Review study on Commission Regulation (EC) No 327/2011

First Interim Report, a discussion document

Date: 31 July 2014

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with reference to Framework Contract ENER/C3/2012-418-Lot2

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Foreword

This document is the first Interim report of the "Fan Review study", a study aimed to assist the European Commission in the revision of Commission Regulation 327/2011 of 30 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. This Regulation is to be revised by March 2015.

The report presents background information and the views, experiences and comments of stakeholders consulted in the context of this study. It is intended to feed into and structure the discussion of the first stakeholder meeting of the study, which is scheduled for 1 October 2014. Parallel to this report we will publish a report listing all the comments received through our survey. A second Interim report is due by the end of this year (2014).

The report does not reflect the opinion of the European Commission. Where opinions are expressed this is only to facilitate a discussion and should not be perceived as a bias towards a certain policy option. The selection of policy options has been and will remain the responsibility of the European Commission, to be presented to the Ecodesign Consultation Forum in the form of Commission Working Documents.

Last but not least we would like to thank all those who have contributed to this first report, by sending in completed surveys, by replying to questions or by other means.

With kind regards,

Martijn van Elburg & Roy van den Boorn

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0 Introduction

Aim of the study

The purpose of this study is to provide background information to the Commission in relation to the revision of Fan Regulation 327/2011[1], as required according article 7 of said regulation:

"The Commission shall review this Regulation no later than 4 years after its entry into force and present the result of this review to the Ecodesign Consultation Forum. The review shall in particular assess the feasibility of reducing the number of fan types in order to reinforce competition on grounds of energy efficiency for fans which can fulfil a comparable function. The review shall also assess whether the scope of exemptions can be reduced, including allowances for dual use fans".

The terms of reference for this review study include the following tasks:

- Task 1 Reduce (differentiated minimum requirements for) fan types;
- Task 2 Reduce exemptions;
- Task 3 Adequacy of dual use allowance;
- Task 4 Requirements for jet fans;
- Task 5 Adequacy of market surveillance.

As the Commission also published a "Fan FAQ document"[2] listing other issues related to the Fan regulation, the Task list has been expanded with:

- Task 6 covering a.o. the not final assembly, incorporated fans, verification tolerances, etc.

We have asked for the opinion of stakeholders regarding these topics, by issuing a survey with over 50 questions. The survey was posted on the study website **www.fanreview.eu** and sent by email to 138 registered stakeholders on 26 June 2011. 28 Completed surveys were returned.

The answers have been summarised in this report, together with some supplementary information from our side. The complete overview of replies received will be made available through a separate document.

The report is not intended to replace the Fan FAQ document, although both may present a view on how items and articles of 327/2011 can be interpreted. Where possible we strived to remain consistent with the FAQ document, but sometimes stakeholder opinions took us into another direction.

Report structure

This interim report follows the structure of the Fan regulation, as this is easy recognisable by the stakeholders involved and helps to facilitate the first steps of the revision process.

[1] OJ.L 90, 8. 6.4.2011: COMMISSION REGULATION (EU) No 327/2011 of 30 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

[2] http://www.fanreview.eu/downloads/FAN%20FAQ%20document.pdf

1 Article 1 Subject matter and scope

This article introduces the term 'fan' which is defined under Article 2.

1.1 Article 1, item 1: Subject matter and scope

General comment

Certain stakeholder(s) have argued that the subject matter and scope should be revised to better reflect the market segments in which fans operate, as this dictates (to a certain degree) the properties of fans placed on the market, the channels through which the fan is placed on the market and the way declaring conformity/market surveillance may take place.

These stakeholder(s) suggest splitting up the Regulation into regulations applicable to (as an example):

1) catalogue fans (mass produced, standard design, for HVAC or other universal applications), possibly split up into:
   a) domestic, commercial applications (e.g. clean air, light duty, normal operating conditions);
   b) industrial applications (e.g. dust loaded air, heavy duty, non-standard operating conditions);
2) bespoke fans, that are designed, produced and sold on basis of client specifications;
3) dedicated fans (for instance fans that cannot be tested using standard airways – or where such test would be meaningless).

CONCLUDING

Such an approach may be able to solve some of the problems currently experienced, but developing this will require much time, and will introduce a need for further discussion on where boundaries between market segments lie, and how possible misuse can be avoided, etc. We believe it would require an effort that extends beyond the available time and resources allocated to this study.

1.1.1 Fans incorporated into products

Many stakeholders agree with the inclusion of 'fans incorporated into products' in the scope, as otherwise a major loophole would be opened, allowing the entry into the EU Community of unregulated fans. The inclusion of incorporated fans within the scope does mean that a cascading of regulations may occur for certain fan applications, mainly in the HVAC sector.

But many other stakeholders argue that double regulation should be avoided as it adds burden to manufacturers without clear gains.

According the Blue Guide[3] the cascading of regulations is allowed. The Commission argues that besides closing loopholes, cascading also allows setting requirements that are more specific, tuned towards the actual application of products.

Note that the Ecodesign Framework Directive 2009/125/EC is first and foremost a Directive aimed at harmonising the internal market, by removal of barriers and/or ensuring a level playing field. The

[3] http://www.fanreview.eu/downloads/Blue-Guide-20140401-en.pdf

Ecodesign Directive however does this only for the measures that address the environmental performance of products.

CONCLUDING

Although many stakeholders do not like the idea that products are subject to double regulation (cascading) they also do not want to open up the EU market to unregulated fans.

Other stakeholders state that regulating at end product level ensures that fans, being part of overall energy efficiency of the regulated product, would not be of low efficiency.

The current inclusion of fans incorporated into products shows the preference of the Regulatory Committee in 2011.

1.1.2 Box and roof fans

Certain stakeholders have indicated a preference to include 'box & roof fans' in the scope of a revised Regulation. The benefit would be that the fans inside need not be removed for the purpose of compliance testing for the Fan regulation, simplifying measurement and calculation.

Other stakeholders have stated that as these products are already (to be) covered by the Ventilation products regulation, there is no need to also consider them in the Fan regulation. But as Box and roof fans may also be used for non-ventilation purposes (such as cooling applications / or removal of heat from processes) some types would not be regulated under the Ventilation products regulation. The fans inside however need to comply with 327/2011.

Again other stakeholders state that the coverage by the (upcoming) Ventilation products regulation should suffice for such simple products, and the whole category of box and roof fans should be exempted from 327/2011. This would open up a loophole for unregulated fans to enter the EU market.

CONCLUDING

Opinions diverge as regards the in- or exclusion of box and roof fans from the scope of the revised 327/2011. No preferred option could be identified.

The options should be scrutinised against article 15 criteria (of Ecodesign Directive 2009/125/EC).

1.2 Article 1, item 2: Exclusions of motor cooling, clothes drier and range hood fans

1.2.1 Impellers for cooling electric motors

As regards the exclusion of products with a sole electric motor of 3 kW or less where the fan (better: 'impeller') is fixed on the same shaft driving the main functionality, most stakeholder argue that the exclusion is valid and should remain.

Figure 1 Impellers for cooling electric motors[4,5]

[4] http://industrialdustcollectors.blogspot.nl/2010_08_01_archive.html

Mentioned as reasons for exclusion are (among others):

- the fan is used to cool the motor and hence adds to motor efficiency. Motors are already regulated under 640/2009. There is no need to further increase regulatory overlap;
- In practice, these fans take up a minor fraction of the overall power, are hardly measurable as a stand-alone item, are not sold or chosen as an independent product, and may be more effectively improved by pressing for an increased energy efficiency of the machines where they are highly integrated. Retaining the exemption would not significantly undermine the effectiveness of the regulation;
- The options to improve the fan are limited (for instance little chance to integrate a nozzle).

None of the stakeholders mentioned the exclusion to form a loophole. Some argued that the impeller cannot be tested independently: The main motor function determines the motor power, not the air power to be delivered.

Stakeholders have stated that there is a possible loophole in connection to motor regulation 640/2009 that also requires the motor to be tested independently. It is said that claims are made that the motor should be tested without the cooling impeller, but – as that could cause the motor to overheat – the motor cannot be tested. This way some inefficient (IE1) motors may still be placed on the market, offering a competitive advantage in first cost.

None of the stakeholders mentioned the need to change the scope of the exclusion (to include larger motors, beyond 3 kW, or to less than 3 kW). Impellers of motors >3kW are regulated under 327/2011, but no stakeholder reported on problems related to such motor impellers.

None of the stakeholders mentioned issues with defining the power input to the impeller (should be based on best efficiency point of the impeller, whereas the driving motor nominal power is based on its main function).

CONCLUDING

Most agree that the exclusion of the 'impeller' placed on a motor shaft for motor cooling purposes should remain[6].

We would like to receive opinions whether the motor power boundaries (>3kW) should remain the same / be enlarged / be reduced.

[5] http://www.hi-wire.co.uk/acatalog/Blue_Fans.html

[6] This assumes that impellers are also covered by the reviewed Regulation – that is discussed under item XX.

1.2.2 Fans of <3kW for clothes driers

As regards the exclusion of *fans in washers / driers of < 3 kW input power*, most stakeholders argue that the exclusion is not valid and these fans should be covered by requirements.

Figure 2 Impellers for clothes driers[7]

Mentioned as reasons to include these fans are (among others):

- the drier fan is technically similar to standard fans that are regulated. Some stakeholders add that a dedicated category may be appropriate (this hints to a different type of performance, not functionally similar to standard fans). These stakeholders state the dimensions and functions are different to that of standard fans (drier fans should be able to withstand higher degree of lint in the air stream).

Reasons to exclude these fans from the scope are:

- Some stakeholders state that the fans in driers may be excluded as the product in which it is incorporated is covered by Ecodesign legislation 932/2012. This does mean that other, similar, drier fans would still be included as 932/2012 only applies to household tumble driers[8].

