Market Surveillance Guidance Document

Eco-design Regulations for Fans – Regulation (EU) 327/2011

Produced by EVIA to assist Market Surveillance Authorities

Introduction:

This document has been produced by the European fan industry to assist manufacturers, importers, customers, end-users, and market surveillance authorities. It could be used to monitor and enforce the eco-design requirements for fans. The requirements are detailed in European Commission Regulation 327/2011 (DG Energy, 2011) and is supported by the Commission's FAQ document (DG Energy, 2018). The document is also intended to help the fan industry in meeting its requirements.

The scope of the eco-design regulation for fans is from small fans, with 125 W input that can fit into a jacket pocket and cost tens of Euros, to large ones with power inputs of 500 kW input that weigh many tonnes and cost tens of thousands of Euros.

The document recognises the technical and financial burden placed on member states in monitoring and enforcing these regulations. It proposes a seven-tiered approach from simple inspection of the product label through to a full independent analysis by a third-party body.

The fan industry does not agree to in-situ measurement of fan performance to assess eco-design criteria. It is not usually technically possible to establish the conditions to determine the necessary criteria.

'One-stop-shop' for enquires:

Enquires should be directed to the EVIA Secretariat by email – secretariat@evia.eu

Contents:

The Tiered Approach:

The Fan Industry recommends a tiered approach from simple review of the product label then steps of increasing analysis through to a full independent measurement by a third party. EVIA's intention with this document is to provide a guide to help market surveillance in making a risk assessment or as a screening tool to decide whether or not to test. The tiered approach can be summarised as:

1) **Review of the Product Rating Plate**

The eco-design regulations stipulate 5 pieces of information that must be present on or near to the product rating plate, in addition to CE-marking where required. Section 1 – Product Rating Plate in this document describes in full and explains by way of examples each requirement, the intention and the consequences of improper use.

2) **An inspection of the manufacturer's eco-design documentation**

The eco-design regulation clearly defines 14 pieces of information that should be provided in a defined order. Section 2 – eco-design documentation in this document describes in full and explains by way of examples each requirement, the intention and the consequences of improper use. This is addition to reviewing the declaration of conformity or incorporation.

3) **A plausibility check**

It is difficult to determine if a fan is being used in its intended manner. Improper use will result in lower energy efficiency and higher energy consumption than indicated by the eco-design declaration. Section 3 – Plausibility Check describes some areas that can be inspected in-situ to determine if further verification would be appropriate. In-situ testing is often more appropriate for large fans, but can be useful also for smaller fans.

4) **third party certified quality management system,**

A good manufacturer will have a third party certified quality management system. A simple check to consider the reliability of the declaration of conformity is to ensure that the certified quality management system includes within its scope design, measurement and production. Section 4 – Quality Management System in this document explains further.

5) **A review of the product testing documentation and type testing results**

The eco-design documentation gives headline data. If there is reasonable doubt that the data is non-compliant, then a review of the product testing documentation should show how that data was determined and would provide indications on the validity of the data. Section 5 – Product Testing Documentation.

6) **A physical verification by Factory Acceptance Testing (FAT) at the manufacturer's facility**

If there is still some doubt regarding the test data, then a product could be tested in the manufacturer's facility with the Enforcement Authority or their representative present. Section 6 – Factory Acceptance Testing explains further.

7) **Purchase a product and third party assess**

If all other checks are inconclusive or are in doubt, then the last action would be to purchase a product and assess in-house or by a third party.

1. Product Rating Plate:

The eco-design regulations stipulate 5 pieces of information that must be present on or near to the product rating plate, in addition to CE-marking where required. Before proceeding to check whether the fan is within the scope of the regulation. Article 1 describes what is within scope and the exclusions.

This section describes in full and explains by way of examples each of those requirements, the intention and the consequences of improper use.

The following figure is an extract from the FAQ (DG Energy, 2018) document and shows a typical product rating plate.

