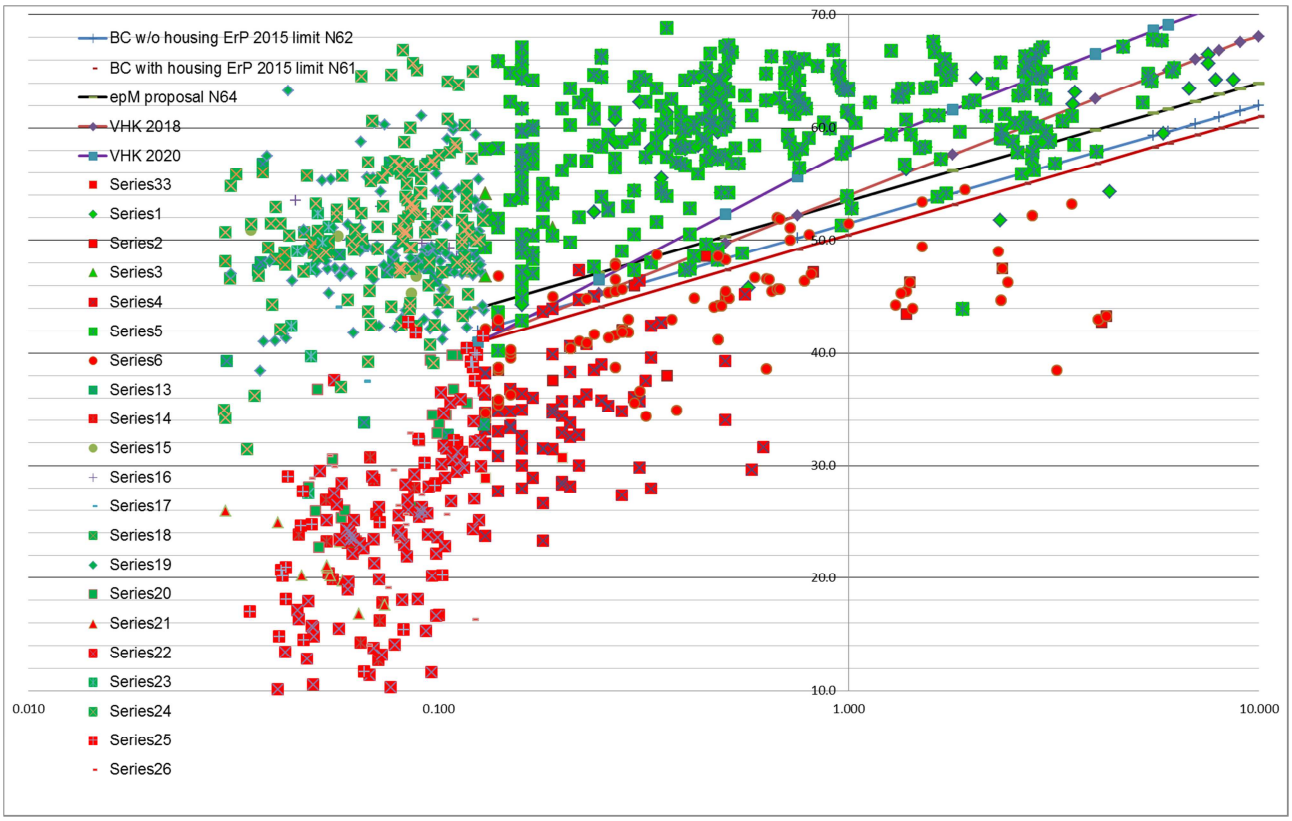
Discussion document – slopes for backward curved centrifugal fans of the fan regulation 327/2011
Revision of EU 327/2011

Mulfingen, February 2015

We see that the proposed slope in the VHK discussion document of 21st November 2014 for Centrifugal fans is not representative of the actual performance of small to large backward curved fans. We see that it gives a large advantage to low power fans and sets a limit that would be very difficult to achieve for high power fans. The current slope of the current regulation for backward curved fans is more representative. We strongly request this slope is retained and that only the level is increased and increased to leave a practical range of high efficient fans. In addition the principle of regulation 327/2011 is being followed with the use of ISO12759 arounf the world. A change from the slopes of this standard would take the EU away from the current position of leading the world.

The graph below shows the scatter of fan efficiencies from 30W to 10 kW of backward curved centrifugal fans. These efficiency points are the peak efficiency of actual fans manufactured by ebm-papst. ebm-papst represents 20% of the European manufactured fans placed on the market. Last year ebm-papst placed on the European market 576,144 backward curved centrifugal fans in the range that were >125 W and above the 2015 limit and puts the market size at 2.9 million units. The dots below the limit are the efficiency of fans sold prior to 2015. The dots to the left of the 125 W limit are outside of the current scope.

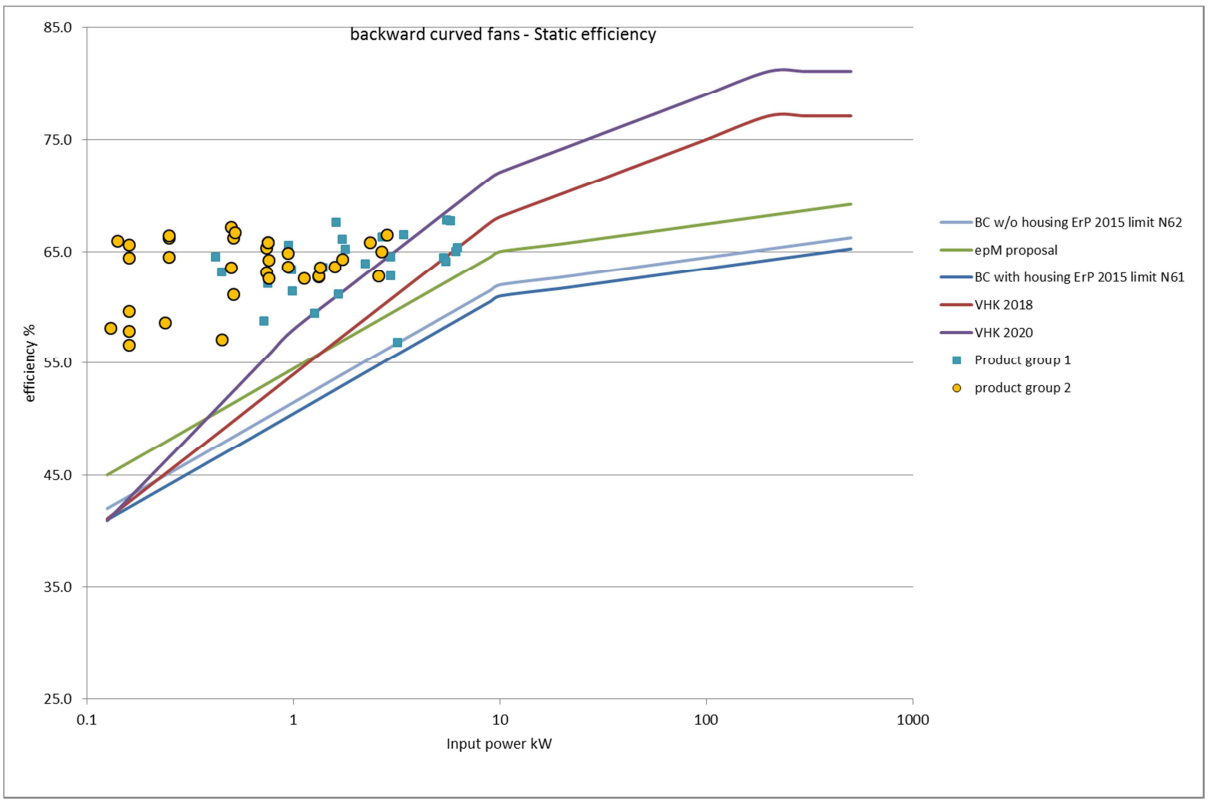


Graph of peak efficiency of backward curved centrifugal fans.

The scatter shows that the current slope is more representative of the trend of fan efficiencies. The following graph is a clearer view as to why the proposed slope in the VHK discussion document of the 21st November 2014 is too steep and would give a large advantage for low power fans and make it too challenging for higher power fans.

Mulfingen, February 2015

It can be seen that the VHK proposal cuts through the high power fans and eliminates them from the market. But those higher power fans are no less efficient than the low power fans. So what is there to gain by distorting the market? One effect, if this slope where to be applied, would be that applications will use a multiple number low power fans to meet the airflow requirements met by the single high power fan – has energy been saved – no. In fact there would be a small increase in energy consumption as the lower power fans are slight less efficient and the end user pays more for more fans. The manufacturer of small fans is the only winner, but this is not what ebm-papst wants. We want to see a sensible pragmatic level that encourages innovation and reduces the impact on the environment.