Cascading of regulations is a major discussion point of this fan review study as it applies also to fans in many other application areas (HVAC is a major application). See also section 1.1.1.

CONCLUDING

The main discussion is whether fans in products that are already regulated under Ecodesign (or also Energy Labelling) should be covered by the reviewed Fan regulation.

Most stakeholders would like to see drier fans covered. However, we should learn more about the actual performance and differences to standard fans. For this we would like to hear arguments whether these fans are indeed different, requiring special treatment, or can be treated as standard fans.

[7] http://shop.zanussi.co.uk/category/Laundry/Tumble+Dryers/Motors%20%26%20Fans

[8] Household combined washer-driers are not covered by Ecodesign measures. There is however a Directive for energy labelling of these appliances: Commission Directive 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers

1.2.3 Kitchen hood fans < 280 W

As regards the exclusion of *kitchen hood fans < 280 W*, opinions appear more diverse.

Figure 3 Impellers for kitchen hoods[9]

Reasons to include range hood fans < 280 W

- the fan is technically similar to standard fans;
- testing should not be a problem;
- although range hoods are covered by 66/2014, it still allows inefficient fans to be used;

Reasons to exclude range hood fans < 280 W

- the domestic kitchen hood is already regulated under 66/2014 - no need to regulate the main component separately

Whether 'double regulation' should be avoided is a major discussion point of this fan review study as it applies also to fans in many other application areas (HVAC is a major application).

CONCLUDING

The main discussion is whether fans in products that are already regulated under Ecodesign (or also Energy Labelling) should be covered by the reviewed Fan regulation.

Here, even if the main application is already covered by 66/2014, many stakeholders agree with double regulation.

1.3 Article 1, item 3: exemptions for ATEX, operating conditions, etc.

1.3.1 ATEX Fans

Most stakeholders argue that the exclusion for ATEX fans should remain.

Reasons to include ATEX fans:

[9] http://shop.zanussi.co.uk/category/Cooking/Cooker+Hoods/Motors%20%26%20Fans

- some stakeholders state that ATEX fans can be made compliant to the Regulation (maybe with adapted, ATEX specific, minimum levels). This would add savings.
- some stakeholder also mention the relation to the (to be revised) Motor Regulation: if the revision includes ATEX motors, then it could be reflected in the revised fan regulation (again, with lower levels probably)

Reasons to exclude ATEX fans:

- the fan assembly must comply with the ATEX Directive: due to constructional requirements the ATEX fan has lower performance. If included then specific requirements need to be identified;
- no loophole is expected as compliance with ATEX adds costs to the fan. They are uncompetitive with standard fans;
- ATEX equipment undergoes 3rd party testing (Directive 2014/34/EC of 26 Feb 2014 recast)

CONCLUDING

The exclusion of ATEX fans does not cause practical problems, but arguably some saving potential is missed. The size of this saving potential is unknown as no data is available energy consumption and improvement potential of ATEX fans. The limited time to review does not allow a full assessment.

It is suggested to keep the exclusion of ATEX fans from the scope.

1.3.2 Fans for emergency use only

This exclusion applies to fans that are used for emergency use only (smoke extraction) at short-time duty, with regard to fire safety requirements set out in Construction Products Directive 89/106/EC[10] (now "CPR" Regulation (EU) No 305/2011) These are not dual-use fans that also function as 'normal' ventilation fans.

Reasons to include emergency use fans:

- there is no check whether the fan is indeed used for emergencies only;
- the fan can be made compliant to requirements (possibly with adapted levels);

Reasons to exclude emergency use fans:

- the fan assembly must comply with the CPR and relevant safety standards: due to constructional requirements the emergency use fan has lower performance. If included then specific requirements need to be identified
- no loophole is expected as the extra cost of the safety-related features, validation testing and third-party certification is enough to make these fans not cost-competitive;
- as these fans operate maybe just a few minutes per month for testing and then maybe in case of an emergency, the saving potential is very limited;

CONCLUDING

The exclusion of emergency use fans is not known to cause practical problems. Also the saving

[10] OJ L 40, 11.2.1989, p. 12.

potential is considered to be negligible due to very short operating hours.

Only in case of misuse as normal ventilation fan, energy saving is lost, but other stakeholders argue that acquisition costs are prohibitive to such misuse. Third party certification is required.

It is suggested to keep the exclusion of emergency fans from the scope.

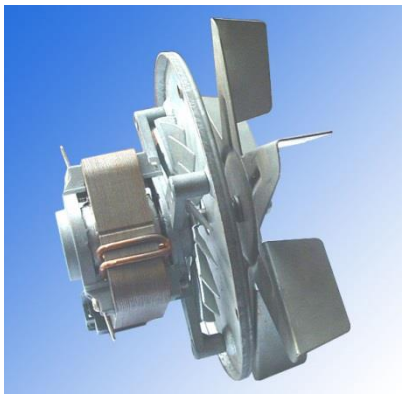
1.3.3 Fans in/for extreme temperatures

This exclusion applies to fans that are used where:

- *operating temperatures of the gas being moved exceed 100 °C;*
- *operating ambient temperature for the motor, if located outside the gas stream, driving the fan exceeds 65 °C;*
- *the annual average temperature of the gas being moved and/or the operating ambient temperature for the motor, if located outside the gas stream, are lower than – 40 °C;*

Examples are fans used in ovens and furnaces.

Figure 4 Impeller for high temperature operation (example: domestic oven[11])



Reasons to include high temperature fans:

- some stakeholders state these fans can be included, as long as the (adapted) minimum levels take into account the design constraints

Reasons to exclude high temperature fans:

- these fans are a really small market segment and overall energy consumption is considered to be very small

Most stakeholders argue that the exclusion fans for these extreme conditions should remain.

It was mentioned that the temperature boundaries should be modified to better reflect current practice:

[11] http://www.o-digital.com/wholesale-products/2179/2188-2/Oven-Fan-Motor-Shaded-Pole-Motor-with-Fan-75661.html

- for fans with the motor in the gas stream the maximum temperature could be 60 ℃;
- for fans where the motor is located outside the gas stream, a gas temperature of 100ºC may be the limit.

Others referred to a definition defined under Eurovent 1/1, Fan terminology, but this definition appears to result in a more limited operating range:

Figure 5 Definition general purpose fan in Eurovent 1.1

3.4.1. General purpose fan

A fan suitable for handling air which is non-toxic, not saturated, non-corrosive, non-flammable, free from abrasive particles, and does not exceed a temperature of 80 °C, or 40 °C if the motor or the fan bearings are in the air stream.

CONCLUDING

The exclusion of extreme temperature fans is not known to cause practical problems. Also the saving potential is considered to be negligible due to limited market relevance.

Only in case of misuse as normal ventilation fan, energy saving is lost. So far, it appears that declaring fitness-for-use under extreme temperatures is not validated by 3rd party testing or another form of certification.

QUESTION: Is fitness for use at high temperatures subject to 3rd party verification, or another form of certification?

It is suggested to keep the exclusion of extreme temperature fans, but to find a way to ensure the product is indeed designed for such use either by 3rd party testing (for extreme temperatures) , or another form of certification, thereby closing a possible loophole.

1.3.4 Fans outside the LVD – Low Voltage Directive

1.3.4.1 LVD

This exclusion applies to fans that are outside the scope of the low voltage directive (>1000 VAC, or 1500 VDC).

Reasons to include 'beyond LVD' fans:

- some stakeholders state these fans can be included as they are principally not different from other fans within scope;

Reasons to exclude 'beyond LVD' fans:

- these fans represent a small market segment;
- the potential for energy saving is considered small as well, as most fans are already designed for optimal efficiency;

Most stakeholders argue that the exclusion of fans for these applications should remain.

1.3.4.2 Motor regulation

Certain stakeholder(s) argue that the range of fan motors covered by the revised regulation 327/2011 should be identical to that of regulation 640/2009 on electric motors. Besides differences in maximum power, regulation 640/2011 is limited to 2, 4 and 6 poles motors, whereas fans can be driven by 8, 10 or 12 poles motors, for which efficiency is low. Many fans are also driven by EC motors of which efficiency is generally higher.

1.3.4.3 Battery driven / lower power boundary

The regulation also does not specify the whether battery operated fans are included or excluded. The Fan FAQ document concluded that battery driven equipment is excluded.

Others have suggested extending the scope downwards to include fans from up to 30 W. This would however require more study, as these fans are found in numerous applications and not just a niche application such as jet fans.

CONCLUDING

The exclusion of fans beyond LVD boundaries is not known to cause practical problems.

The saving potential is considered to be small as the very large fans are in most cases already designed to have optimum efficiency.

It is suggested to keep the exclusion of fans outside the LVD from the scope.

Alignment of fan motors with the Motor regulation 640/2009 is not considered practical as it would seriously limit the application range of fans covered by the fan regulation.

1.3.5 Fans for toxic, highly corrosive, abrasive environments etc.

This exclusion applies to fans that are intended for 'toxic, highly corrosive or flammable environments or in environments with abrasive substances'.

Reasons to include fans for 'hazardous' conditions:

- a few stakeholders state these fans can be included and regulated as well, albeit with specific requirements;

Reasons to exclude fans for 'hazardous' conditions:

- there are certain design constraints on these fans that make them unsuitable for inclusion in the regulation;

Most stakeholders argue that the exclusion of fans for these applications should remain.

Stakeholders (and the FAQ document) mention the lack of definitions for the respective conditions. The CLP Regulation[12] could be referenced with regard to defining flammable, corrosive (incl. oxidising) and toxic environments. We invite the legal team of DG ENER C3 to judge whether a simple reference

[12] Regulation (EC) No 1272/2008 on classification, labelling and packaging (CLP) of substances and mixtures

suffices, or that complete definitions need to be included [can be tackled when reaching Working Document stage].

The concept of abrasive environments however is not covered by the CLP Regulation. For this either the definition in the Fan FAQ document may be kept, or a suitable alternative definition may be found.