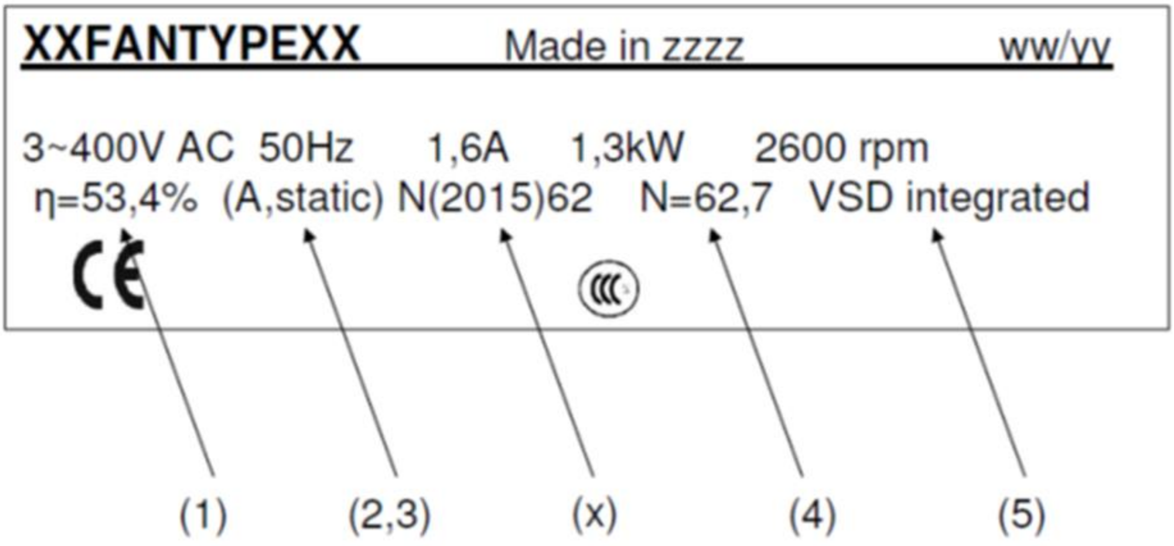


Figure 1- an example of a product rating plate

1) Fan overall efficiency rounded to one decimal place

The efficiency is determined by a ratio of electrical power input to the motor (or VSD) terminals to the air output power. The efficiency is calculated using either static or total pressure and is described further in section 5.

The regulation requires the fan to meet a minimum efficiency requirement. The maximum efficiency of a fan is achieved at its optimum efficiency point, also known as Best Efficiency Point. The value declared here is its optimum efficiency.

2) Measurement category A, B, C or D

The measurement category is the arrangement of the product and the measurement equipment as described in EN ISO 5801. It is also called Installation Category; the fan should be measured to replicate the manner in which it is intended to be installed.

The category is chosen by the manufacturer depending on the intended use of the product. For example, the product could be designed for use in a ducted arrangement where an air duct is fitted to the supply and exhaust side of the fans. This would be arranged and measured as a type D measurement category. It is important to understand that the same fan measured in each of the 4 categories is likely to give different results and different efficiencies.

This does not mean that one measurement category is more efficient than another. It means that a fan is designed and optimised for a particular category and may perform less well and consume more power if used in a category that was not intended.

Ideally the fan should be measured in that category and the efficiency declared for the intended use of the product. An example of inappropriate application would be the use of an axial fan designed for use in a ducted inlet that is used in an application without a ducted inlet. Application/intended use of the fan should be checked against national, regional and/or local regulations. The fan manufacturer is not ultimately responsible for the application/installation of the fan by the customer.

There are times when a particular aerodynamic effect or space restrictions require the operation of a fan in a non-optimum arrangement. In such instances the fan should be measured and the eco-design declaration made for the category.

3) Efficiency category – static or total

The efficiency stated in 1) is determined by a ratio of electrical power input to the motor (or VSD) terminals to the air output power. The efficiency is calculated using either static or total pressure and is described further in section 5. The label shall declare whether static or total has been used.

The declaration should also align with the stated measurement category, see the table below for further explanation

Measurement category	description	Static or total
A	Free inlet, free outlet	static
B	Free inlet, ducted outlet	total
C	Ducted inlet, free outlet	static
D	Ducted inlet, ducted outlet	total

Table 1 - installation categories

4) Efficiency grade at optimum efficiency point

The efficiency grade stated here is the target energy efficiency grade based on the electrical power input at the optimum efficiency point of the fan. It is not necessarily the operating point.

For example the rating plate shown is for a backward curved centrifugal fan without a housing. It states an efficiency grade of N62,7 together with an efficiency of 53,4% at the optimum efficiency point. It also states it was determined in a measurement category A arrangement and with static pressure. According to Annex 1 table 2 of regulation 327/2011 the appropriate target energy efficiency formulae is;

$$\eta_{target} = 4{,}56 \times \ln(P) - 10{,}5 + N$$

Where;
P is the electrical power input to the motor (P_e), or variable speed drive (VSD) (P_{ed}) if fitted, at the optimum efficiency point. *P* is not always the same as the power stated on the rating plate. Often the power stated on the rating plate is its maximum rated power, for example Line 1 of Figure 1 are the maximum values, Line 2 is the required ecodesign declaration.