Graph showing two backward curved centrifugal product ranges

It is important to avoid the discussion of small and large fans. The regulation is based on power input. A small fan can have a high power motor and conversely a large fan can have a low power motor. Looking at the low end of the power range there is a cluster of seven fans in the power range 0.14 to 0.16 kW. The fan size of these seven fans is from 220 mm to 355 mm. This highlights why discussing small or large fans is misleading. The question is more an air power; these seven fans have an air power range of 76 W to 105W so they represent low output power fans. The dots to the right hand side are high output power; the last cluster of four fans has an output power range of 3.5 kW to 4 kW. The fan size varies from 500 to 900 mm diameter that again underlines why talking fan size is misleading.

Mulfingen, February 2015

The scatter also shows that there is a spread of efficiencies. The yellow dots represent one range of impellers with the similar geometry from 220 mm diameter to 630 mm diameter. The blue dots are another range of geometrically similar impellers from 250 mm to 900 mm diameter. The efficiency of each product range is not a neat straight line from small to large diameter.

There is a spread of efficiencies and this comes from having other variable parameters other than diameter. There is a change in width of impeller, speed and volume to pressure ratio. The variety is there to meet the requirements of different applications. Some want the lowest noise possible without space constraints; others have space constraints driven by outside measures. Some applications use the air pattern of the fan that defines a physical shape to enhance the application characteristics whereas others do not.

One slope that just allows the very best efficiency will drive fans to be one shape, one speed and one volume flow to pressure ratio. It will look good on paper until there is a realisation that the product into which the fan is integrated is now compromised. The fan will not be operating near its peak efficiency and in many cases will be consuming more power than if one of those 'less efficient fans' where still available and being used near its peak efficiency.

Multiple regulation works if there is still a variety of characteristics left that allow a diversity of solutions to meet a variety of needs; if a high level is set for component driving solutions to one without diversity then the component will be used badly in an application that would not integrate well with the building.

In addition we see that the principle of regualtion 327/2011 has been adopted by many countries outside of Europe around the world when they adopted the supporting standard ISO12759. This was demonstrated at the AMCA International Fan Efficiency Regulation Symposium in Schwabisch Hall during July 2014 attended by both VHK and the Commission. A change away from these slopes will take the European Commission away from its position of leading the world. It would also put the European based manufacturers at a disadvantage. Currently they are making fans that meet regulation 327/2011 that are now being sold to meet similar regulations outside of Europe. A fundamental change now to the principle of 327/2011 would add additional work and cost.

ebm-papst Position Statement – no to reducing the limit for small fans
Revision of EU 327/2011

Mulfingen, January 2015

A reduction in any of the current minimum energy efficiency limits (MEL) would be a backward step and a waste of the investment and gains achieved so far.

The ecodesign fan regulation 327/2011 (EU, 2011) is effective. Even without any market surveillance and enforcement ebm-papst can show that at least 1.75 TWh has been saved since its introduction.

It is claimed that the current limits for small fans are too challenging, but ebm-papst EU production figures show that 300,000 units where changed to more energy efficient ones in the first year after the requirements became effective and that 600,000 will change after tier 2 on the 1st January 2015.

ebm-papst

ebm-papst is a German based leading manufacturer of motors, fans and controls with production facilities throughout Germany, Europe, the USA and China. Per year ebm-papst produces about 60 million motors and fans which are globally marketed via 57 subsidiaries. Of the total global staff of 12,000 some 9,000 work in Europe. In order to maintain these jobs, ebm-papst recognised the need to focus on energy efficiency very early on; ebm-papst have been developing and manufacturing high efficient fans and EC technology since 1965.

Background

The ecodesign fan regulation 327/2011 defines a method to assess the energy performance of a range of fan types in the input power range of 125 W to 500 kW.

Regulation 327/2011 defines minimum energy efficiency requirements for six types of fan; axial, centrifugal forward curved and centrifugal radial bladed, centrifugal backward curved without housing, centrifugal backward curved with housing, mixed flow and cross flow. Each is then divided into two categories to set a minimum energy efficiency limit (MEL) using an Efficiency Grade (N). The two categories relate to the efficiency assessed using static pressure and another using total pressure. The MEL are slopes that set lower targets for smaller fans and higher targets for larger fans based on the input power.

Fan market

It is acknowledged that the fan market is difficult to determine. The Energy using Product Lot 11 study (Ragden et al, 2007) states the apparent production for the year 2005, including production plus imports minus exports, as 51 million units. This would be a figure for all fans including those beyond the scope of the subsequent regulation 327/2011.

The European Ventilation Industry Association (EVIA) estimates the Ventilation industry is €7 billion and employs 45,000 people of which 60% consist of fan manufacturing; a €4.2 billion European fan industry employing 27,000 people. ebm-papst place on the European market €800 million fans indicating a 20% share of the sector.

In the small fan range 125 W to 750 W ebm-papst placed in the EU market in the last 12 months 1.3 million pieces that fall within the scope of regulation 327/2011. Based on ebm-papst market share of 20% this would put the EU production figures at 6.5 million units plus those imported.

Lost energy savings

ebm-papst Position Statement – no to reducing the limit for small fans
Revision of EU 327/2011

Mulfingen, January 2015

Without understanding the details of the proposal to reduce small fan limits it is difficult to define the potetial losses. We know that signifcant gains have been acheived and that some of this would be lost if the limit was reduced.

Since 2013 ebm-papst has revised a number of fans to increase the efficiency to meet the Tier 1 level of the regulation. The table below shows that for ebm-papst production 175 GWh/year have been saved for the two years since 1st January 2013 this equates to 350 GWh. Based on a market share of 20% then 1.75 TWh have been saved, just for fans produced and placed on the market in the EU.

Limits				
Fans replaced in ebm-papst	units	350.000		
Savings per fan	W	100		
Operation time per fan per year	h	5000		
Savings per year	GWh	175		

Table of estimated savings per year due to the Tier 1 limit. For ebm-papst production only.

From its own analysis ebm-papst can advise that the Tier 2 minimum energy efficiency limit coming into force in January 2015 will impact 600,000 units per year. We see 300 GWh/year saving is achieved based on the calculations below. Based on a 20% market share this becomes 1.5 TWh/year just for EU produced fans and does not included imported units.

Limits				
Fans replaced in ebm-papst	units	600.000		
Savings per fan	W	100		
Operation time per fan per year	h	5000		
Savings per year	GWh	300		

Table of estimated savings per year due to the Tier 2 limit. For ebm-papst production only.

Impact

ebm-papst recognises the difficulties of the fan regulations but has invested significant sums to improve its range of fans to meet the requirements of the directive. A reduction of the slope would mean the investment is wasted.

ebm-papst Position Statement – no to reducing the limit for small fans
Revision of EU 327/2011

Mulfingen, January 2015

The ecodesign fan regulation had a significant impact on the fan manufacturing and fan using industry. It has stimulated investment in new technological development in aerodynamic, electrical and electronic engineering. In the fiscal year 2013/14 ebm-papst invest €86 million in research and development. That investment is mirrored by similar companies in the industry.

Conclusion

It is seen that the market has responded to the requirements of the fan regulation 327/2011 and that technology is available to increase the efficiency of small fans. A reduction of the current limits would be a backward step and could result in an increase in energy consumption.

ebm-papst Position Statement – no to reducing the limit for small fans
Revision of EU 327/2011

Mulfingen, January 2015

References
European Commission (2011) *Commission Regulation (EU) No 327/2011 of march 2011 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.* The Official Journal of the European Union

Dr. Peter Radgen, Julia Oberschmidt, W T W Cory (2007) *EuP lot 11: fans for ventilation in non-residential buildings Final Draft Report.* Fraunhofer Institute Systems and Innovation Research, Karlsruhe

ebm-papst Position Statement – fans integrated in other energy related products
Revision of EU 327/2011

Mulfingen, January 2015

A change in the scope of the ecodesign fan regulation 327/2011 (EU, 2011) to exclude fans integrated in other energy-related products would destroy the fan industry in Europe. More than 20,000 jobs, revenues of €4.2 and 1.5 TWh/year energy saving will be lost.

The ecodesign fan regulation 327/2011 is effective. Even without any market surveillance and enforcement ebm-papst can show that at least 350 GWh has been saved so far since its introduction. All this gain would be lost if the European Commission succumbs to the pressure to adversely change the scope of the regulation.

ebm-papst

ebm-papst is a German based leading manufacturer of motors, fans and controls with production facilities throughout Germany, Europe, the USA and China. Per year ebm-papst produces about 60 million motors and fans which are globally marketed via 57 subsidiaries. Of the total global staff of 12,000 some 9,000 work in Europe. In order to maintain these jobs, ebm-papst recognised the need to focus on energy efficiency very early on; ebm-papst have been developing and manufacturing high efficient fans and EC technology since 1965.

Background

The ecodesign fan regulation 327/2011 defines a method to assess the energy performance of a range of fan types in the input power range of 125 W to 500 kW.

Regulation 327/2011 defines minimum energy efficiency requirements for six types of fan; axial, centrifugal forward curved and centrifugal radial bladed, centrifugal backward curved without housing, centrifugal backward curved with housing, mixed flow and cross flow. Each is then divided into two categories to set a minimum energy efficiency limit (MEL) using an Efficiency Grade (N). The two categories relate to the efficiency assessed using static pressure and another using total pressure.

