional data at partial load operating points

- What is missing?
  - An agreed methodology to interpolate between the curves for a fan with an integral VSD, or to be used with a VSD
  - Description of partial-load for a fixed speed fan



Activity by the Commission – proposed revision

3. INFORMATION REQUIREMENTS ON PARTIAL LOAD OR AT SPECIFIED DUTY

(1) For all fans, except custom fans:

Three years after entry into force, the partial-load operational performance of the fan shall be provided for all fans, except custom fans. This shall be described by a minimum of three performance curves at different speeds: one at the stated inherent speed, one at the minimum recommended speed, plus an additional one between the other two. More than three curves can be provided.

Performance curves shall comprise a sufficient number of test points to permit the characteristic curve to be plotted over the normal operating range.

A calculation method

- Direct measurement versus calculation method
- What may not be included in a calculation method?
- Is a calculation always equivalent to a direct measurement?

fan air power, P_u

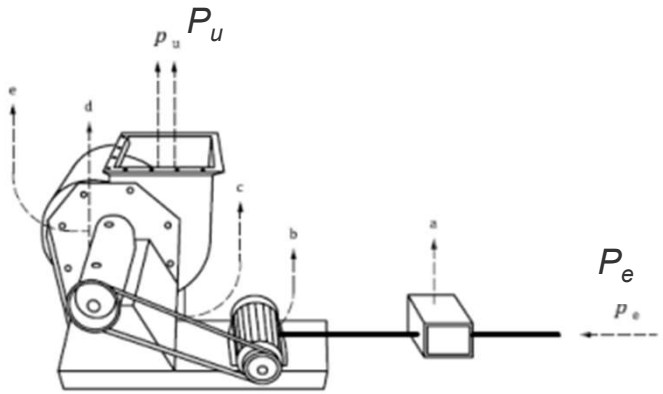
$$P_e = \frac{q_{vsg1} \times p_f \times k_p}{\eta_r \times \eta_b \times \eta_T \times \eta_{mot}}$$

fan impeller efficiency

bearing efficiency

transmission efficiency

motor efficiency



Key

P_e electrical input power

P_u volume flow and pressure (air power)

a Variable speed device loss (heat).

b Motor losses (heat).

c Belt losses (heat).

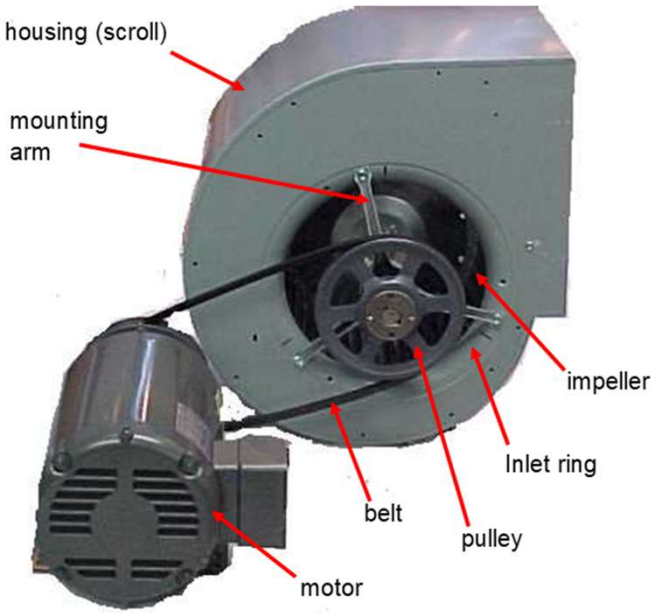
d Bearing losses (heat).

e Impeller and casing aerodynamic losses (heat).

A calculation approach

- European Commission. Regulation 327/2011 ecodesign requirement for fans driven by motors with an electric input power between 125 W and 500 kW
- C_m is the compensation factor to account for matching of components = 0,9
- $\eta_e = \eta_r \cdot \eta_m \cdot \eta_T \cdot C_m \cdot C_c$

Calculation method

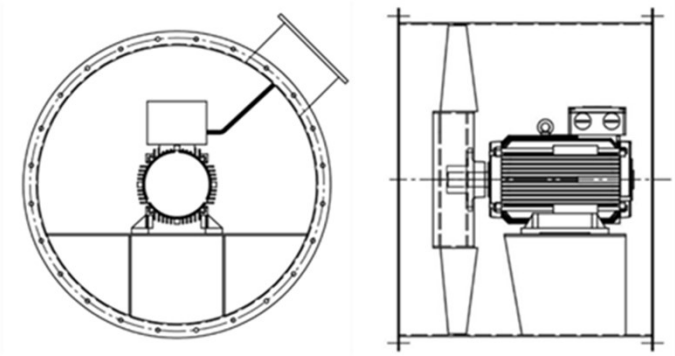


A calculation method

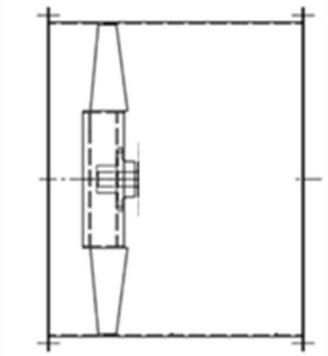
- ISO 5801 – direct measurement
- $\eta_e = \frac{P_u}{P_e}$
- $\eta_{ed} = \frac{P_u}{P_{ed}}$
- The fan air power P_u is measured
- The motor input power P_e and the drive control electrical input power P_{ed} are measured