Stakeholder EVIA has presented a definition for clean air, which would rule out most abrasive environments as well (see section 3.4.3 on non-gaseous substances). Possibly the two exemptions can be joined in a single exemption.

Certain stakeholder(s) argue that fans designed for specific applications, such as the process and power industry, need to be very robust as a breakdown causes substantial financial losses. These fans are designed for maximum reliability as well. These applications should be handled as extreme operating conditions [the stakeholder(s) did not mention whether this should be reflected in amended limit values, or result in an exclusion from scope].

For a discussion on 'backward inclined fans', see Section 2.2.

CONCLUDING

The exclusion of fans for toxic, highly corrosive, abrasive environments etc. is not known to cause practical problems, besides the lack of definitions for these terms.

It is suggested to keep the exclusion of such fans from the scope. As regards the definitions of toxic, flammable, corrosive: These may be dealt with by referencing the CLP Regulation 1272/2008. As regards abrasive, the fan FAQ or an alternative definition may be used.

1.3.6 Replacement fans

The regulation shall not apply to fans which are "*placed on the market before 1 January 2015 as replacement for identical fans integrated in products which were placed on the market before 1 January 2013; except that the packaging, the product information and the technical documentation must clearly indicate regarding (a), (b) and (c) that the fan shall only be used for the purpose for which it is designed and regarding (d) the product(s) for which it is intended*"

This means that there is a 'grace period' of two years, after which all fans placed on the market, including sold as replacement of fans sold before 2013, must comply with 2015 requirements.

This exclusion has caused a heated debate for most stakeholders. Many state that the exclusion of replacement fans from the requirements until 1 January 2015 is way too short as exclusion period. Fan manufacturers, which include fan integrators, state that they are legally or voluntarily bound to supply replacement parts up to 10 years after sales. The situation is not helped by the impression that the regulation considers both complete fans as well as the impeller only (as not final assembly) as a 'fan'.

The concept of replacement is not mentioned in the Blue Guide (nor is refurbishment, or reconfiguration).The Blue Guide does state that repairing products does not constitute a placing on the market (page 16, bottom). So it should be allowed for manufacturers to supply parts for repairing that result in the repaired fan being compliant to requirements applicable at time of first placing on market.

Simply stopping the supply of fans for replacement purposes that have been sold to final customers two years before creates problems at various levels. The review website www.fanreview.eu has a presentation by Eurovent that sketches the various issues that may be encountered.

On the other hand, the Commission does not want outdated fans to keep running forever.

A proper definition of what constitutes 'replacement' (or the act of replacing) is needed. The industry argues that the act of changing a part or the complete fan because of malfunction, within the technical life of the product, is better described as 'repair'. They therefore argue for a grace period of 5 to 10 years (the minimum technical life, or often the guaranteed period for availability of service parts), after which the act of changing a part or the complete fan because of malfunction is considered 'replacement' and not 'repair'. The industry thinks to avoid loopholes (parts or complete fan for repair being used as new installation) by clearly labelling the parts with "for repair purposes only" (or similar). Many manufacturers already operate separate production lines for compliant products (EU market) and non-compliant products (for export).

It would be best to include definitions for *refurbishment* and *reconfiguration*, etc., so that it's clear which acts are considered to constitute a placing on the market and which not (repair, refurbishment, reconfiguration). A possible definition for refurbishment has been suggested by Eurovent: *"Refurbished fans shall not be considered as new fans placed on the market, as long as the parts which are repaired or replaced are identical to the original ones or provide a same or better efficiency*".

An explanation of terms related to refurbishment, reconfiguration, substantial modification and repair is also provided in Annex I. The text is from the ATEX Directive 94/9/EC.

CONCLUDING

The industry argues rather unanimously that replacement fans, or replacement parts, (intended for repair) should be allowed to be placed on the market until 5 to 10 years after the sales transaction.

The fan or part should be clearly labelled "for repair purposes only".

2 Article 2 Definitions

2.1 The definition of a fan

The product regulated is a 'fan', which is defined as:

1) *'Fan' means a rotary bladed machine that is used to maintain a continuous flow of gas, typically air, passing through it and whose work per unit mass does not exceed 25 kJ/kg, and which:*
   a) *is designed for use with or equipped with an electrical motor with an electric input power between 125 W and 500 kW (≥ 125 W and ≤ 500 kW) to drive the impeller at its optimum energy efficiency point,*
   b) *is an axial fan, centrifugal fan, cross flow fan or mixed flow fan,*
   c) *may or may not be equipped with a motor when placed on the market or put into service;*

The definition used in Regulation 327/2011 has given cause to confusion and various interpretations of what is actually regulated, as the meaning of a 'fan' varies throughout 327/2011: 'Fan' may mean the

combination of an impeller and a motor, and which may include other components such as housings, transmissions and drives, but 'fan' may also mean just the impeller (see item "c)" above – not equipped with a motor).

'Fan' in the meaning of just the impeller is in line with the definition of 'not final assembly' ("consisting of at least an impeller"), the calculation method applied to not final assemblies (starts with shaft power, the rest can be filled in using default values) and the inclusion in the scope of cooling impellers (fan wheels) for cooling electric motors >3kW that are positioned on the main motor shaft. This cooling impeller is not a complete assembly as the motor driving the impeller cannot be selected for optimum fan efficiency – it is logical that the fan (impeller) has to be verified without the motor that drives it.

For a discussion on 'not final assembly' → see also Section 9.4

CONCLUDING

The revised regulation should define more clearly the products that are regulated. Parts and complete products should not be covered by the same definitions.

2.2 Backward inclined, curved or aerofoil

Certain stakeholder(s) have commented on the lack of consideration for backward-inclined centrifugal fans. These are used in process industry where there is a possibility of contaminants in the air stream or where increased strength is required for high pressure applications. They are a major sector of the market for the process industry fans.

Our interpretation of the definitions in 327/2011 is that backward inclined fans are not excluded from the scope (although the wording in the definition uses 'backward-curved'). Also backward aerofoil is included.

The logical next question is whether backward-inclined fans can meet the requirements that apply to backward curved (or backward aerofoil as well).

It can be demonstrated that the backward-inclined blade is a backward-curved blade having a singular (infinite) radius of curvature. With proper design, the backward-inclined impeller can be made equally efficient compared with any backward-curved one. These two blade designs are essentially equivalent, and are sometimes joined together under the common name of “constant-thickness blades”. The aerofoil impeller has some aerodynamic advantage, at the cost of manufacturing complexity, and sensitivity to internal corrosion.

The larger fan sizes (1.5 meters of impeller diameter and beyond), are more typical, in Europe, of the industrial plants, like fans for lightly-leaden dust convection systems or forced-draught fans in large power-station boilers. All designs mentioned have been tried for such applications. On these sizes, the efficiency advantage of aerofoil begins to approach or exceed the 5% mark, but the costs spiral up as well. For industrial applications, where the airflow may often be loaded with condensing water or more aggressive compounds (e.g. in the forced draught fans of large power-station boilers), the reduction in downturn time and maintenance cost of a design having more easily to inspect and repairable blades may still justify the use of a constant-thickness design, especially where noise is not a major issue.

3 Article 3 Ecodesign requirements

3.1 Article 3, item 1: Ecodesign requirements

[see discussion in Section 8, on Regulation Annex I]

3.2 Article 3, item 2: exemption from 1st tier of 'ventilation' fans

The 1st tier of minimum energy efficiency requirements applies only to **ventilation fans** and thus excludes fans in laundry and washer-driers > 3 kW electric input power, fans in indoor units of room AC (< 12 kW cooling power) and fans in ICT products fans.

Most stakeholders stated that there is no further need to exclude these products. But certain stakeholders stated that in case the product is covered by specific legislation, the fans incorporated should be exempted from the revised regulation. Indeed, most if not all of these applications are covered by specific legislation (or are being considered, such as 'Lot 24' non-household laundry and dishwashing appliances). Here we recognise the reoccurring discussion regarding *fans incorporated into products* and *cascading of regulations*.

As of 2015 the 2nd tier applies to **'fans'**, which means these exemptions no longer apply, and drier fans, indoor AC fans and ICT fans are covered by energy efficiency requirements.

CONCLUDING

The main discussion is whether fans in products that are already regulated under Ecodesign (or also Energy Labelling) should be covered by the reviewed Fan regulation.

Most stakeholders agree with no longer exempting such fans from ecodesign requirements.

3.3 Article 3, item 3: Information requirements

[see discussion in section 8.3, Regulation Annex I]

3.4 Article 3, item 4: Exemptions

This item of Article 3 excludes certain 'fan' types from specific ecodesign requirements. We have the perception that not many stakeholders are aware that these fans may still be covered under the information requirements (Annex I, section 3).

The Fan FAQ document does provide some interpretations as regards leaf blowers and vacuum cleaners and concluded that these products are not covered by the information requirements.

The exemptions for specific ecodesign requirements covers: **fans > 8000 rpm, fans with ratio > 1.1 and fans for non-gaseous substances.**

3.4.1 Fans > 8 000 rpm

This limitation has been introduced to exclude fans in vacuum cleaners from the regulation (see also Fan FAQ document). Most stakeholders agreed with the exclusion.

Some stakeholders argued in favour of their inclusion, but failed to explain why they should be included.

3.4.2 Fans with ratio > 1.1

Most stakeholders agreed with the exclusion of such fans as they are considered to be compressors (or at least not fans), in accordance with ISO 5801. Interestingly, the EN ISO 13349 sets the boundary between compressors and fans at a ratio of 1.3.

Some stakeholders argued in favour of including fans > 1.1, and referred to narrow blade backward curved impellers that deliver high pressures. These stakeholders did not define a next upper limit. Other stakeholders commented that such narrow bladed fans show poor efficiencies, and argued for exemption, even for a ratio less than 1.1.