A key point of the regulation is stated in Article 1 Subject Matter and Scope and states that the regulation includes those fans integrated in other energy-related products as covered by Directive 2009/125/EC.

Fan market

It is acknowledged that the fan market is difficult to determine. The Energy using Product Lot 11 study (Ragden et al, 2007) states the apparent production for the year 2005, including production plus imports minus exports, as 51 million units. This would be a figure for all fans including those beyond the scope of the subsequent regulation 327/2011.

The European Ventilation Industry Association (EVIA) estimates the Ventilation industry is €7 billion and employs 45,000 people of which 60% consist of fan manufacturing; a €4.2 billion European fan industry employing 27,000 people. ebm-papst place on the European market €800 million fans indicating a 20% share of the sector.

In the range 125 W to 3 kW ebm-papst placed in the EU market in the last 12 months 2 million pieces that fall within the scope of regulation 327/2011. Based on ebm-papst market share of 20% this would put the EU production figures at 10 million.

Lost energy savings
From its own analysis ebm-papst can advise that the Tier 2 minimum energy efficiency limit coming into force in January 2015 will impact 600,000 units per year. We see 300 GWh/year saving will be achieved. Based on a 20% market share this becomes 1.5 TWh/year saving for tier 2 just for EU produced fans and does not included imported units.

Mulfingen, January 2015

Limits				
Fans replaced in ebm-papst	units	600.000		
Savings per fan	W	100		
Operation time per fan per year	h	5000		
Savings per year	GWh	300		

Table of estimated savings per year due to the Tier 2 limit. For ebm-papst production only.

Since 2013 ebm-papst has revised a number of fans to increase the efficiency to meet the Tier 1 level of the regulation. The table below shows that for ebm-papst production 175 GWh/year have been saved for the two years since 1st January 2013. This equates to 350 GWh in total since 1st January 2013. Based on a market share of 20% then 1.75 TWh have been saved, just for fans produced and placed on the market in the EU.

Limits				
Fans replaced in ebm-papst	units	350.000		
Savings per fan	W	100		
Operation time per fan per year	h	5000		
Savings per year	GWh	175		

Table of estimated savings per year due to the Tier 1 limit. For ebm-papst production only.

Impact

If the scope of the ecodesign fan regulation 327/2011 is changed to exclude those integrated in other energy-related products then a loophole is created. Energy related product produced outside of the EU and imported into the EU would not need to use fans that meet the fan regulation limit. They could revert back to using the less efficient fans used before January 2013 when the regulation came into force.

It can be foreseen that energy-related equipment manufacturers would move their production outside of the EU to compete with those already outside using the cheaper less efficient fans. They are unlikely to continue to use the higher efficient fans manufactured in the EU and would replace them with less efficient ones. The 1.75 TWh saving to date would be lost plus the additional saving from tier 2. 99% of the 2 million units placed in the EU market by ebm-papst are subsequently integrated in other energy using products. ebm-papst is typical of many large European fan manufacturers.

Mulfingen, January 2015

ebm-papst employ 9,000 people in Europe manufacturing some 50 million fans of which 60% are place within the European Union. If energy-related manufactures move outside of the EU and use cheaper less efficient ones, more than 5,000 jobs will be lost. Across the European fan industry some 27,000 jobs could be lost.

Discussion

The impact on energy-related product manufacturers is difficult, but not impossible. Since 1st January 2013 thousands of products have changed from using less efficient fans to more efficient ones meeting the required limits. This is demonstrated by our sales data above and understanding that 99% of those sales are subsequently integrated in other products.

Some have been easy to change as they have had the same physical size and performance. Others have required to modify their units to make the more efficient fan fit. Some applications have become even more efficient than the just the fan saving.

Often a more energy efficient fan has improved the energy-related product and system beyond that of just the fan component gain. The refrigeration system is a good case in point where it can be shown system savings have been far greater than the total fan consumption.

Conclusion

The ecodesign fan regulation 327/2011 is effective. Even without any market surveillance and enforcement ebm-papst can show that at least 350 GWh has been saved since its introduction. This plus €4.2 revenue and tens of thousands of jobs would be lost if the European Commission succumbs to the pressure to adversely change the scope of the regulation.

References

European Commission (2011) *Commission Regulation (EU) No 327/2011 of march 2011 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.* The Official Journal of the European Union

Dr. Peter Radgen, Julia Oberschmidt, W T W Cory (2007) *EuP lot 11: fans for ventilation in non-residential buildings Final Draft Report.* Fraunhofer Institute Systems and Innovation Research, Karlsruhe

ebm-papst proposal to extend the scope of fan regulation 327/2011
Revision of EU 327/2011

Mulfingen, January 2015

There is an opportunity for a further 525 GWh/year saving in the short term by the simple extension of the scope of regulation 327/2011 (EU, 2011) to cover smaller fans. The 2011 Study on Amended Working Plan (VHK, 2011) identified a savings potential of small fans (<125 W) of 21.4 PJ/year by 2030. An extension of the scope of the current ecodesign requirements for fans below 125 W would be a simple implementation of the proposal of the study. It would set the path for future up lifts of limits to achieve the projected 21.4 PJ/year savings by 2030.

The proposal is to extend the scope to include fans with input power between 30 W and 125 W. Specifically to set efficiency grade N27 for axial fans and forward curved centrifugal fans and N37 for centrifugal backward curved fans, using the static efficiency category.

The negative impact is low as the proposal would use long established technology that can be applied with minimum change using the frame work of the current regulation.

A new separate study would not be needed to consider a separate regulation. This would save cost to the Commission and industry and deliver energy savings in a few years.

ebm-papst

ebm-papst is a German based leading manufacturer of motors, fans and control with production facilities throughout Germany, Europe, the USA and China. Per year ebm-papst produces about 60 million motors and fans which are globally marketed via 57 subsidiaries. Of the total global staff of 12,000 some 9,000 work in Europe. In order to maintain these jobs, ebm-papst recognised the need to focus on energy efficiency very early on; ebm-papst have been developing and manufacturing high efficient fans and EC technology since 1965.

Background

The ecodesign fan regulation 327/2011 defines a method to assess the energy performance of a range of fan types in the input power range of 125 W to 500 kW. The method to assess the efficiency of these fans is the same as that to assess fans below 125 W and so a new study to identify a methodology is not required.

Regulation 327/2011 defines minimum energy efficiency requirements for six types of fan; Axial, Centrifugal forward curved and centrifugal radial bladed, centrifugal backward curved without housing, centrifugal backward curved with housing, mixed flow and cross flow. Each is then divided into two categories to set a minimum energy efficiency limit (MEL) using an Efficiency Grade (N). The two categories relate to the efficiency assessed using static pressure and another using total pressure.

The 2011 Study on Amended Working Plan under the Ecodesign Directive identified a savings potential of 21.4 PJ/year by 2030. This study considered all motors <125 W power input. The study identified 11 million units were produced in 2009, with 11 million imported and 2.2 million exported and stated an apparent consumption of 21 million units.

The small fan market

The Study on Amended Working Plan under the Ecodesign Directive notes that ‘the fan market, due to its ubiquitous properties, is notoriously difficult to quantify’. Using alternative accounting methods it can be shown that it is larger than the estimate 21 million units.

Mulfingen, January 2015

The European Ventilation Industry Association (EVIA) estimates the Ventilation industry is €7 billion and employs 45,000 people of which 60% consist of fan manufacturing; a €4.2 billion European fan industry employing 27,000 people. ebm-papst place on the European market €800 million fans indicating a 20% share of the sector.

ebm-papst manufactures and places within EU 5.24 million units in the range 30 W to 125 W. Based on 20% share that would put this sector of the fan market manufactured within Europe at 26.2 million units. The Study on Amended Working Plan stated 11 million units are manufactured and placed in the EU. This would indicate the estimated saving in the study are out by a factor of at least 2½.
Further the study includes products that we see as outside of the scope of ecodesign so reducing its estimates, for example fans in cars are outside the scope but included in the Study on Amended Working Plan.

The EVIA estimates would not include fans in PC's that are included on the scope of the study. ebm-papst is the only European based manufacturer of such fans, these together with its products sold to the car industry have not been considered when estimating ebm-papst market share of 20%.

Potential savings

The Study on Amended Working Plan under the Ecodesign Directive discusses a change from a shaded pole motor to an EC-Motor (electronically commutated AC to DC motor) and comes to a conclusion that this would reduce the energy consumption by 50%. This figure should be larger with a change to EC-Motor. A 50% reduction can be achieved with a simpler change from AC shaded pole to a long established AC capacitor motor technology. The reasoning is explained below.

Taking a fan in the median position of the power input range 30 to 125 W, one with 75 W input. Taking typical values for a shaded pole motor efficiency of 20% and impeller efficiency of 40% then the air power out of the fan would be 6W. Changing to an AC capacitor motor of typically 40% motor efficiency, for the same air power out the input power reduces to 38W, a 50% saving. A change to EC would see even greater savings.

On the understanding that ebm-papst represents 20% of the production of fans in the EU and based on the number of shaded pole motors we produce the number of units produced in the EU can be estimated at 2.3 million units.