N is the Efficiency Grade stated in table 1 of Annex 2 of 327/2011

Rearranging the equation the power input at the optimum efficiency point can be determined;

$$P = e^{\left(\frac{\eta_{target}+10,5-N}{4,56}\right)}$$

Putting the above values into the equation; $e^{\left(\frac{53,4+10,5-N}{4,56}\right)} = 1,33\text{ kW}$ = P = P_e (or P_{ed} if fitted with a VSD)

Based on the declared values stated on the rating plate the power input at the optimum efficiency point is 1,33 kW which is similar to the power input stated on the rating plate. The power input calculated above can be checked against the declared value in the Product Information, see Annex I section 3.2.(9). See 5) below if a VSD is fitted.

The values of the data published on the rating plate meet the requirements of safety standards. In consequence the stated power will not be the same as that at the optimum efficiency point. Power at optimum efficiency is published in the product information as required by Regulation (EU) 327/2011 Annex I.3.

Whilst the calculated value is likely to differ from the value stated on the rating plate, there should be some correlation. If it is significantly higher or lower further investigation should be considered.

5) A statement where a VSD (variable speed drive) is integrated or whether it must be fitted to achieve the grade claimed in 4)

Annex 1 section 3.2.(5) of regulation 327/2011 requires a statement whether a VSD is fitted or has been used in the determination of the optimum efficiency.

- If it is stated that a VSD is integrated, then it must be checked that the VSD is fitted to the motor.
- If it is stated that a VSD must be installed with the fan, then it can be checked that a VSD has been installed.

If a VSD is fitted a 'part load compensation factor' will have been applied in determining the declared optimum efficiency, see Annex II section 3.1.(b).

Where P_{ed} is < 5 kW the compensation factor C_c is -0.03 x ln(P_{ed}) +1.088

Where P_{ed} is ≥ 5 kW the compensation factor C_c is 1,04

Taking the above example, see 4), the input power was determined to be 1,33 kW. As the power is less than 5 kW the compensation factor is calculated from the equation $C_c = -0,03 \times \ln(P_{ed}) + 1,088$. Therefore C_c = -0,03 x ln(1,33) + 1,088 = 1,08.

The compensation factor increases the calculated efficiency of the fan; using the formulae from Annex II, 3.1(b) of the regulation $\eta_e = (P_{u(s)}/P_{ed}) \times C_c$ the factor increases the final declared value by 1,08.

An alternative way of using the factor and value is to apply it to check the stated figure of item (9) of the Product Information Requirements, see Annex I 3. 2. (9). Using the above example, see 4, the input power of the declared efficiency was determined to be 1,33 kW. If this is divided by the compensation factor it will indicate the measured value used to calculate the efficiency. 1,33 divided by 1,08 is 1.23 kW, this figure should be the same or close to the power input stated for (9) of the Product Information Requirements and similar to the power stated on the product rating plate.

2. Product information requirements on fans:

The eco-design regulation clearly defines 14 pieces of information that must be provided in a defined order in the technical document and on the free access website of the manufacturer. This section describes in full and explains by way of examples each requirement, the intention, and the consequences of improper use. This information must also be available on the free access websites of the manufacturer.

1) **Overall efficiency (η). Rounded to 1 decimal point**

This is the value at the optimum efficiency point. It is the declared value, based on measurement or calculation. Where a VSD is used the stated value will have been calculated using the compensation factor, Annex II 3.1.(b)

2) **Measurement category used to determine the energy efficiency (A-D)**

See Annex A

3) **Efficiency category (static or total)**

See Section 5

4) **Efficiency grade at optimum efficiency point**

The efficiency grade based on the electrical power input at the optimum efficiency point of the fan. It is not necessarily the operating point.