The regulation could improve upon internal consistency by moving the exemption from Article 3, to Article 1, as part of defining the scope (experts agree that work of 25 J/kg matches a ratio of 1.1). Their inclusion for the information requirements seems to conflict with the general perception that these products are not considered fans.

3.4.3 Fans for conveying non-gaseous substances

The specific ecodesign requirements shall not apply to fans which are designed to operate "*as conveying fans used for the transport of non-gaseous substances in industrial process applications".*

This limitation has been introduced to remove from the scope of specific ecodesign requirements fans that are used to transport or move fibres (as used in textile machinery/processes) or other solid substances (beads, coal dust, leaves and twigs, etc.), by means of air. Such fans are often of the centrifugal type with radial impeller blades, with very wide clearances, as this exhibits the least chance of clogging.

The relevant terms however are not defined in 327/2011: conveying fans, non-gaseous substances and industrial process applications are not further specified. EN ISO 13349 does mention 'dust fans', and 'conveying fan / transport fan'.

Almost all stakeholders agreed that fans for such purposes are to remain excluded from the scope. A more specific definition would be appreciated.

In this respect EVIA has issued a document giving limit values for 'clean air', based upon industry know-how[13]. This 'definition' of clean air is also presented in the Fan FAQ document.

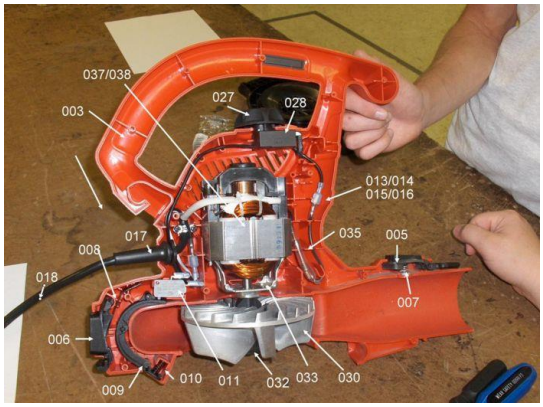
Figure 6 Definition of clean air

Dry air		Humid air (>70%)	
Max . dimension of suspended particles [mm]	Max concentration of particles [g/m^3]	Max . dimension of suspended particles [mm]	Max concentration of particles [g/m^3]
<1	<0.2	<0.05	<0.05

It was also not intended to cover leaf suction / blowers within the scope of 327/2011. The Fan FAQ document mentions these products can be considered to be excluded as the air stream may be considered 'abrasive' (the purpose is often also to shred leafs and twigs).

[13] EVIA - Fans Guidance Document

Figure 7 The 'fan' in a leaf blower[14]



CONCLUDING

The exemption of these 'fans' (*8000 rpm, >1.1, non-gaseous*) still seems justified.

Their inclusion in Article 3 of the regulation however means they still need to comply with information requirements, whereas the general perception is these products are not 'fans' as intended to be covered by the regulation.

It is recommended to maintain the exemptions, but move the exemption to the scope definition.

3.5 Article 3, item 5: Dual use

The dual use fan is not defined in Article 2. A description of what is meant is only found in Article 3, item 5: *dual use fans designed for both ventilation under normal conditions and emergency use, at short-time duty, with regard to fire safety requirements as set out in Directive 89/106/EC*.

Stakeholder opinions vary regarding the inclusion of dual use fans, their definition and the subsequent special allowance.

3.5.1 Definition of dual use

Some stakeholders suggested a small modification: besides the correct legal definition of their emergency use, perhaps the more common words “fans used as powered smoke and heat exhaust ventilators, in case of fire, as well as for normal ventilation” might help to clarify the meaning.

3.5.2 Dual use allowance level

3.5.2.1 The 2nd tier

The operation of dual use fans in case of emergency requires bigger gaps between impeller and inlet cones, which affect efficiency. To this all stakeholders agree. All stakeholders also agree that the reduction of the 10% allowance (Tier 1) to 5% (Tier 2) should be repealed. The reduction in efficiency allowance coupled with the increase in efficiency grade means that a life safety HT axial fan has to

[14] https://wiki.ece.cmu.edu/ddl/index.php/Image:Leaf_Assem.JPG

achieve an improvement of 13% in its efficiency to comply with the regulation after 2015. This improvement is too drastic, especially as it is to be achieved primarily by impeller redesign, as all other 'loss factors' (housing, motor, etc.) remain the same (between 2013 and 2015).

If the allowance is kept constant, then further efficiency improvement (beyond 2015) is likely to occur by means of the motor regulation.

Certain stakeholder(s) mentioned as reason not to implement the second tier of 5% is that these products need to be tested by notified bodies. Re-testing of already certified products would likely take several years and would incur significant costs to the industry.

3.5.2.2 Reversible

Dual use fans are usually reversible fans, working in one direction for extracting fumes and in the other for introduce fresh air. Reversible fans are less efficient because the blade profile is symmetrical, worsening aerodynamic efficiency. Some stakeholders argued for differentiated requirements for reversible and non-reversible dual use fans, but no stakeholder provided information or comments on how to treat reversible and non-reversible dual use fans (What is the difference in energy efficiency for both products? What is the effect on requirements?)

3.5.2.3 No loophole

Stakeholders state that dual-use fans need to be certified by a notified body of the EU (3rd party certification) according with the harmonized European Standard 12101-3. Dual-use fans are more expensive, due to constructional measures which will incur a significant increase in the manufacturing cost. The certification and extra costs prevent misuse.

CONCLUDING

No stakeholder comments have been received opting for an exclusion of dual use fans. So their inclusion within the scope is broadly accepted. The inclusion of dual use fans is not known to cause problems related to misuse or loopholes. As the dual use fan requires mandatory 3rd party certification according Harmonized European Standard EN 12101-3, its potential use as 'loophole' is considered to be theoretical at most.

There is however an immediate problem with the combined tier II ecodesign requirements and reduced allowance (from 10% to 5%). Several manufacturers have stated that it is increasingly difficult, if not impossible, to supply products that meet these extra tight requirements.

The review study cannot change the Regulation as it is. Problems related to non-compliance have to be dealt with together with the Commission and the Member States who are responsible for follow-up.

What the review study can do is sketch possible future requirements. For now it seems that the majority of stakeholders argue that the combination of the 2nd tier and the reduced allowance is too strict. During the presentation of Working Documents to the Consultation Forum, the allowance for a revised regulation can be discussed.

3.6 Jet fans[15]

There is no article that applies to jet fans, although the jet fan technically meets the generic definition of centrifugal or axial fans. The working principle, providing the basis for a performance measurement, is however very different to that of standard fans: Jet fans are designed to deliver thrust, and do not produce pressure as defined by the Fan Regulation. Therefore the efficiency of a Jet Fan would fail to meet the minimum efficiency criteria as they currently stand.

Stakeholders have not directly opposed the inclusion of jet fans.

3.6.1 Definition of jet fan

Stakeholders state that the definition of EN 13349, point 3.5.3 could be used: *'jet fan means fan used for producing a jet of air in a space and unconnected to any ducting'*.

Whether this suffices to differentiate jet fans from other fans needs further assessment. The above definition only refers to intended use and does not allow discerning on basis of technical parameters which would be the preferred approach.

Another stakeholder suggested to reword jet fans to 'Air Circulating Fans' as the main function is circulating air without pressure building up. This stakeholder mentions two categories: Tube-axial en Non-Tube-axial. The air circulating fans are not only designed for tunnels or parking's, but can be used in greenhouses, agricultural and Industrial applications.

From the definition or the measurement and calculation method it should be clear whether silencers are to be included in the efficiency measurement or not.

Certain stakeholder(s) mentioned the need to cover stationary applications only, as some mobile applications of jet fans have special constructional requirements regarding build space/weight etc., which restrict performance/efficiency.

3.6.2 Jet fan requirements

Some information on jet fan efficiency has been received, based on testing according the recently adopted EN 13350. Whether this allows setting requirements, while making sure that life cycle costs for end users are reduced, needs to be looked at in the second stage of this review study.

Jet fans are often also reversible which limits optimum efficiency. This aspect should be reflected in possible requirements (differentiated for reversible and non-reversible).

As most jet fans are also dual use fans, this could mean that, assuming requirements for jet fans are introduced, allowance for dual use jet fans would apply. One stakeholder commented regarding the dual use aspect of jet fans, that although the majority of jet fans may be dual use, the working principle of jet fans allows a larger air gap, which means that dual use jet fans may be just as efficient as single use jet fans.

As jet fan efficiencies are completely different to other fans this will require a benchmarking exercise to establish separate values for efficiency targets, with proper consideration of dual use/single use and reversible/non-reversible.

[15] Jet fans are discussed under Article 3, because of the overlap of issues with dual use fans.

[this benchmarking exercise has not been completed yet]

CONCLUDING

No stakeholder comments have been received opting for an exclusion of jet fans. So their inclusion within the scope is considered to be accepted.

The definition of jet fans should avoid problems related to misuse or loopholes.

The average and BAT efficiency and costs of cannot yet be discussed. This will be treated in the second phase of the study.

3.7 Article 3, item 6: Measurement and calculation

[see discussion in section Regulation Annex II]

4 Article 4 Conformity assessment & Article 5 Market surveillance

This section deals with both *conformity assessment* and *market surveillance*, as these are linked.

The current method for conformity assessment is 'self-declaration' (*the internal design control system set out in Annex IV to that Directive or the management system for assessing conformity set out in Annex V to that Directive*). Enforcement of the requirements is the responsibility of market surveillance authorities of national Member States.

4.1 Current situation

Stakeholders are unanimous that market surveillance is not visibly active in the fan market. They have not experienced any fines, comments on non-compliant products from any market surveillance within the EU. Most surveillance is performed by manufacturers themselves who buy and test products of their competitors. At this moment there is no proof that significant amount of non-compliant products enter the market. Most customers are diligent and ask for compliant products. Still, it may be that non-compliant products are placed on the market directly, or imported as incorporated fans, but there is no data to substantiate this.