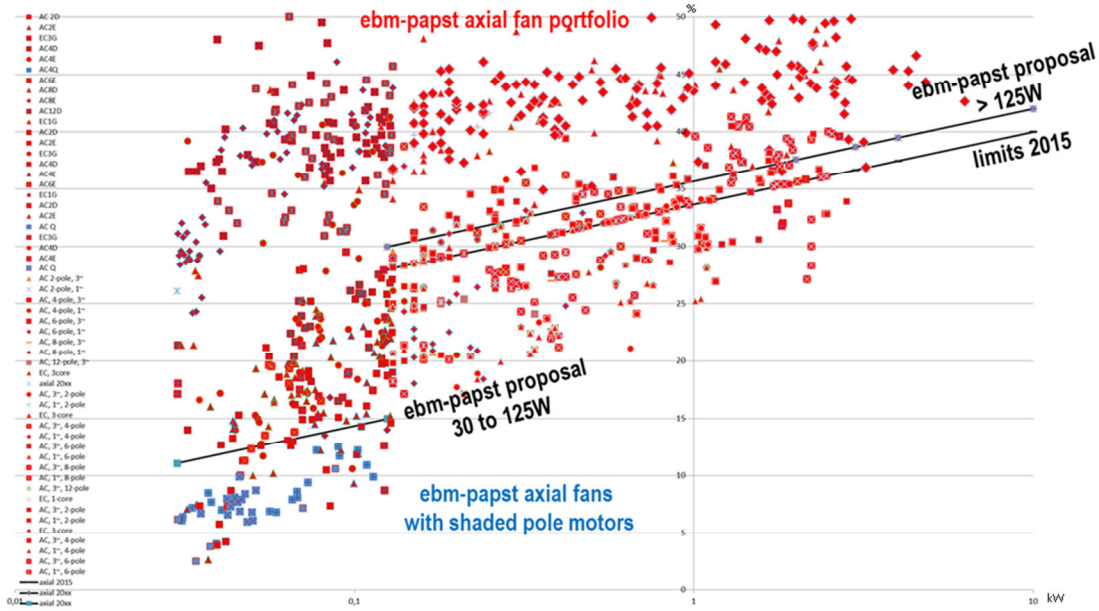
They will be used on a variety of applications; refrigeration plant, general ventilation, machine cooling, cooker hoods, inverter cooling, etc. The usage will vary depending on the application. The following estimates are based on half the stock operational for 20% of the time and half the stock for 50% of the time.

Applying 38 W savings to 2.3 million units used 20% and 50% of the time shows an opportunity to reduce energy consumption by 263 GWh/year with a simple change of the motor from AC shaded pole to AC capacitor.

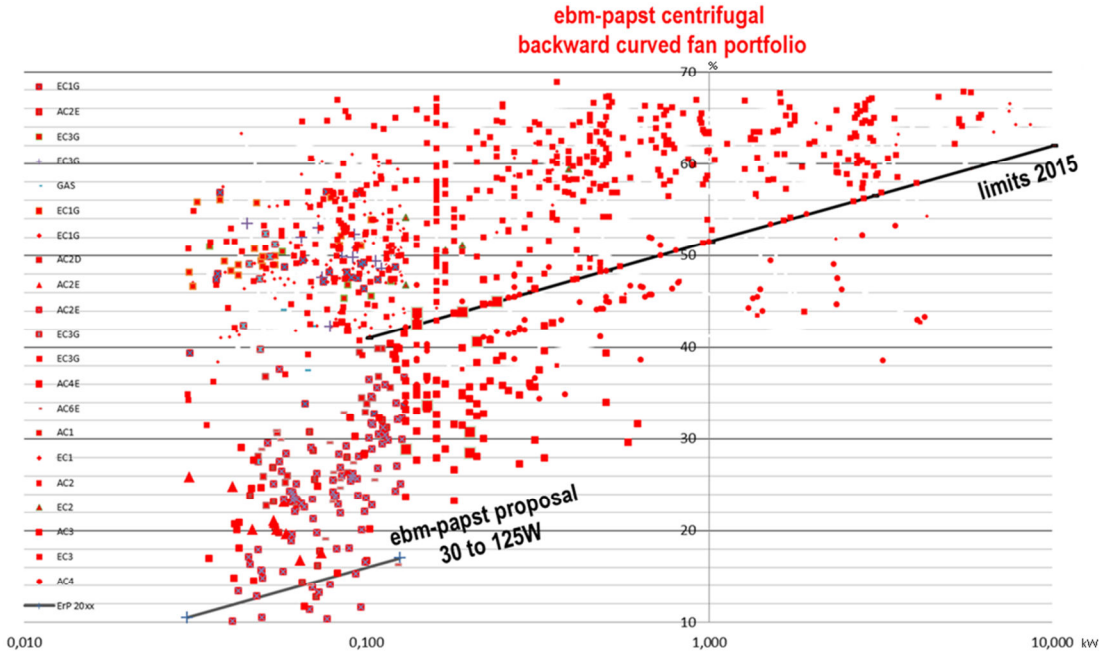
This saving can be doubled as the Study on Amended Working Plan shows that the same number of fans units is imported each year taking the potential saving to 525 GWh/year.

The following graph shows dots for each fan currently supplied by ebm-papst and how the above proposed MEL would impact the market.

Mulfingen, January 2015



Graph showing maximum efficiency of axial fan in the range 30 W to 10 kW – in particular the propose N27 limit for the 30 to 125 W range.



Graph showing maximum efficiency of backward curved centrifugal fans in the range 30 W to 10 kW – in particular the propose N37 limit for the 30 to 125 W range.

ebm-papst proposal to extend the scope of fan regulation 327/2011
Revision of EU 327/2011

Mulfingen, January 2015

Impact assessment

We see that just extending down the existing slopes would be too severe an impact on the industry, it would cause more damage than gain. However incremental increases from a lower point over a longer period to eventually align with the >125 W slopes would allow industry to invest in the change and receive a return on that investment.

We see a change to a capacitor motor is easy, where the motor is integrated in the impeller, such as an external rotor motor then they are physically the same. If the motor is separate then the impeller is on a shaft and is relatively easy to change. There is a need for a capacitor that would create some difficulties to locate in some applications. If the industry is given sufficient notice then we see this could be accommodated.

Changes to the impeller are a little more difficult and would incur investment in new tools and take longer, but could be considered in a future uplift of the limit.

A change to EC-motor is more complex. Whilst ebm-papst has suitable EC motors others in the market have not and would need time to develop. A change could also impact impeller designs and tools and so could be considered as a longer term second uplift.

The scope of the current fan regulations could easily be extended down to 30W. An initial limit of N27 for axial fans and forward curved fans and N37 for backward curved fans, based on static efficiency, will deliver 525 GWh/year saving in the first year.

Discussion

The small fan market (30 W to 125 W) is larger than estimated based on the ebm-papst EU sales data. A short term energy saving can be achieved with a minimum energy efficiency limit set that moves the market from AC shaded pole motors to AC capacitor motors. Existing measurement techniques are already used to assess the product performance and the framework of the current regulation would be suitable to monitor, verify and enforce the requirements.

An extension of the scope will signal to the industry an opportunity to invest in new fan developments to further increase the product efficiency. It will allow future increase in the limits to move the market in the longer term to more advanced technologies.

Conclusion

An extension of the scope of regulation 327/2011 would be easy and deliver 525 GWh/year savings in the short term and set a framework to transform the market in the longer term to achieve the potential savings of 21.4 PJ/year identified in the 2011 Study on Amended Working Plan.

References

Van Holsteijn en Kemna B.V. (VHK) (2011) *Final report task 3 version: 16 December 2011 Study on Amended Working Plan under the ecodesign Directive.* http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/product-groups/files/ecodesign_wp_task_3_16-12-2011_en.zip

European Commission (2011) *Commission Regulation (EU) No 327/2011 of march 2011 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.* The Official Journal of the European Union

ebm-papst proposal to fix a loophole in the fan regulation with respect to Mixed Flow Fans
Revision of EU 327/2011

Mulfingen, January 2015

The definition of mixed flow fans has created a loophole where subtle physical design geometry provides a potential to lose 0.9TWh/year savings. We propose to split the mixed fan group in two sub-groups so that limits can be set that reflect the true aerodynamic potential of the fan.

We propose an efficiency grade N50 for mixed flow fans with a α angle of ≥20° to ≤45° and N58 for α angle ≥45° to ≤70°.

ebm-papst

ebm-papst is a German based leading manufacturer of motors, fans and controls with production facilities throughout Germany, Europe, the USA and China. Per year ebm-papst produces about 60 million motors and fans which are globally marketed via 57 subsidiaries. Of the total global staff of 12,000 some 9,000 work in Europe. In order to maintain these jobs, ebm-papst recognised the need to focus on energy efficiency very early on; ebm-papst have been developing and manufacturing high efficient fans and EC technology since 1965. For more information please see our separate document.

Background

The ecodesign fan regulation 327/2011 (European Commission, 2011) defines a method to assess the energy performance of a range of fan types in the input power range of 125 W to 500 kW.