- ISO 5801 – calculation – Annex E - Input power calculation for driven fans at design point
- $P_e = \frac{q_{Vsg1} \times p_f \times k_p}{\eta_r \times \eta_b \times \eta_T \times \eta_{mot}}$
- fan air power $P_u = q_{Vsg1} \times p_f \times k_p$
- fan impeller efficiency $\eta_r = \frac{P_u}{P_r}$
- The annex states it is important to use the efficiency at the actual absorded power of the various components of the fan

A calculation method



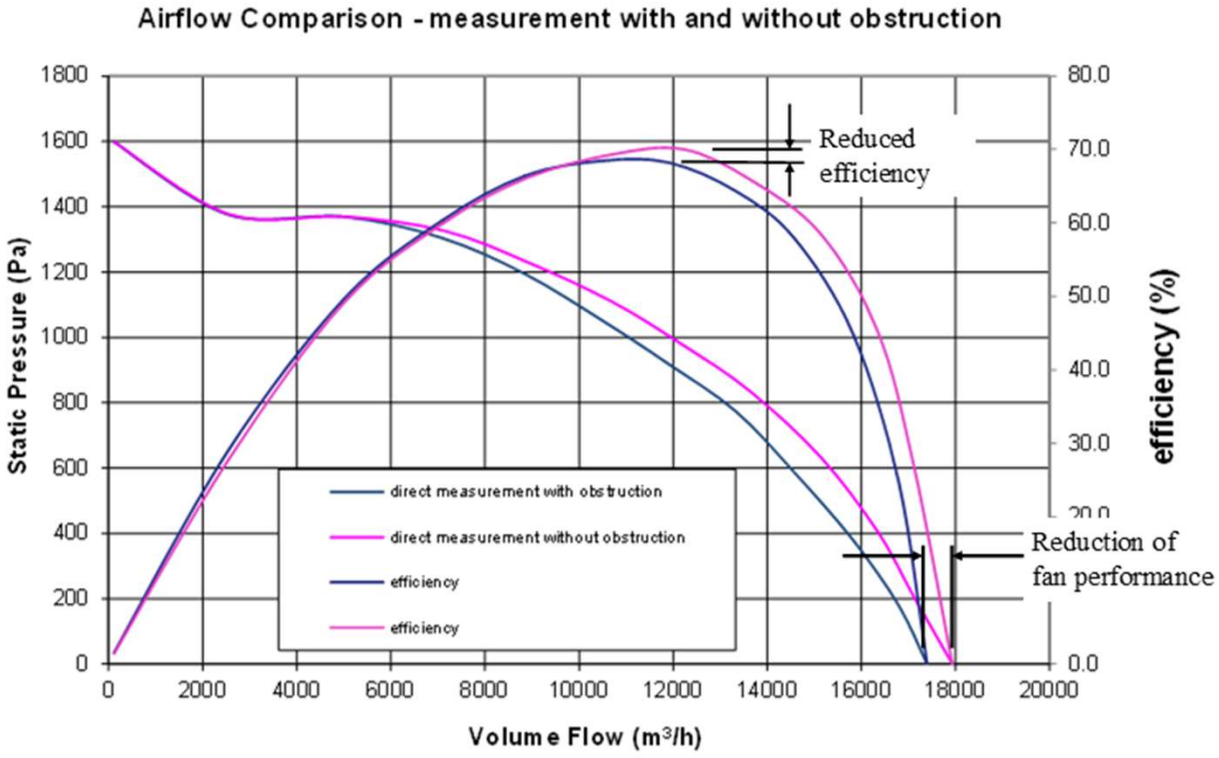
driven fan – cased axial fan



did the measurement of the fan (non-driven fan) consider the aerodynamic losses of the motor and motor support?

A calculation method

ISO/TR 16219 estimates that cartridge and pillow bearing blocks at the fan inlet can adversely affect the volume flow by as much as 5%, see table 11 of the technical report



Jet fans

- Define a sufficient number of operating points to fully describe the complete operating characteristic of the Jet fan.
  - For a single speed motor there is only one operating point. A system efficiency metric is not applicable.
  - For Jet fans without variable speed drives or not intended to be used with variable speed drives, but fitted with a multiple fixed speed motor, the additional operating point is at the lower speed settings.
  - For Jet fans with a variable speed drive (VSD) or intended to be used with a variable speed drive the additional data points shall be at 30% and 50% of the inherent speed.
- For each operating point, the published data to include thrust, electrical power input, rotational speed, efficiency, and sound characteristic as a minimum requirement.
- For Jet fans with or intended to be used with VSD determine a method of interpolation to ascertain the performance at any point between the defined operating points of 30, 50 and 100% rotational speed.

Circulating fans

- Determine a method to describe the performance and losses based on thrust measurement. The data made available shall be electrical input power, thrust and impeller diameter.
- Determine a minimum efficiency criterion based on electrical input power versus thrust versus impeller diameter, at rated speed.
- Determine a System Efficiency metric (being an additional information requirement) based on volume flow rate (m^3/h) and electrical input power (W) at a minimum of three, to be determined, speeds (only when the fan is declared as being suitable for speed control by the manufacturer). Volume flow rate to be calculated directly from the thrust measurement. Volume flow rate to be provided to assist the user in the selection and use of the product.

Revision of fan test standard

- Amend FprEN17166 to add new definitions, information requirments at partial-load, methodology to interpolate data from published test points
- Encourage revision of Annex E of ISO 5801 to include the calculation methodology described in ISO 12759-2 and to make reference to IEC 60034-2-3
- Revision of Jet fan standards not required for partial-load requirements
- Agree in principle of AMCA 230 becoming a ISO standard and develop that standard so that it is adopted as an EN ISO

Thank you

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