5) **Whether the calculation of the fan efficiency assumed use of a VSD and if so, whether the VSD is integrated within the fan or the VSD must be installed with the fan**

When a VSD is used the declared optimum efficiency is adjusted using a compensation factor, see Annex II section 3.1.(b)

6) **Year of manufacture**

This cannot be declared on a free access website as it is constantly changing. It is declared on the product label, see figure 1 (ww/yy)

7) **Manufacturer's name or trademark, commercial registration number and place of manufacture**

8) **Products model number**

9) **The rated motor power inputs(s) (kW), flow rate(s) and pressure(s) at optimum energy efficiency**

10) **Rotations per minute at the optimum energy efficiency point**

11) **The 'specific ratio'**

The specific ratio is defined in Article 2 definition 18. A detailed explanation is given in the Commissions official FAQ (DG Energy, 2018), see section 2.5. This explains that fans with a pressure development of > 11,145 Pa at the optimum efficiency point are outside of the scope of the regulation.

12) **Information relevant to for facilitating disassembly, recycling, or disposal at end-of-life**

13) **Information relevant to minimise impact on the environment and ensure optimal life expectancy as regards to installation, use and maintenance of the fan**

14) **Description of additional items used when determining the fan energy efficiency, such as ducts, that are not described in the measurement category and not supplied with the fan**

A boundary defines a region of the fan that encompasses the significant elements that affect the conversion of power (electrical or mechanical) into air volume flow rate and pressure. All significant elements used during measurements that affect the conversion of power shall be included within the boundary, e.g. see redline in Figure 2. Significant elements and their relative position used to determine the fan efficiency shall be stated within the test report, the product information and/or technical documentation. Section 5 of EN17166 Fans – procedures and methods to determine the energy efficiency for the electrical input power range 125 W to 500 kW should be referred to for a more comprehensive set of examples.

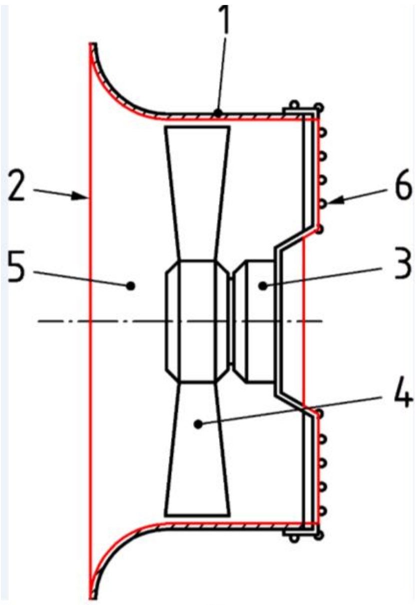


Figure 2 – diagram from EN 17166 showing the boundary of the fan for test purposes

3. Plausibility Check:

Section 3 - Plausibility Check provides a guide to assist Market Surveillance Authorities (MSAs) in identifying potential non-compliance. It explains the key constituent elements of a fan and design features that are important in the conversion of electrical power to air power, hence in the achievement of declared efficiencies.

Key elements of a fan -

A fan consists of at least an impeller, stator and motor, see column 1 of table 2;

- An impeller to convert mechanical power to airflow rate and pressure (the output of a fan). Note the impeller is sometimes called a rotor. An example of an impeller is shown in figure 2.
- A stator which guides the air toward, through and from the impeller
- A motor to convert electrical power (the input to the fan) to mechanical power

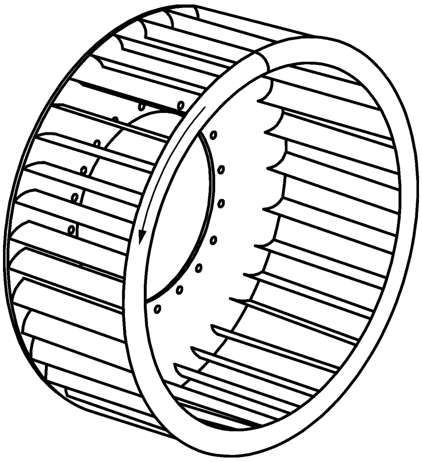


Figure 3 - an example of an impeller; an impeller for a Centrifugal Forward Curved Fan. Source - definition 3.6.1 of FprEN17166

Impellers are within the scope of regulation 327/2011, see section 2.2 of the FAQ to Commission Regulation (EU) No 327/2011 (DG Energy, 2018). The performance is determined when fitted with a motor and stator and the compliance statement should define the motor and stator elements used when determining the performance.

If these significant elements are not present when the impeller is put into service or another motor or another stator is used then a new Declaration of Conformity (DOC) for the new fan (impeller + motor +stator) is required. See FAQ on the Ecodesign Directive 2009/125/EC (DG Growth, 2019), specifically question and answers (1)3 and (1)4 in section Commission Regulation (EC) No 327/2011.