Regulation 327/2011 defines minimum energy efficiency requirements for six types of fan; axial, centrifugal forward curved and centrifugal radial bladed, centrifugal backward curved without housing, centrifugal backward curved with housing, mixed flow and cross flow. Each is then divided into two categories to set a minimum energy efficiency limit (MEL) using an Efficiency Grade (N). The two categories relate to the efficiency assessed using static pressure and another using total pressure. The MEL are slopes that set lower targets for smaller fans and higher targets for larger fans based on the input power.

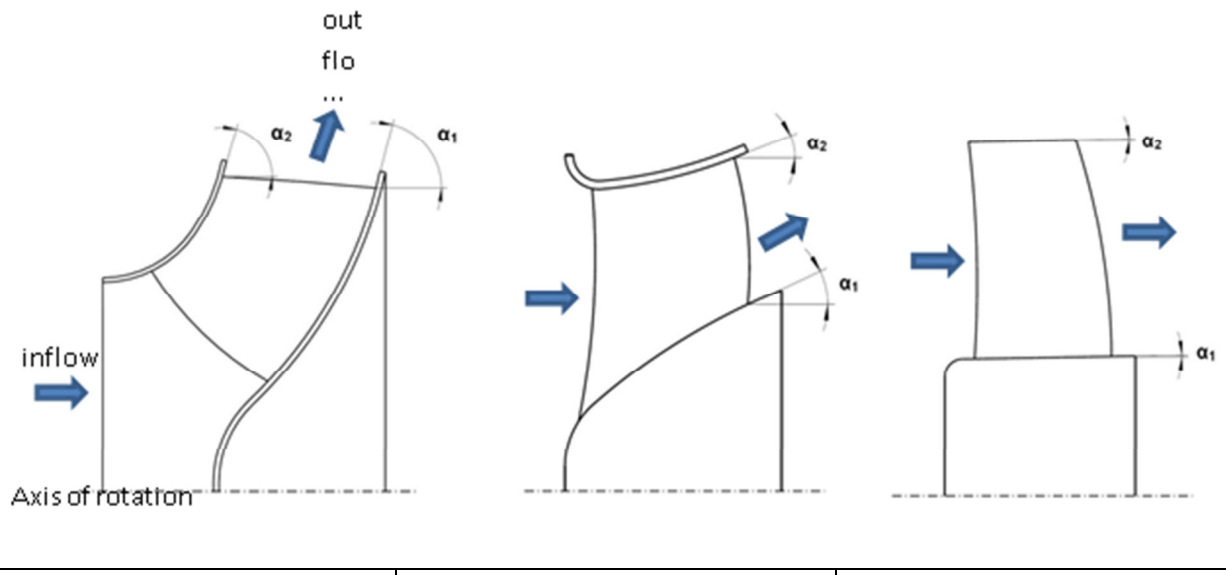
A mixed flow fan is a fan in which the gas path through the impeller is intermediate between that of backward curved centrifugal and axial types.

Mixed flow fans where not clearly defined in the regulation. The industry through the European Industry Association (EVIA) created a guidance document to clarify a number of aspects with mixed flow being one. It has subsequently been defined by an angle α, see an extract below;
These fan types are identified by the angles α_1 and α_2 (see figures). The angle α_1 is the angle of the tangent at the hub at the intersection of the blade trailing edge with the hub. The angle α_2 is the angle of the tangent at the shroud or at the outer diameter of the blade at the intersection of the blade trailing edge with the shroud or with the outer diameter of the blade. The fan types are defined as

Fan type	Angle α [a]
Axial fan	α<20°
Mixed flow fan	20°≤α<70°
Centrifugal fan	70°≤α
[a] where $\alpha = (\alpha_1 + \alpha_2)/2$	

ebm-papst proposal to fix a loophole in the fan regulation with respect to Mixed Flow Fans
Revision of EU 327/2011

Mulfingen, January 2015



Centrifugal fan	Mixed flow fan	Axial fan

Fan market

It is acknowledged that the fan market is difficult to determine. The Energy using Product Lot 11 study (Ragden et al, 2007) states the apparent production for the year 2005, including production plus imports minus exports, as 51 million units. This would be a figure for all fans including those beyond the scope of the subsequent regulation 327/2011.

The European Ventilation Industry Association (EVIA) estimates the Ventilation industry is €7 billion and employs 45,000 people of which 60% consist of fan manufacturing; a €4.2 billion European fan industry employing 27,000 people. ebm-papst place on the European market €800 million fans indicating a 20% share of the sector.

ebm-papst placed on the European market last year 576,000 backward curved centrifugal fans in the range 125 W to 10 kW. With a European manufacturing market share of 20% this would put the European manufactured market at 2.9 million units.

Axial – Mixed Flow – Backward curved centrifugal

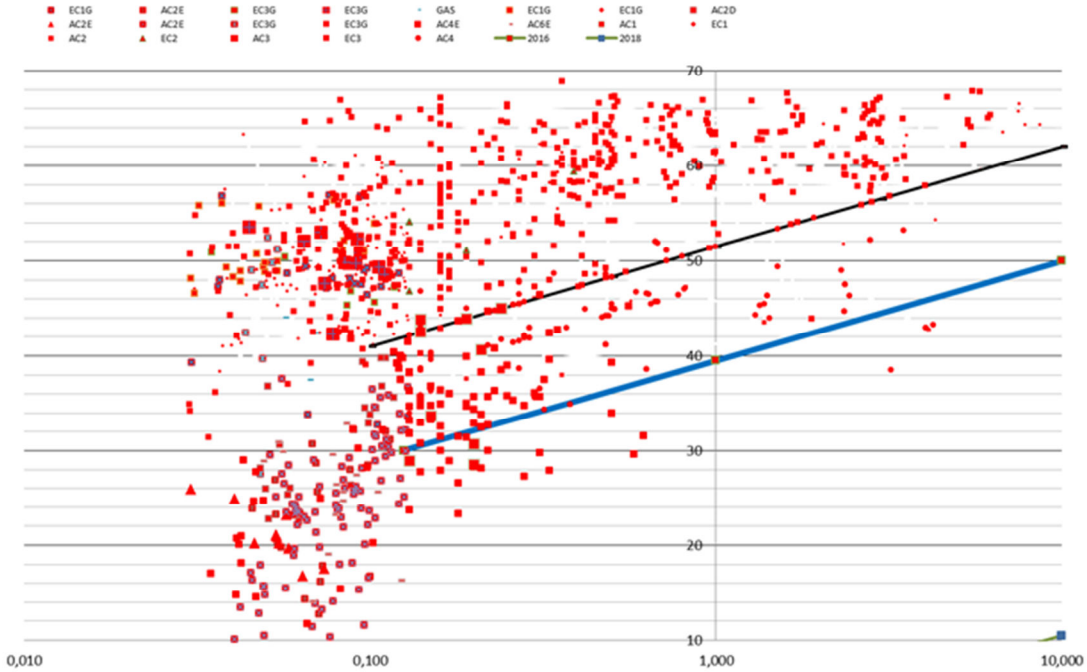
There is a significant difference in the energy efficiency potential between an axial fan and a backward curved centrifugal fan. Considering the current targets for 2015, the target for axial fans is N40 and for backward curved centrifugal fan N62. For a typical small fan of 0.75 kW the difference in percentage efficiency targets is 32.9% versus 50.2%

The mixed flow is an intermediate fan between the two and is set a target of N50 in the 2015 tier; 38.2%

What needs to be considered is the a mixed flow can be right in the middle with an α angle of 45°, but it could be more like an axial fan if the α angle is closer to 20°, in which case the target level is tough compared to the axial target of 32.9%. Or it could be more like a backward fan in characteristic if the α angle is closer to 70°, in which case the target is much too easy compared to the backward curved of 50.2%.

Mulfingen, January 2015

It can be seen that clever geometry of a mixed flow fans will realise an alternative to backward curved with a very low efficiency target. A mixed flow could be designed with an α angle of 69°, 1° less than a backward curved fan, and then need meet a much lower energy target. The graph below shows the two limits, the higher for backward curved and the lower for mixed flow. The dot in between represents real fans taken off the market before 2015 that could be replaced by cleverly designed mixed flow fans meeting a much lower efficiency level.



Graph showing the current 2015 limits for backward curved fans (black line) and mixed flow (blue line)

Lost energy savings

The lost energy saving can be seen in the above graph. The graph shows 40% of backward curved fans have been taken off the market with the 2013 and 2015 limit. With clever geometry a mixed flow giving similar performance to a backward curve would allow this number of fans back on the market at a lower efficiency limit.

With a European manufacturing market of 2.9 million some 1.15 million units have been taken off the market and replaced by more energy efficient ones.

Taking a typical input power of 0.75 kW, the output air power of a backward curved fan would be 0.4 kW. A mixed flow fan meeting the same output air power and meeting the lower mixed flow limit would consume 0.9 kW, a 0.15 kW increase.