Stakeholders fear that the lack of enforcement 'ridicules' the EU surveillance scheme, damages the ErP measures and the internal market.

4.2 Improvement of surveillance

Most stakeholders suggest that the biggest improvement potential lays in increasing the resources of Member States for adequate market surveillance. These resources can be money, people, testing facilities etc. Another comment is that market surveillance can be discussed at product level how to test, where to test, what to test. Manufacturers are aware that this is a horizontal issue, also affecting other regulations produced under the Framework Directive.

Some stakeholders suggest intensified naming and shaming (but non-compliance has to be discovered first). Also an improved presence of market surveillance authorities (combined with testing) at trade fairs and exhibitions is mentioned, as it may help to deter non-compliant manufacturers.

4.2.1 EC initiatives

Currently there is a study being performed, ECOPLIANT, aimed at strengthening market surveillance. It establishes a framework and supporting infrastructure for cost-effective coordination of monitoring, verification and enforcement of the Ecodesign Directive that is suitable for use across the whole European Economic Area (EEA). It will also identify and share best practice. The project was launched 20 April 2012 and is supported by the European Commission's Intelligent Energy Europe (IEE) programme. Ecopliant is being run by a consortium of National Government policy leads and MSAs from ten different countries.

Some stakeholders mention that responsibility for market surveillance should be transferred from MS level to EU level.

4.2.2 What about self-certification (by a third party)?

The Chinese fan regulation relies on a form of self-certification, which includes accredited labs from manufacturers. The USA – still in the early stages of developing a possible fan regulation – may opt for a self-certification a scheme, but also in the USA, the DOE will need to reserve budget for enforcement.

In the EU the idea of a self-certification scheme was introduced some years ago by Eurovent Certification, but the interest in participating in such a scheme remained low.

From our discussions with various stakeholders we have the impression that there are roughly two schools of thought regarding self-certification.

Opposed

Voluntary self-certification by a third party results in extra costs with little benefits: With voluntary self-certification all responsible manufacturers would be confronted with extra costs for certification. Some even more than others, because of their typical model ranges (the variety and/or the speed of change in product ranges) or because their models are made on client specification and each fan is different to the other models produced.

The benefits would be limited because those manufacturers, who are already playing by the rules, will see little extra sales because of certification, because free-riders would still be unrestrained. The chances of authorities to identify manufacturers (or importers) that bend or circumvent the rules do not necessarily increase.

In the end there is still a need for rigorous market surveillance by an independent authority with sufficient budgets, knowledge and testing capacity. Whether this is organised at MS level or at EU level is a second order problem.

These manufacturers prefer the existing self-declaration, combined with more rigorous market surveillance.

In favour

On the other side there are companies who are not opposed to voluntary self-certification. They have experienced the working of self-certification for instance in the US, where AMCA operates such a scheme. Here the schemes functions in a typically market driven environment, where clients create a demand for certified fans, driving the overall share of certified products upwards.

The certification scheme, as set up by AMCA, is self-policing, as AMCA is responsible for regular compliance checks (factory visits, random testing, etc.).

These manufacturers prefer the self-certification routes as the costs are regarded as investments into a better controlled market, with more manufacturers playing by the rules.

Differences

Some people respond that the US and EU markets are different in the sense that the US market requires less certification efforts (read: costs), as the product ranges are longer-lasting and technologies do not change that much over time. The EU market is much more fluid, and product ranges have much shorter life cycles, leading to higher certification costs.

The US certification scheme also does not address fans incorporated into products.

Some other ideas mentioned are: compliance checking by manufacturers themselves. This seems to be stretching the limits of market surveillance. A major concern is how to ensure impartiality of the test.

A way to lower test costs could be to set up an accreditation scheme for manufacturers' test labs, besides the official Notified Bodies.

CONCLUDING

Most stakeholders seem to prefer the current scheme, but the problems lack of surveillance go beyond the revision of 327/2011.

It is suggested to further explore possible other ways of identifying and removing non-compliant products from the market.

5 Article 6 Indicative benchmarks

[This will be considered at a later stage]

6 Article 7 Revision

[This will be considered at a later stage]

7 Article 8 Entry into force

[This will be considered at a later stage]

8 Regulation ANNEX I Ecodesign Requirements for fans

8.1 Item 1 Definitions for the purpose of Annex I

[the definitions shall be discussed at a later stage – where relevant]

8.2 Item 2 Fan energy efficiency requirements

8.2.1 Levels

As regards the current specific ecodesign requirements, of Regulation 327/2011, many stakeholders have addressed the following issues:

1. The requirements for smaller fans in particular are very stringent;
2. The requirements for dual use fans are very stringent, in particular because of the reduced allowance;

Limitation of this report

The purpose of this report is not to discuss possible limit values. That discussion shall be reserved for the full Working Document, presenting the Commission's proposal to the Ecodesign Consultation Forum.

We have set out to do some quantitative analysis as well, with a view to describe the current average efficiency and BAT efficiency (BAT = Best Available Technology, without consideration of economic factors). This analysis is still ongoing and we hope to present initial findings as soon as possible.

8.2.2 Fan categories

The Revision article in 327/2011 explicitly calls for a possible reduction of complexity, reducing requirements for fan types, etc.

Some stakeholders argue for an increase in the number of categories (mentioned are: tangential fans[16], backward inclined[17], jet fans[18])

There are however stakeholders who suggest reducing the number of categories but this depends on the efficiency of these fans. For instance putting the backward curved fans together in one category.

Most stakeholders state that the number of fan categories cannot be reduced without creating more problems. The diversity of designs, efficiencies and application characteristics or installation is too broad to simplify.

From the comments received regarding dual use fans and jet fans it appears there is a need to properly consider the reduced efficiencies of reversible fans. At least one stakeholder argued in favour of extending such allowance to reversible **axial** fans as well.

[16] These are actually included in 327/2011 as 'cross flow' fans.
[17] The definition of backward curved also covers inclined fans, as the definition is not limited to curved blades – straight blades (if pointing backwards) are also covered.
[18] Jet fans are in principle covered by the generic definitions, but require a different metric for determining energy efficiency.

Some suggested differentiating the requirements per application level: impellers, fan systems and fans incorporated into products.

8.2.3 Measurement categories

Stakeholders are divided over the number of measurement categories (A-C or B-D). Just over half of the respondents think the two measurement categories cannot be avoided. Each fan category should have a preferable measurement category depending on the purpose of the fan or depending on their application. Further they operate differently if measured on a test rig intended for a different category fan. Adopting just one of the two metrics, would mean, in a number of cases, to distort the choice of the most appropriate fan, potentially compromising the energy efficiency of the application.

Then there are stakeholders that argue that total efficiency should be kept, whatever the fan category.

And others argue that static efficiency should be the basis for regulating, as much of the discharge velocity is lost.

Besides this discussion stakeholders request further clarification whether a measurement category should be selected (assigned to) the envisaged installation of the fan, or whether it is left at the discretion of the fan manufacturer.

8.2.4 Power slopes

Most stakeholders think it is not possible to avoid two power slopes, although, one can argue that a single slope from - 125W to 500kW - could be envisaged, matching the combined curvature of the two current slopes.

Stakeholders argue that the slope of minimum efficiency is however too steep for especially the smaller fans. As both motor efficiency[19] and fan efficiency are worse for smaller fans, the slopes should follow these effects.

Another proposal is to take the relationship between fan diameter and fan efficiency into account as done in ISO 12759 and the FEG requirements.

CONCLUDING

Simplification of the regulation would be welcomed but views differ, as the number of possible different fan applications is overwhelming. Nonetheless each fan can be characterised by its operating points (pressure vs flow rate).

A reduction in (or simplification of) fan categories is therefore strongly linked to the method for calculating (target) efficiencies – **see also Section 9.5 on calculating the (target) efficiency**.

[19] From 125W to 400W fans use mostly small PSC motors (permanent split capacitor). The range from 400W up to 1 - 1.5kW mostly use PSC motors of bigger size but a few three-phase motors are available. From 1- 1.5kW up to 10KW are mostly small/medium three-phase motors. Over 10kW are mostly big three-phase motors on which it is possible to apply all the methods to obtain higher levels of efficiency.

8.3 Item 3 Product information requirements

In general, stakeholders do not have many issues with the information requirements. Some state that the required information could be reduced / limited to essential information only.

One stakeholder commented on the indication of the speed at which optimum efficiency is reached: If aerodynamics, effects of motors, drives or other ancillary equipment, are left aside[20], the Fan Laws state that the optimum efficiency does not change with speed. Therefore any speed can be mentioned as speed for optimum efficiency.

In order to address a possible loophole in the regulation, related to use of electronic speed drives for moving the optimum efficiency point to a lower power input, the conditions for determining power input need to be described – this is considered in the section on 'Article 2 - Definitions' and 'ANNEX II - Measurement and calculation'.

The requirements ask for indication of year of manufacturer on websites and publications. This is probably a mistake. The Fan FAQ states to include year of manufacture in the CE marking requirements.

9 Regulation ANNEX II Measurements and calculations

9.1 Item 1 Definitions for the purpose of Annex II

According the regulation a 'not final assembly' *means an assembly of fan parts, consisting of at least the impeller, which needs one or more externally supplied components in order to be able to convert electric energy into fan gas power*.

The above definition allows the impeller to be considered a 'fan'. The most recent interpretation of the Commission services is that the impeller is only covered by requirements when placed on market as replacement part[21]. The sales of impellers to subsequent fan integrators (that combine the impeller with motor, possibly housing and/or transmission, etc.) is not considered as 'placing on the market'[22]. Not all stakeholders share this view.

See also Section 9.4.1 on the calculation method, as the not final assembly has been introduced to allow a comparative assessment of both complete and not final assemblies.