Combinations of Impeller plus Motor without a Stator, see column 2 of table 2, are also within the scope of Regulation 327/2011, see section 2.2 of the FAQ to Commission Regulation (EU) No 327/2011 (DG Energy, 2018). As in the case of the Impeller, the performance is determined when used with a stator. The compliance statement should define the stator used when determining the performance.

If a different stator is used when put into service a new Declaration of Conformity (DOC) for the fan (impeller + motor +stator) is required.

The stator can take many forms. A stator can be called a housing, wall-plate, wall-ring, inlet-ring, inlet-bell, inlet-cone, or orifice-panel. The following table shows examples of different housings for each fan type.

If the stator is missing, for example the backward curved fan without a scroll is operating without an inlet-ring or inlet-cone then further investigation of the stated efficiency is recommended.

Fan Impeller, motor and stator	Incomplete fan Impeller and motor only	Stator	Names of stators
			Inlet cone Venturi inlet Inlet bell
			Wall plate Wall ring Orifice plate
			Scroll Housing

Table 2 - showing complete, incomplete fans and stator

Sometimes it is difficult to identify the boundary of the fan, what is included within the fan and has been included within the ecodesign declaration of conformity. Further there might be other elements, such as an additional casing, that is not within the boundary and is not part of the ecodesign declaration of a fan.

A fan in its simplest form is an impeller, motor, and stator. Other elements can be part of the overall fan including a variable speed drive, inlet and/or outlet guides, diffusers, etc. The scope of the fan is declared within the ecodesign declaration of conformity. See FprEN 17166 (European Standard, Final draft 2019) for further information on the boundary of the fan and other significant elements.

Often there is a confusion as some products are called fans, but they are not fans within the scope of 327/2011. For example, Box Fans are Ventilation Products that are a fan with an additional casing. For an explanation of the difference between a Casings and a Housing (stator of a fan) see FprEN17291 (European Standard, Final Draft 2018) Fans – Procedures and methods to determine and evaluate the energy efficiency of non-residential unidirectional ventilation units.

Here is an example of a Box Fan, a non-residential unidirectional ventilation unit, that is a fan (impeller, motor and stator) with an additional casing.

Figure 4 - an example of a Box Fan (a non-residential unidirectional ventilation unit)

Design features of fans -

The following diagrams show differences in design features of axial and centrifugal fans. They indicate the difference between a simple design and a design where more care has been applied, in the column headed 'improved efficiency'. For example, with an axial fan it is more expensive to produce and manufacture consistently a design with a small 'tip clearance', that is the distance between the outer tip of the impeller blade and the inside of the housing. Designs with smaller tip clearance are more efficient than those with large clearances (based on geometrically identical fans).

If features from the simple design column are present in the fan being surveyed, then further investigation of actual efficiency is recommended.

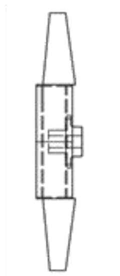
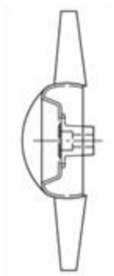
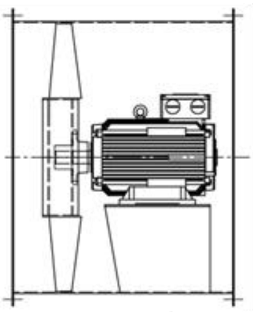
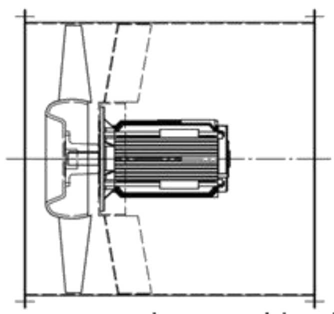
	Simple design	Improved design	Efficiency difference
Impeller hub	 Flat impeller hub	 Impeller hub with cowl	~ 3-5 %
Motor mounting	 Foot mounted motor	 Flange mounted motor with guide	~ 3-8 %