Based on ebm-papst having a 20% share of this market, typical 5,000 hours per year usage and that 40% of the fans would changed from high efficient to low efficient mixed flow then 0.9TWh/year would be lost.

ebm-papst proposal to fix a loophole in the fan regulation with respect to Mixed Flow Fans
Revision of EU 327/2011

Mulfingen, January 2015

Impact

The impact would be the be the lost energy savings to Europe of 0.9 TWh/year

Discussion

A solution to this loophole would be to split the mixed flow category into two;

- one for mixed flow fans that have an axial characteristics, a α angle of ≥20° to ≤45°, with a limit of N50
- one for mixed flow fans that have a backward curved characteristic, a α angle ≥45° to ≤70°, with a limit of N58

Conclusion

To prevent a backward step and a loss of 0.9 TWh/year saving the mixed flow category needs to be split into two to prevent the change from high efficient backward curved to a category that has a low limit.

References
European Commission (2011) *Commission Regulation (EU) No 327/2011 of march 2011 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.* The Official Journal of the European Union

Dr. Peter Radgen, Julia Oberschmidt, W T W Cory (2007) *EuP lot 11: fans for ventilation in non-residential buildings Final Draft Report.* Fraunhofer Institute Systems and Innovation Research, Karlsruhe

ebm-papst proposal to increase the limit of Axial Fan of the fan regulation
Revision of EU 327/2011

Mulfingen, January 2015

ebm-papst proposes that the minimum energy efficiency limit (MEL) of axial fans can be raised from the current N40 to N50, but using the baackward curved centrifugal fan slope (static efficiency category). This will increase energy saving by 317 GWh/year.

The ecodesign fan regulation 327/2011 (EU, 2011) is effective. Even without any market surveillance and enforcement ebm-papst can show that at least 1.75 TWh/year has been saved since its introduction. An increase in the axial fan limit would build on the energy savings achieved so far.

ebm-papst

ebm-papst is a German based leading manufacturer of motors, fans and controls with production facilities throughout Germany, Europe, the USA and China. Per year ebm-papst produces about 60 million motors and fans which are globally marketed via 57 subsidiaries. Of the total global staff of 12,000 some 9,000 work in Europe. In order to maintain these jobs, ebm-papst recognised the need to focus on energy efficiency very early on; ebm-papst have been developing and manufacturing high efficient fans and EC technology since 1965.

Background

The ecodesign fan regulation 327/2011 defines a method to assess the energy performance of a range of fan types in the input power range of 125 W to 500 kW.

Regulation 327/2011 defines minimum energy efficiency requirements for six types of fan; axial, centrifugal forward curved and centrifugal radial bladed, centrifugal backward curved without housing, centrifugal backward curved with housing, mixed flow and cross flow. Each is then divided into two categories to set a minimum energy efficiency limit (MEL) using an Efficiency Grade (N). The two categories relate to the efficiency assessed using static pressure and another using total pressure.The value of N is applied to an equation that calculates the minimum efficiency limit for a fan with a declared electrical power input at its point of maximum efficiency.

The small to medium size axial fan market

It is acknowledged that the fan market is difficult to determine. The Energy using Product Lot 11 study (Ragden et al, 2007) states the apparent production for the year 2005, including production plus imports minus exports, as 51 million units. This would be a figure for all fans including those beyond the scope of the subsequent regulation 327/2011.

The European Ventilation Industry Association (EVIA) estimates the Ventilation industry is €7 billion and employs 45,000 people of which 60% consist of fan manufacturing; a €4.2 billion European fan industry employing 27,000 people. ebm-papst place on the European market €800 million fans indicating a 20% share of the sector.

In the range 125 W to 10 kW ebm-papst placed on the EU market in the last year 704,904 axial fans that fall within the scope of regulation 327/2011. Based on ebm-papst market share of 20% this would put the EU based production figures at 3.5 million units.

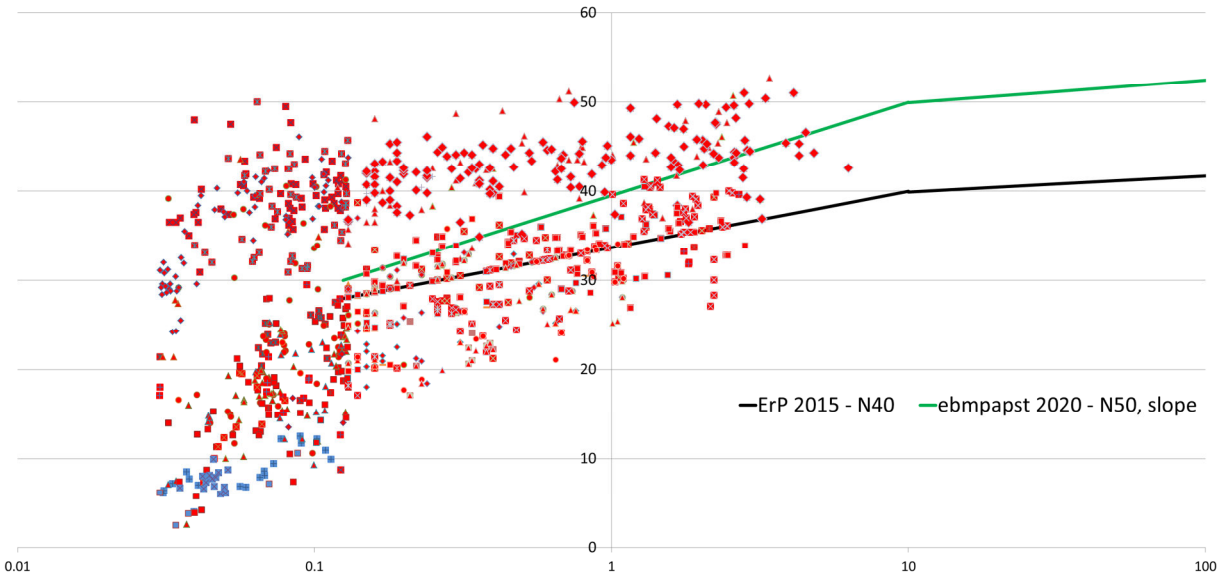
Potential savings

From ebm-papst production figures for the European market we see that the average power input is 0.75 kW. Taking the case of a fan that just meets the current N40 limit and applying the target efficiency formula it can be shown that a 0.090 kW saving is made by changing the slope to the same as the backward curved centrifugal fans and choosing a limit of N50.

Mulfingen, January 2015

We see that the backward curved centrifugal slope is more representative of axial fans, see the graphp below, and also provides a similification of the regulation.

The following graph shows dots for each fan currently supplied by ebm-papst and how the above proposed MEL would impact the market.



Graph showing maximum efficiency of axial fan in the range 125 W to 10 kW, in particular the proposed increase of the MEL from N40 to N50 (using the current centrifugal slope)

According to ebm-papst production data 20% of fans would be affected by this increase. With an estimated market size of 3.5 million units then 700,000 units would be taken off the market and replaced by more energy efficient ones.

If the average usage time is 5,000 hours per year and a typcal saving is 0.090 kW then the yearly saving potential is 317 GWh/year, plus the additional savings from imported fans.

Impact assessment

The ecodesign fan regulation had a significant impact on the fan manufacturing and fan using industry. It has stimulated investment in new technological development in aerodynamic, electrical and electronic engineering. In the fiscal year 2013/14 ebm-papst invest €86 million in research and development. That investment is mirrored by similar companies in the industry and has made it possible to increase the minimum energy efficiency limits.

Discussion

ebm-papst's proposal is to increase the static efficiency category limit from N40 (using the current slope 2.74xln(P)-6.33+40) to N50 (using the slope 4.56xln(P)-10.5+50). We see that most of our fans are used as components in other energy-related products and an energy efficiency assessment using static pressure is the correct way.

Mulfingen, January 2015

The MEL based on total pressure could also be increased but we do not have any figures to discuss the pro's and con's of such a change. However if the total pressure is not increased then a loophole can be created whereby fans could be assessed using the total pressure equations even though they are not intended to be used in an application where the total pressure is utilised.

Since 2013 ebm-papst has revised a number of fans to increase the efficiency to meet the Tier 1 level of the regulation. The table below shows that for ebm-papst production 175 GWh/year have been saved for the two years since 1st January 2013 this equates to 350 GWh. Based on a market share of 20% then 1.75 TWh have been saved, just for fans produced and placed on the market in the EU.

Limits				
Fans replaced in ebm-papst	units	350.000		
Savings per fan	W	100		
Operation time per fan per year	h	5000		
Savings per year	GWh	175		

Table of estimated savings per year due to the Tier 1 limit. For ebm-papst production only.

Conclusion

A further 123 GWh/year would be saved across the European fan manufacturing industry and would build on the 1.75 TWh already saved due to the effect of the ecodesign fan regulations. This is a conservative figure as it does not include savings from imported units.