9.2 Item 2 Measurement method

Most stakeholders agree with the current set of measurements to establish fan efficiency: One shall establish fan curves for volume flow rate, pressure (static and or total – depending on measurement category) and power input (to shaft or complete assembly). The method is set out in ISO 5801, to be used in combination with ISO 12759.

The manufacturer has to establish the best efficiency point to find the power input, but certain stakeholder(s) had issues with the approach for defining the input power at optimum efficiency point, as the inclusion of the motor plus possible drives makes it hard to define the optimum point (in theory this would be the impeller optimum point driven by a motor that – in those conditions – also performs at

[20] Also ignoring friction with air, compressibility and bearing losses.
[21] Note: this has no legal meaning, as only court rulings result in jurisprudence.
[22] This interpretation follows from our discussion with DG ENER C3.

optimum efficiency). The complication is caused by the fact that motor efficiency changes per speed and load factor. If a VSD is applied, establishing the optimum motor efficiency is even more complicated.

For this reason the text of the ISO 12759 standard includes a requirement that the optimum efficiency of the fan and motor assembly should be identified along the maximum achievable speed line.

The above solution, for measuring at maximum achievable speed, may be pragmatic, but it introduces other issues, as shown in the example below[23].

EXAMPLE: Consider a fan running at 3000 rpm, absorbing 48 kW and operating at its best efficiency point, and fitted with a 55 kW motor. This fan could have a safe maximum operating speed of say 110% of continuous speed, so 3300 rpm. As power varies to the cube of speed, power for that speed will increase by 30and would now be 64 kW, which exceeds the motor power at design point. What power must be used for establishing whether the fan is inside the scope, or for calculating the target efficiency: 48 kW or 64 kW? What motor efficiency should be used?

Some stakeholders believe that the best one can do is ask the manufacturer to declare the probable (or design) operating speed, which shall be the speed at which they had carried out the calculation of efficiency, and the operating point at this speed.

9.3 Item 3.1 Calculation method / driven fans

We received relatively little discussion regarding the measurement and calculation method of 'driven fans'. Even the part load compensation factor (correcting for inclusion of VSD in electric input power) was not topic of much discussion. Most of the attention focused on not final assemblies (see below).

9.4 Item 3.2 Calculation method / not final assembly fans

Under this heading we discuss the issues related to **not final assemblies**.

9.4.1 Need for not final assembly?

We asked whether the (concept of the) 'not final assembly' is needed. Stakeholders showed very different opinions on this.

A majority of stakeholders are of the opinion that fans are ultimately all driven by electric motors and should be regulated at that point, so the final manufacturer is responsible for declaring conformity, even if he/she has configured the fan on basis of OEM parts. All configurations that occur before the placing on the market by the final 'fan integrator' could be considered 'fan parts' that do not need to be regulated as the final assembly will be regulated. This view is mostly held by complete fan manufacturers.

Then there is the view that the 'not final assembly' should be limited to bare shaft fans only. The missing motor can be included in a calculation of overall efficiency, by referring to minimum required motor efficiencies according 640/2009.

Then there is a third view, mainly voiced by impeller manufacturers that prefer to keep the interpretation of not final assembly (which is based on just the impeller). Having the possibility to regulate just the impeller ensures that impellers placed directly on the market (sold to end customers) remain regulated. Secondly, regulating the impeller helps to ensure that fans of which compliance verification is difficult / impossible (or meaningless) still use parts that are compliant. In case a fan

[23] Example provided by a stakeholder.

integrator uses OEM components that have been declared to be in compliance by the supplier and then changes these components, the compliance testing needs to be done again. If fan integrators do not have test facilities, they should be able to rely on fan suppliers for testing and declaring compliance.

One stakeholder suggested a 'middle way' in which manufacturers of not-final assemblies are required to provide a declaration of performance, short of the assumption of responsibility of a full DoC, stating under which conditions a compliant final assembly may be built by the final "integrator", and stating the performance achievable if these conditions are fulfilled.

It appears that one of the problems is that in some cases fan components (impellers, housings, etc.) are placed on the market with an application in mind that is comparable to that of a complete assembly or driven fan. In this case the regulation should aim to level the playing field and determine the fan performance as it is brought onto the market, regardless how that 'fan' came into existence. This advocates declaring conformity for the complete assembly.

In other cases fan components (impellers, housings, etc.) are placed on the market with an application in mind that is essentially difficult to be serviced by a complete assembly fan. The fan integrator buys components separately so that each component can be optimally tuned towards the final application[24]. In this case the fan regulation should be flexible enough to allow placing on the market of fan 'parts', and not frustrate the possibility to optimise the configuration with respect to its final application.

Some stakeholders suggested an approach to address this complexity, which is to accept fan compliance testing under different conditions than the final integration conditions. The component suppliers (i.e. impeller OEM) can calculate the efficiency using a non-final assembly calculation approach, but taking into account the actual motor data and motor load. This in order to ensure a proper matching of the fan and motor. The final fan integrator must ensure that the impeller configuration and motor etc. used, match that of the OEM declaration otherwise compliance verification would need to be performed on the final product.

9.4.2 Calculation method not final assemblies (formula, defaults)

Considering the formula applied to calculation of efficiency of 'not final assemblies', almost all stakeholders agree that:

1. the formula for 'not final assemblies' introduces 'penalties' that many stakeholders consider unjust (matching of component factors);
2. the formulas for default efficiencies of components are not correct.
3. the variety of fans placed on the market cannot be adequately represented by just 'driven fans' and 'not final assemblies'

Each will be further discussed below.

Overall formula for not final assemblies

The formula for not final assemblies is based on efficiency values for motor and driving arrangement and compensation factors (representing energy losses) for 'matching of component's and 'part load compensation' (to correct for a variable speed drive).

[24] For instance where the inlets are either part of the body or that the inlets are designed for a specific performance.

Especially the factor for losses from 'matching of components' is considered unjust: Imagine two identical fan configurations of impeller, transmission and motor. The one placed on the market as a complete assembly does not receive a penalty for matching of components. If the other is placed on the market as 'not final assembly' it receives a penalty, although the components themselves are identical.

The formulas are not correct

This comment mainly concerns the formula for calculating small motor efficiency. The energy efficiency target for Tier 1 and Tier 2 as derived from the not final assembly calculation method currently uses an unrealistically low motor default value for motors below 750 Watts. This results in unrealistically high impeller efficiency. Stakeholders state the motor default value should be changed to the IE2 values as in the new IEC 60034-31 Standard.

In this point the Fan regulation interfaces with the Motor regulation. Of course the Fan regulation must assume that, in case the actual motor is not known, the motor efficiency will be in compliance with the Motor regulation (minimum IE2). The Motor regulation 640/2009 however does not cover single-phase motors, or motors that are not AC synchronous, 2-6 poles, etc. So many motors used for smaller fans are not regulated and the efficiency is to be calculated using the default formula, which results in very low efficiencies – thus very high requirements on impeller efficiency.

The variety of not final assembly fans

The most common not final assembly fan is the bare shaft fan (motor not supplied by OEM). Other configurations are the 'motorised impeller' (inlet nozzle not supplied by OEM), ' partly knocked-down, un-complete fan' (motor to be chosen by integrator) and 'impeller only', which allow smaller manufacturers (fan integrators) to produce complete fans without extensive investments in manufacturing technology.

9.5 Item 4 Method for calculating the (target) energy efficiency

At this point we like to discuss the formula to be used for determining fan efficiency.

9.5.1 Expressing fan efficiency

Most stakeholders have no problem with expressing fan efficiency as the ratio of fan air power (flow rate * pressure) divided by electric input power[25]. It is a so-called 'air-to-wire' ratio.

In regulation 327/2011 the target fan efficiency is calculated on the basis of the fan input power, following a natural logarithm-curve and an integer N that shifts that curve upwards.

But other ways to express the target efficiencies exist:

1. FEG and FMEG grades (where efficiency is plotted against fan diameter);
2. minimum efficiency as function of pressure coefficient, specific speed and blade shape as in Chinese standard GB 19761, also related to the Cordier diagram;
3. minimum efficiency as function of flow volume and pressure, as in PBER.

The PBER and specific speed / pressure coefficient will be explained a bit further below.

[25] For jet fans a different approach is required – see EN 13350.

9.5.1.1 PBER

A recent development is the introduction of the PBER approach, a.o. discussed within AMCA. PBER means Performance Based Efficiency Requirement and can be an application independent metric for fan efficiency. It is defined (calculated) as:

Figure 8 PBER application independent[26]

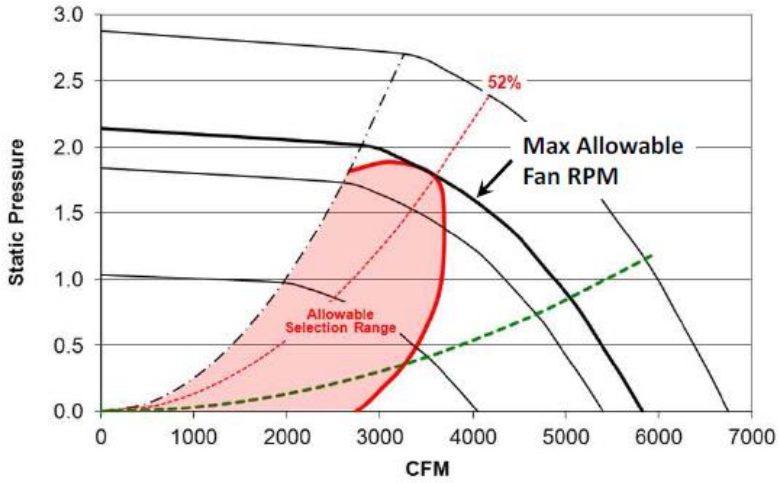
$$Min\ Fan\ SE\ at\ BEP \geq 60\% \left(\frac{CFM}{250 + CFM}\right)\left(\frac{Ps}{0.25 + Ps}\right)$$

Where 60% is a provisional target efficiency and 250 and 0.25 are provisional values (can be changed depending on goal of metric), SE is static efficiency (based on shaft power) and BEP is best efficiency point. The introduction of the capacity factor (using CFM) and application factor (using pressure Ps) determine the allowable operating range of the fan.