References

European Commission (2011) *Commission Regulation (EU) No 327/2011 of march 2011 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.* The Official Journal of the European Union

Dr. Peter Radgen, Julia Oberschmidt, W T W Cory (2007) *EuP lot 11: fans for ventilation in non-residential buildings Final Draft Report.* Fraunhofer Institute Systems and Innovation Research, Karlsruhe

ebm-papst proposal to increase the limit of Backward Curved Centrifugal fans
Revision of EU 327/2011

Mulfingen, February 2015

ebm-papst proposes that the minimum energy efficiency limit (MEL) of backward curved centrifugal fans can be raised from the current N62 to N64. This will increase energy saving by 78 GWh/year. Increasing the slope to the one proposed in the VHK discussion document of 21st November will not increase the energy savings, this would result in the use of multiple lower efficiency fans to meet airflow requirements.

The ecodesign fan regulation 327/2011 (EU, 2011) is effective. Even without any market surveillance and enforcement ebm-papst can show that at least 1.75 TWh/year has been saved since its introduction. An increase in the backward curved centrifugal fan limit as proposed by ebm-papst would build on the energy savings achieved so far.

ebm-papst

ebm-papst is a German based leading manufacturer of motors, fans and controls with production facilities throughout Germany, Europe, the USA and China. Per year ebm-papst produces about 60 million motors and fans which are globally marketed via 57 subsidiaries. Of the total global staff of 12,000 some 9,000 work in Europe. In order to maintain these jobs, ebm-papst recognised the need to focus on energy efficiency very early on; ebm-papst have been developing and manufacturing high efficient fans and EC technology since 1965.

Background

The ecodesign fan regulation 327/2011 defines a method to assess the energy performance of a range of fan types in the input power range of 125 W to 500 kW.

Regulation 327/2011 defines minimum energy efficiency requirements for six types of fan; axial, centrifugal forward curved and centrifugal radial bladed, centrifugal backward curved without housing, centrifugal backward curved with housing, mixed flow and cross flow. Each is then divided into two categories to set a minimum energy efficiency limit (MEL) using an Efficiency Grade (N). The two categories relate to the efficiency assessed using static pressure and another using total pressure.The value of N is applied to an equation that calculates the minimum efficiency limit for a fan with a declared electrical power input at its point of maximum efficiency.

The 2015 limit of the backwark curved centrifugal fan is higher in relative terms than the other types, axial, forward curved and mixed flow. This is because the data used by the consultant in the original study was biased toward high efficient fans with using EC motor technology in the backward curved without housing catagory. This can be seen as the backward curved without housing, typically more efficient than without housing, was set a lower target. ebm-papst was a major contributor to the original study and at that time the market using backward curved centrifugal fans without housing had already changed to significant use of high efficient EC motors, more so than compared to the other product groups. This led to the consultant drawing a line higher in relative terms compared to the others. The line removed the majority of fans with AC induction motors in this product group. The other product groups where left with fans using AC induction motors.

The levels proposed by ebm-papst for axail fans, forward curved centrifugal fans and mixed flow fans moves the level up an to align to to the level of the backward curved fan.

The small to medium size axial fan market

It is acknowledged that the fan market is difficult to determine. The Energy using Product Lot 11 study (Ragden et al, 2007) states the apparent production for the year 2005, including production plus imports minus exports, as 51 million units. This would be a figure for all fans including those beyond the scope of the subsequent regulation 327/2011.

ebm-papst proposal to increase the limit of Backward Curved Centrifugal fans
Revision of EU 327/2011

Mulfingen, February 2015

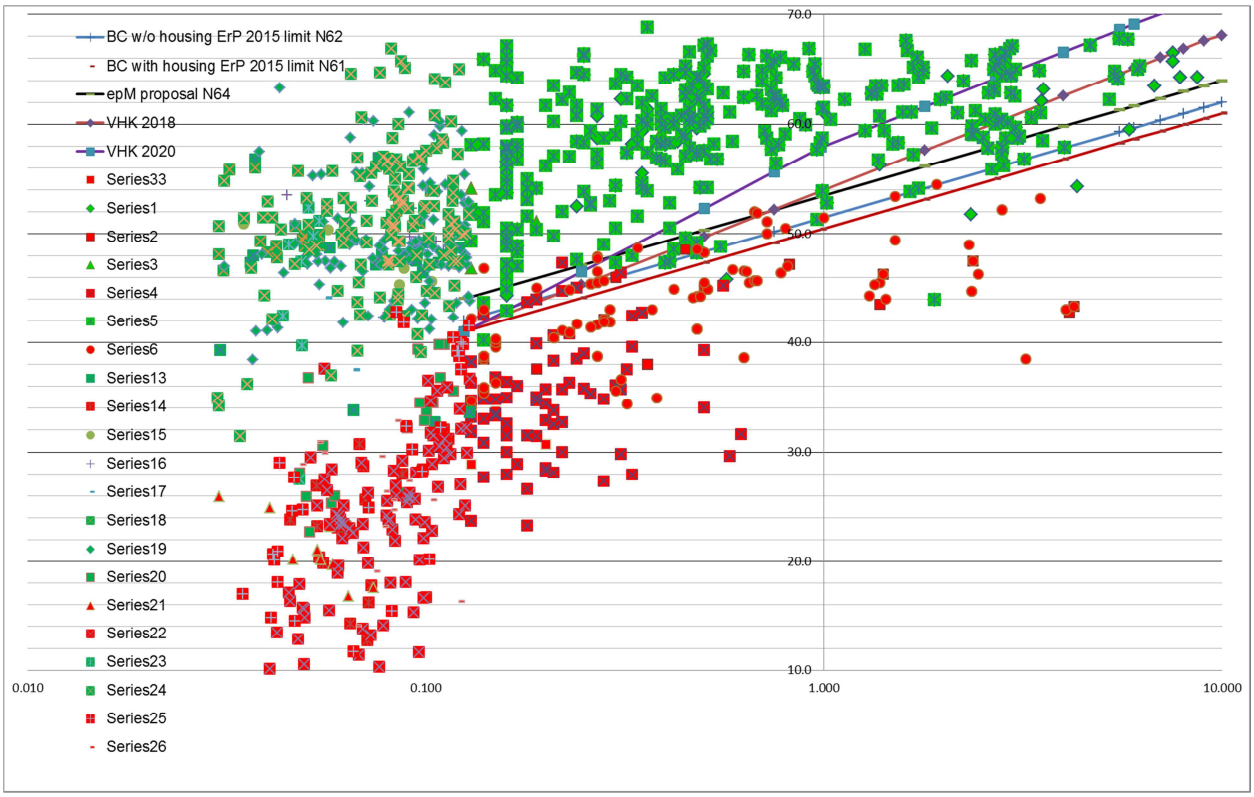
The European Ventilation Industry Association (EVIA) estimates the Ventilation industry is €7 billion and employs 45,000 people of which 60% consist of fan manufacturing; a €4.2 billion European fan industry employing 27,000 people. ebm-papst place on the European market €800 million fans indicating a 20% share of the sector.

In the range 125 W to 10 kW ebm-papst placed on the EU market in the last year 576,144 backward curved centrifugal fans that fall within the scope of regulation 327/2011. Based on ebm-papst market share of 20% this would put the EU based production figures for backward curved centrifugal fans without a scroll at 2.9 million units.

Potential savings

From ebm-papst production figures for the European market we see that the average power input is 1 kW. Taking the case of a fan that just meets the current N62 limit and applying the target efficiency formula it can be shown that a 0.034 kW saving is made by changing the slope to N62.

The following graph shows dots for each fan currently supplied by ebm-papst and how the above proposal would impact the market. The dots below the 2015 level show what has been removed from the market since 2011. Dots to the left of 125 W are outside the scope of the regulation.



Graph showing maximum efficiency of backward curved centrifugal fan in the range 125 W to 10 kW, in particular the proposed increase of the MEL from N62 to N64

Mulfingen, February 2015

According to ebm-papst production data 16% of fans would be affected by this increase. With an estimated market size of 2.9 million units then 461,000 units per year would be taken off the market and replaced by more energy efficient ones.

If the average usage time is 5,000 hours per year and a typcal saving is 0.034 kW then the yearly saving potential is 78 GWh/year, plus the additional savings from imported fans.

Impact assessment

The ecodesign fan regulation had a significant impact on the fan manufacturing and fan using industry. It has stimulated investment in new technological development in aerodynamic, electrical and electronic engineering. In the fiscal year 2013/14 ebm-papst invest €86 million in research and development. That investment is mirrored by similar companies in the industry and has made it possible to increase the minimum energy efficiency limits.

Discussion

ebm-papst's proposal is to increase the static efficiency category limit from N62 to N64. We see that most of our fans are used as components in other energy-related products and an energy efficiency assessment using static pressure is the correct way.

The MEL based on total pressure could also be increased but we do not have any figures to discuss the pro's and con's of such a change. However if the total pressure is not increased then a loophole can be created whereby fans could be assessed using the total pressure equations even though they are not intended to be used in an application where the total pressure is utilised.

The VHK proposed slope would be devasting to the market wasting the investment made over the last 4 years since the publication of regulation 327/2011 and would not save Carbon emissions. As large backward curved centrifgual fans with EC motor technology would be removed from the market there would be a change to using two or more less efficient samller fans to do the work of the one larger one. See the separate document for further explaination.