According the developers the metric is independent of fan type or category, as the PBER establishes efficiency only based on CFM and pressure. For driven fans, possibly including belts, an extra factor needs to be added.

When used as metric for measures it would limit the maximum allowable fan speed (rpm). Customers could still buy this fan and use it in a condition outside the red surface, but they would not be able to purchase fans that are labelled to run beyond the max fan rpm line.

Figure 9 PBER graph



According the authors the savings to be achieved by the PBER approach will increase drastically if the legislators use it to regulate actual applications (as in energy codes, building codes, and rebate schemes). The PBER then becomes application dependent.

9.5.1.2 Cordier diagram and derived approaches

When discussing ways to express fan efficiencies of several fan categories in a single metric, the Cordier Diagram cannot be ignored: It plots 'tip speed ratio' (related to *specific speed number*) against the 'diameter number'. Even if the typical operating points of for instance axial and forward and backward

[26] Apologies for the non SI units. The figure was copied from a presentation to WG 11.

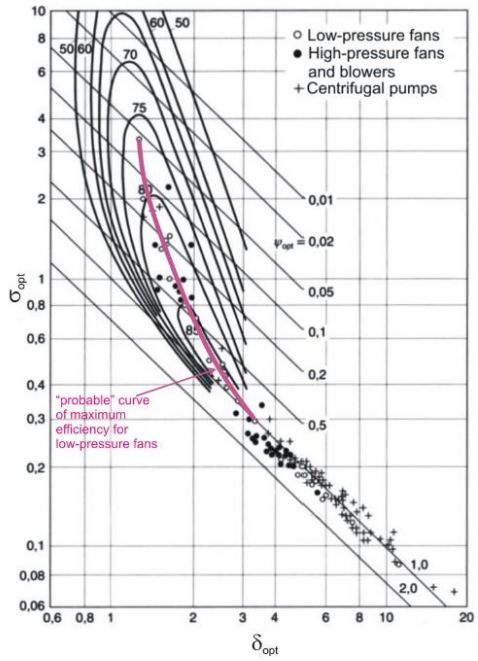
curved centrifugal fans are different, the best fans supposedly would operate in a narrow band in that Cordier diagram.

An approach based on the Cordier diagram might be helpful in reducing the number of requirements for various fan categories, but further study is needed, especially regarding low pressure fans.

Also, the tip speed ratio (or specific speed number) and diameter number are not defined in ISO 5801:2008.

Based on the Cordier diagram the dissertation by Mrs. Pascu[27] presents an approach based on ideal efficiency (for axial fans only). Possibly minimum fan efficiency (at best efficiency point) could be a percentage of that ideal efficiency.

Figure 10 Cordier diagram, adapted[28]



The Chinese fan standard (since May 13, 2005) sets minimum efficiency requirements (based on stagnation pressure) for centrifugal fans categorised according pressure coefficient and specific speed (and blade shape for pressure coefficient <0.6). For Aerofoil fans the hub-ratio is also taken into account.

It seems appropriate to investigate further the possibility to combine multiple fan types in a reduced set of curves, by changing the metric of the x-axis from input power to another parameter.

9.6 Item 5 Applying the target energy efficiency

[this will be developed at a later stage]

[27] Maria Teodora Pascu, Moderne Auslegungs- und Entwurfsstrategie für Axialventilatoren, Erlangen, 2009
[28] Maria Teodora Pascu, Moderne Auslegungs- und Entwurfsstrategie für Axialventilatoren, Erlangen, 2009

10 Regulation ANNEX III Verification procedure for market surveillance purposes

General procedure

In the Fan Regulation 327/2011, it is stated in article 5,

"When performing the market surveillance checks referred to in Article 3(2) of Directive 2009/125/EC, the authorities of the Member States shall apply the verification procedure set out in Annex III to this Regulation."

Annex III states:

When performing the market surveillance checks referred to in Article 3(2) of Directive 2009/125/EC, the authorities of the Member States shall apply the following verification procedure for the requirements set out in Annex I.

1) *The authorities of the Member State shall test one single unit.*
2) *The model shall be considered to comply with the provisions set out in this Regulation if the overall efficiency of the fan (η_e) is at least target energy efficiency*0,9 calculated using the formulas in Annex II (Section 3) and the applicable efficiency grades from Annex I.*
3) *If the result referred to in point 2 is not achieved:*
   a) *for models that are produced in lower quantities than five per year, the model shall be considered not to comply with this Regulation,*
   b) *for models that are produced in quantities of five or more per year, the market surveillance authority shall randomly test three additional units.*
4) *The model shall be considered to comply with the provisions set out in this Regulation if the average of the overall efficiency (η_e) of the three units referred to in point 3 is at least target energy efficiency*0,9 using the formulas in Annex II (Section 3) and the applicable efficiency grades from Annex I.*
5) *If the results referred to in point 4 are not achieved, the model shall be considered not to comply with this Regulation.*

Values of verification tolerances

Most stakeholders consider the tolerances to be reasonable enough for most products, but there are some market niches where larger-than-average production tolerances or measurement uncertainties led to difficulty while attempting to comply with the current tolerance.

One comment has been received regarding the verification procedure, related to the 'adding of tolerances'. As it happens there has been a court case in at least one Member State whereby the judge ruled that the tolerance as described in the applicable test standard, may be added (summed) to the verification tolerance allowed by the authorities (as in 1%+1%=2%).

This appears to be double counting of tolerances as verification tolerances (as for example stated in the Fan regulation) comprise all tolerances (repeatability, reproducibility and product variability) as the procedure is based on a random selection of products placed on the market (not a round-robin test, or test confined to a single laboratory). This assumes that the measurement tolerance stated in a test standard is already included in the tolerance for verification.

Very large equipment

Of particular relevance is the market surveillance of very large fans of which only a single model (or at maximum a very limited number of models) are produced. Such low production volume would not allow the verification procedure described by 327/2011 (testing of another three appliances) and also incurs practical problems as related to testing house capacity and costs etc.

This problem (of testing of very large equipment, with very small sales volume) is not unique to fans.

The ISO standard 5802 is dedicated to in-situ testing of very large fans. Experience teaches us that testing tolerances are much wider, as test conditions are more difficult to control, but as the equipment is produced at tighter tolerances, the overall certification tolerance may be adequate.

11 Regulation ANNEX IV Indicative benchmarks

[This will be considered at a later stage]

This completes the overview of stakeholder comments received.

12 Preparing for the first stakeholder meeting

As stated in the introductory remarks, the main purpose of this report is to feed into and help structure the discussion of the first stakeholder meeting to be held on 1 October 2014.

As providing a summary of all items discussed is difficult to do without resulting in an uninspirational list of opinions, we instead want to share our view of what we think will be the major and minor discussion points for the upcoming stakeholder meeting.

12.1 Minor points

As minor points we consider the following. In most cases stakeholders are fairly consistent in their opinions.

1. Exemptions and exclusions:
    a. For fans in 'off standard' operating conditions (ATEX, emergency, non-gaseous): including them will most likely result in an even more complex revised regulation. Often extra analysis will be required. Not many stakeholders support this.
    b. Including fans in other products: Where these are fairly standard fans (fans in driers, range hoods, indoor AC, ICT) the inclusion in the scope is often supported (if the product is not covered by other regulations). Where these are 'off-standard' fans (for motor cooling, for vacuum cleaners) the exclusion is often supported;
2. Extending the scope:
    a. Jet fans: inclusion will solve an existing problem of how to deal with jet fans. Reversibility and dual use must be properly considered;
    b. Box and roof fans: (see major points)
3. Improving consistency / coherency: The text can be improved at various instances, such as the scope: exclusion of battery operated, fans of ratio >1.1, provide definition of clean air, improve definitions of backward curved/inclined/aerofoil fans, etc.;
4. Defining the conditions for establishing the best efficiency point (at maximum allowable speed, or other...);
5. Stringency of minimum energy efficiency requirements: Although the requirements determine the overall savings, it is considered a minor point as the discussion on the level of stringency cannot be concluded within this study. Proposing requirements (also for the allowance for dual use) is the responsibility of the Commission.

12.2 Major points

As major points we consider the following items.

1. **Fans incorporated into products** / coverage of fans by cascading regulation. Many stakeholders are against coverage of the fan if the end-product itself is also covered by an ecodesign regulation. The consequence is that unregulated fans are allowed to be placed on the EU market when incorporated into such products, imported into the EU.
2. **Market surveillance** / enforcement of the regulation. Stakeholders appear to prefer the current set up whereby Member States are responsible for surveillance, but are at the same time not pleased with the lack of surveillance. A main challenge will be the passing on of costs – is it possible and proportional?
3. **The impeller** - to be included as not final assembly or not. Treating impellers similar to complete fans (by applying loss factors for missing components) introduces problems as the final

configuration is often not known. But the alternative, based on testing the final product is also problematic, as fan applications are so diverse, and not every fan application can be serviced by a standard complete assembly;

4. **Replacement fans**: This point is a major issue for many stakeholders. A fairly straightforward solution (extending the grace period) can be imagined, but a final decision can only be taken by the Regulatory Committee.
5. **Box and roof fans**: Opinions differ to a large degree. No clear majority for a single option.
6. **The measurement and calculation method**: Alternative approaches to the current measurement and calculation method may simplify / reduce the number of differentiated requirements.

We hope to see you in the coming stakeholder meeting.