Since 2013 ebm-papst has revised a number of fans to increase the efficiency to meet the Tier 1 level of the regulation. The table below shows that for ebm-papst production 175 GWh/year have been saved for the two years since 1st January 2013 this equates to 350 GWh. Based on a market share of 20% then 1.75 TWh have been saved, just for fans produced and placed on the market in the EU.

Limits				
Fans replaced in ebm-papst	units	350.000		
Savings per fan	W	100		
Operation time per fan per year	h	5000		
Savings per year	GWh	175		

Table of estimated savings per year due to the Tier 1 limit. For ebm-papst production only.

Mulfingen, February 2015

Conclusion

A further 78 GWh/year would be saved across the European fan manufacturing industry and would build on the 1.75 TWh already saved due to the effect of the ecodesign fan regulations. This is a conservative figure as it does not include savings from imported units.

References
European Commission (2011) *Commission Regulation (EU) No 327/2011 of march 2011 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.* The Official Journal of the European Union

Dr. Peter Radgen, Julia Oberschmidt, W T W Cory (2007) *EuP lot 11: fans for ventilation in non-residential buildings Final Draft Report.* Fraunhofer Institute Systems and Innovation Research, Karlsruhe

ebm-papst proposal to increase the limit of Forward Curved Centrifugal Fans of the fan regulation
Revision of EU 327/2011

Mulfingen, January 2015

ebm-papst proposes that the minimum energy efficiency limit (MEL) of forward curved fans can be raised from N44, using current slope, to N54 using the backward curved slope (static efficiency category). This will increase energy saving by 116 GWh/year.

The ecodesign fan regulation 327/2011 (EU, 2011) is effective. Even without any market surveillance and enforcement ebm-papst can show that at least 1.75 TWh/year has been saved since its introduction. An increase in the forward curved centrifugal fan limit would build on the energy savings achieved so far.

ebm-papst

ebm-papst is a German based leading manufacturer of motors, fans and controls with production facilities throughout Germany, Europe, the USA and China. Per year ebm-papst produces about 60 million motors and fans which are globally marketed via 57 subsidiaries. Of the total global staff of 12,000 some 9,000 work in Europe. In order to maintain these jobs, ebm-papst recognised the need to focus on energy efficiency very early on; ebm-papst have been developing and manufacturing high efficient fans and EC technology since 1965. For more information please see our separate document.

Background

The ecodesign fan regulation 327/2011 defines a method to assess the energy performance of a range of fan types in the input power range of 125 W to 500 kW.

Regulation 327/2011 defines minimum energy efficiency requirements for six types of fan; axial, centrifugal forward curved and centrifugal radial bladed, centrifugal backward curved without housing, centrifugal backward curved with housing, mixed flow and cross flow. Each is then divided into two categories to set a minimum energy efficiency limit (MEL) using an Efficiency Grade (N). The two categories relate to the efficiency assessed using static pressure and another using total pressure. The value of N is applied to an equation that calculates the minimum efficiency limit for a fan with a declared electrical power input at its point of maximum efficiency.

The small to medium forward curved centrifugal fan market

It is acknowledged that the fan market is difficult to determine. The Energy using Product Lot 11 study (Ragden et al, 2007) states the apparent production for the year 2005, including production plus imports minus exports, as 51 million units. This would be a figure for all fans including those beyond the scope of the subsequent regulation 327/2011.

The European Ventilation Industry Association (EVIA) estimates the Ventilation industry is €7 billion and employs 45,000 people of which 60% consist of fan manufacturing; a €4.2 billion European fan industry employing 27,000 people. ebm-papst place on the European market €800 million fans indicating a 20% share of the sector.

In the range 125 W to 10 kW ebm-papst placed on the EU market in the last year 618,937 forward curved centrifugal fans that fall within the scope of regulation 327/2011. Based on ebm-papst market share of 20% this would put the EU based production figures at 3 million forward curved centrifugal fans.

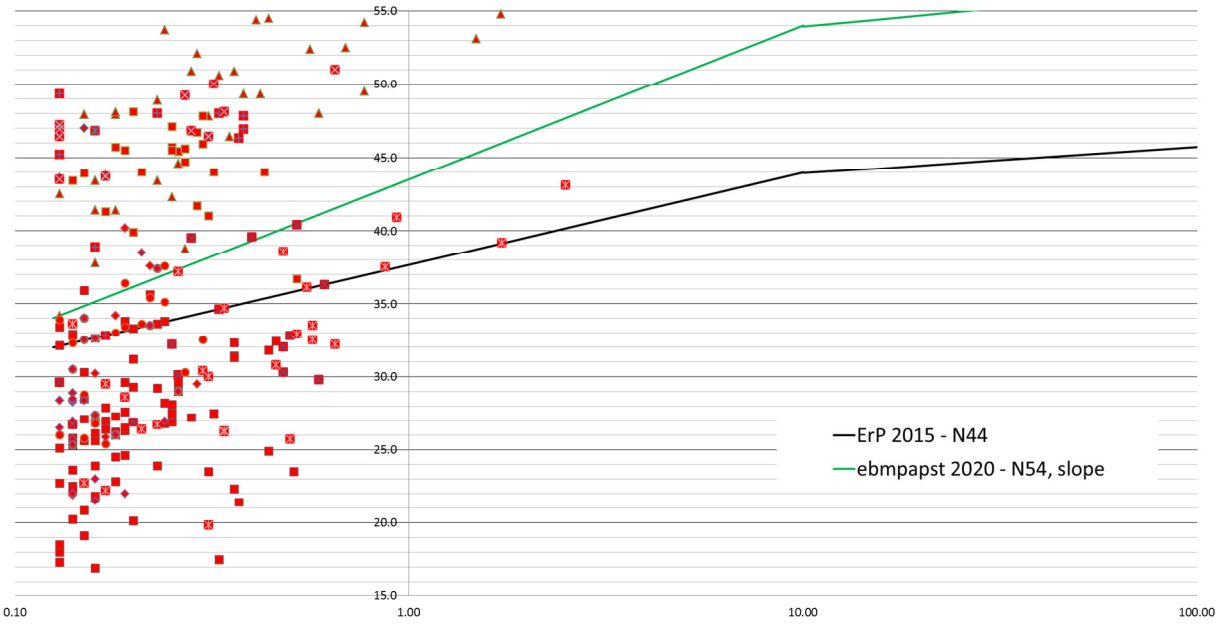
Potential savings

From ebm-papst production figures for the European market we see that the average power input is 0.5 kW. Taking the case of a fan that just meets the current N44 limit and applying the proposed target efficiency formula it can be shown that a 0.050 kW saving is acheived.

Mulfingen, January 2015

We propose that the slope is changed to that of the backward curved fans. We see that this is more representativie of foward curved fans, see the graph below. Further this is a way of simplifying the regulation.

The following graph shows dots for each fan currently supplied by ebm-papst and how the above proposed MEL would impact the market.



Graph showing maximum efficiency of forward curved centrifugal fan in the range 125 W to 10 kW, in particular the proposed increase of the MEL from N44 to N54 (backward curved slope).

According to ebm-papst production data 15% of centrifugal forward curved fans would be affected by this increase, some 460,000 units would be taken off the market and replaced by more energy efficient ones.

If the average usage time is 5,000 hours per year and the typical saving is 0.025 kW then the yearly saving potential is 58 GWh/year in addition to the same effect on imported fans.

Impact assessment

The ecodesign fan regulation had a significant impact on the fan manufacturing and fan using industry. It has stimulated new technological development in aerodynamic, electrical and electronic engineering. In the fiscal year 2013/14 ebm-papst invest €86 million in research and development. That investment is mirrored by similar companies in the industry and has made it possible to increase the minimum energy efficiency limits.

Discussion

Mulfingen, January 2015

ebm-papst's proposal is to increase the static efficiency category limit by two points, N44 to N46. We see that most of our fans are used as components in other energy-related products and an energy efficiency assessment using static pressure is the correct way. The MEL based on total pressure could also be increased and we would suggest N49 to N51. We do not have any figures to discuss the pro's and con's of such a change. However if the total pressure is not increased then a loophole can be created whereby fans could be assessed using the total pressure equations even though they are not intended to be used in an application where the total pressure is utilised.

Since 2013 ebm-papst has revised a number of fans to increase the efficiency to meet the Tier 1 level of the regulation. The table below shows that for ebm-papst production 175 GWh/year have been saved for the two years since 1st January 2013 this equates to 350 GWh. Based on a market share of 20% then 1.75 TWh have been saved, just for fans produced and placed on the market in the EU.

Limits				
Fans replaced in ebm-papst	units	350.000		
Savings per fan	W	100		
Operation time per fan per year	h	5000		
Savings per year	GWh	175		

Table of estimated savings per year due to the Tier 1 limit. For ebm-papst production only.

Conclusion

A further 116 GWh/year would be saved across the European fan manufacturing industry and would build on the 1.75 TWh already saved due to the effect of the ecodesign fan regulations. This is a conservative figure as it does not include savings from imported units.

References

European Commission (2011) *Commission Regulation (EU) No 327/2011 of march 2011 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.* The Official Journal of the European Union

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