Annex A Definitions related to refurbished, reconfigured, repaired products – based on ATEX 94/9/EC

Source:
http://ec.europa.eu/enterprise/sectors/mechanical/documents/guidance/atex/application/chapter7/index_en.htm#h2-5

Directive 94/9/EC: Guidelines on the application

On this page:

7. USED, REPAIRED OR MODIFIED PRODUCTS AND SPARE PARTS [1]

7.1. General

As a general rule, manufacturers need to consider whether the product is being placed onto the EU market or taken into service for the first time, or if the modifications are such that the intention or the result is to place a product onto the market, which has to be considered as a new product. If the answer to either of these questions is "yes", then Directive 94/9/EC fully applies. In all other cases the Directive 94/9/EC does not apply and the responsible person will have to ensure that any other relevant national or EU legislation is considered as appropriate.

Within this context two points should be made:

- In the following paragraphs, these guidelines refer only to products for which Directive 94/9/EC is potentially applicable. Products not subject to Directive 94/9/EC are therefore excluded from these discussions.
- The application of Directive 94/9/EC to an "as new" product is without any prejudice to intellectual property legislation.

With regard to the information to be provided for repair of equipment, see § 10.1.3 "Documents accompanying the product".

7.2. Definitions

Used product and second hand product: a product which has been placed on the EU market prior to the coming into force of Directive 94/9/EC and put into service on the EU territory. This product was in

compliance with the then applicable legislation: national or EU, depending on the date. The ATEX Directive 94/9/EC does not apply.

Used products that were on the market and used in the EU before the date of entry into force of Directive 94/9/EC are not covered by it. These products have been marketed and used in accordance with the regulations in force at that time. They circulate in the EU based on Articles 28/30 of the EC Treaty unless they are modified so that health and safety characteristics have been affected.

For used products imported from a non EU country and made available for the first time in the EU after 30 June 2003 for the purpose of distribution and/or use in the EU Directive 94/9/EC shall apply.

7.3. Reconditioned (or refurbished) products

These are used products which were on the market and used in the EU but whose performance has changed over time (due to ageing, obsolescence, etc.), and which have been modified so as to be restored. The case of products whose external appearance has been modified and improved by a cosmetic or aesthetic operation after they have been placed on the market and put into service is a particular form of refurbishment aimed at restoring the external appearance of the product. If this occurs with no substantial modification Directive 94/9/EC does not apply.

7.4. Reconfigured products

Reconfigured products are used products which were on the market and used in the EU but whose configuration has been modified, by the addition (upgrading) or the removal (downgrading) of one or more parts (components, sub-assemblies such as plug-in cards or modules, etc.). If this occurs with no substantial modification Directive 94/9/EC does not apply.

7.5. Substantially modified products

In general, the relevant text of the "Guide to the Implementation of Directives Based on New Approach and Global Approach" (Blue Guide), chapter 2.1. "Products submitted to Directives" applies. In the sense of Directive 94/9/EC it is any modification affecting one or more of the health and safety characteristics covered by EHSRs (e.g. temperature) or the integrity of a type protection. In this case Directive 94/9/EC has to be applied. This does not preclude the application of other relevant Directives.

The general principle is that Directive 94/9/EC re-applies to a modified product where the modification is considered to be substantial and if it is intended to be placed again on the EU market for distribution and/or use.

7.6. Repaired products

These are products whose functionality has been restored following a defect without adding new features or any other modification. As this occurs after the product has been placed on the market and the product is not to be sold as a new product the ATEX Directive 94/9/EC does not apply.

This does not preclude that national regulations of the Member States on the working environment may require some kind of assessment of the repaired product as well.

7.7. Spare parts

These are items intended to replace a defective or worn out part of a product previously placed and put into service on the EU market. A typical repair operation would be replacement by a spare part.

The manufacturer of the spare part is normally not required to comply with Directive 94/9/EC unless the spare part represents an equipment or component as defined by the Directive. If so, all obligations laid down in the Directive have to be fulfilled.

If the manufacturer of the original spare part offers a new, different one in its place (due to technical progress, discontinued production of the old part, etc.), and it is used for the repair, the repaired product (as long as no substantial modification of the repaired product takes place) does not need to be brought into conformity at this time with Directive 94/9/EC as the repaired product is not then placed on the market and put into service.

[1] The application of the ATEX Directive to "as-new equipment" is without any prejudice to intellectual property legislation. See Directive 89/104/EEC relating to the marks and the decision of the European Court of 11th July 1996, C427/93, 429/93, 436/93 Bristol Meyer Squibb.

[2] See Directive 89/104EEC relating to the marks and the decision of the European Court of Justice of 11 July 1996 in Joined Gases C-427/93 and C-436/93 Bristol Meyer Squibb.

[3] Both terms, reconditioned / refurbished, as well as reconditioning / refurbishment are used interchangeably in this chapter.

[4] This can involve a modification of the electrostatic characteristics. The use of different materials or different external dimensions of the product might adversely change its ATEX performances. For example, a plastic enclosure may provide much lower electrostatic protection than a metallic enclosure.

[5]/enterprise/policies/single-market-goods/documents/blue-guide/index_en.htm

Annex B Calculation (indicative) of stock of dual use, parking garage and other specific fan applications

[Note: This information was collected for a different study in 2010 and not updated since]

Tunnel ventilation

The EU-27 has 5860 km of tunnels[29] , including railroad (ca. 23%), subway (28%), and road tunnels (49% of km capacity). Road tunnel safety is regulated at Member State level[30] and under Directive 2004/54/EC on minimum safety requirements for tunnels[31]. The scope of the Directive is road tunnels longer than 300 m.

Road tunnels in the scope of the Directive 2004/54/EC are on average around 1,1 km and account for ¾ of the total road tunnel capacity. In the European Union they entail approximately 2000 tunnels that need to be equipped with adequate ventilation capacity to evacuate toxic fumes and guarantee the swift combustion of hazardous substances.[32]

Typical configurations for dual-carriage way tunnels include 2 jet fans with a capacity of 90 m³/s per unit and 2 exhaust axial fans with capacity 70 m³/s per unit (excluding stand-by capacity). Total peak airflow is 320 m³/s or 1,15 million m³/h per tunnel.[33] Part load operation levels differ widely, but a typical design value is an average of 50-60% part load, i.e. around 0,6 million m³/h. For the EU as a total this amounts to 1200 million m³/h or 0,33 million m³/s. At an estimated average electric power of 2 kW per m³/s during 8760 hours per year the EU-27 electricity consumption for road tunnel ventilation is 5,8 TWh/a. [34]

Vehicles in subway and railroad tunnels do not produce exhaust fumes and the ventilation is aided by the piston-ventilation caused by the trains moving through the narrow tunnels. Hence the ventilation requirement is significantly less: For this application an electricity consumption of 0,5 TWh is estimated.

Parking building ventilation

The EU-27 has about 100 mln. m^2 floor area of parking buildings. Ventilation is subject to strict fire safety regulations. ECN sets the average electricity consumption –for a modern system—at around 5 kWh/m^2 per year. For the EU-27 this comes down to 0,5 TWh/a.

Fans for industrial exhaust fume purification

The E-PER database[35] lists 24.000 large industrial installations in the EU-27 and EEA-countries (2008). These installations are subject to several provisions of European emission regulation such as the LCPD-

[29] CIA World Factbook data 1.1. 2009

[30] ITA COSUF, Survey of existing regulations and recognised recommendations (road tunnels), Committee on Operational Safety of Underground Facilities, 30 April 2008.

[31] Directive 2004/54/EC of the European Parliament and of the Council of 29 April 2004 on minimum safety requirements for tunnels in the Trans-European Road Network

[32] Compare data for France (source: cetu): 765 road tunnels, of which 80 in range 300-500m, 40 in range 500-1000m, 32 >1000m. Total length of all road tunnels is 338 km, of which 76 km for tunnels <300m

[33] Note that capacity depends on the number of lanes, e.g. for a 4-6 lane tunnel capacity is two to three times as high. Example: 6-lane Australian Eastlink 1,6 km tunnel with fan electricity use 12,4 GWh/a.

[34] Calculation: 0,33 million m^3/s x 2 kW/(m^3/s) x 8760 h= 5781 million kWh = 5,8 x 10^{12} Wh = 5,8 TWh

[35] http://eper.ec.europa.eu/eper/

directive (large combustion plants), the WI-directive (waste incineration), the IPPC directive (integrated pollution prevention and control), AAQD framework directive (ambient air quality as well as local or national regulations at Member State level.

For the purification of polluted process-air and flue-gases these installations operate special exhaust fans, designed to withstand high temperatures, abrasive substances and/or chemically aggressive fumes. The number of fans per installation is not known, but as a first dome estimate some 50.000 installed special fans are assumed at a capacity of 40-50 kW per fan. Assuming an operating time of 8000 h/a the total electricity consumption for these special fans is estimated at around 20-25 TWh/a.

Industrial oven fans

Industrial oven fans means fans that enhance the drying, curing, baking or heating process by forced air convection inside the oven and that are designed to withstand high temperatures. Combustion fans – normally not required to operate at high temperatures—are excluded.

Oven fans exist in all sizes and in almost all industrial sectors. At this stage it is very difficult to make an estimate, but even if we limit the application to fans above 3 kW there may well be >100.000 installations in the EU-27 that operate such fans. At 5000h operating hours per year, 4 kW per fan the total electricity consumption is estimated to be between 2 TWh, max. 4 TWh/a.

Mining fans

In the EU-27 there are probably some 100 operational deep mines that require special ventilation provisions for mining personal working underground. Most other mines are surface mines (quarrying, opencast pit) and most other deep mines extract ores fully mechanized (e.g. long-walling), requiring only a minimum workforce of machine operators.

Even if these mines would require a volume of 10 000 m^3 to be ventilated at 10 $m^3/m^3.h^{-1}$ the total equivalent volume for 100 mines would not amount to more than 10 million $m^3/m^3.h^{-1}$. This amounts to 2777 m^3/s and at 2 $kW/m^3.s^{-1}$ and 6000 operating hours per year it results in an electricity consumption of 33 GWh/a. Even allowing for some 500 mines the electricity consumption would not amount to more than 0,17 TWh/a.