Table 3 - typical design features of axial fans – part 1

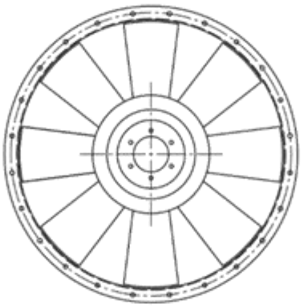
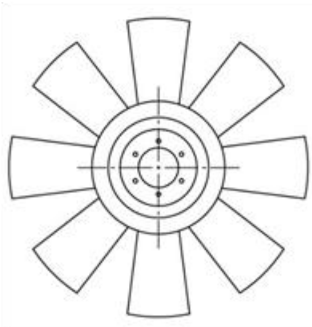
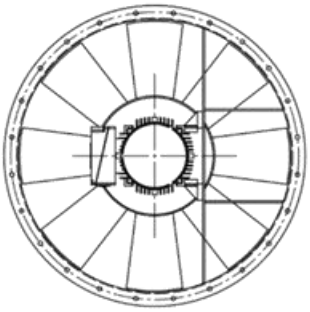
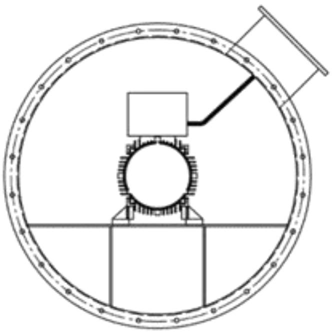
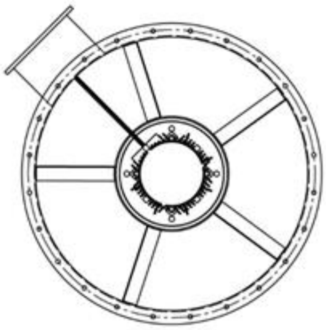
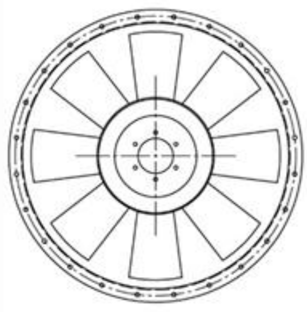
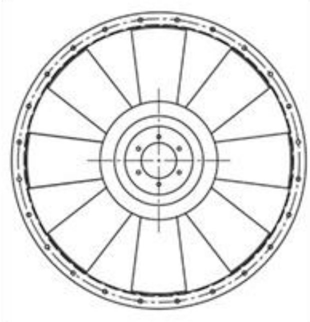
	Simple design	Improved design	Efficiency difference
Impeller hub	 Flat impeller hub	 Impeller hub with control	~ 3-5 %
Motor mounting	 Foot mounted motor	 Flange mounted motor with guide	~ 3-8 %
Motor Terminal box	 Foot mounted motor	 Flange mounted motor with guide	~ 1-3 %
Tip clearance	 Large tip clearance 2,5 % of diameter	 Small tip clearance 0-2,5 % of diameter	~ 1-8 %

Table 4 - typical design features of axial fans - part 2

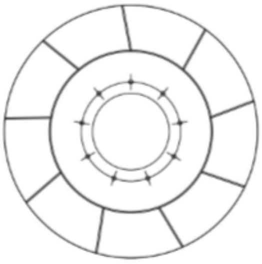
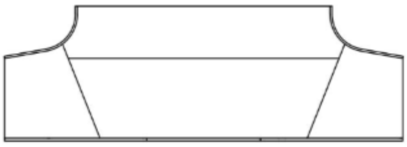
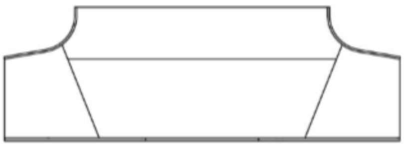
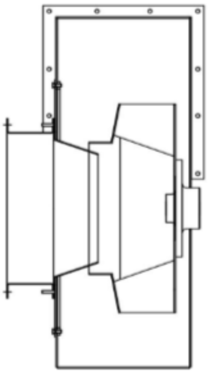
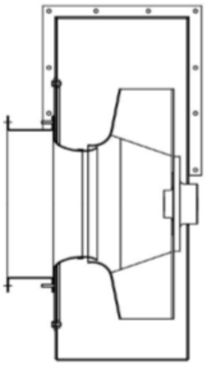
	Simple design	Improved design	Efficiency difference
Impeller design	 Straight or forward curved blade	 Backward inclined	10 -20 %
Impeller shroud	 Open impeller	 With impeller shroud	10-20 %
Impeller inlet shroud	 Straight	 With optimized shroud	3-8 %
Casing inlet cone	 With straight inlet	 With shaped inlet	3-8 %

Table 5 - typical design features of centrifugal fans – part 1

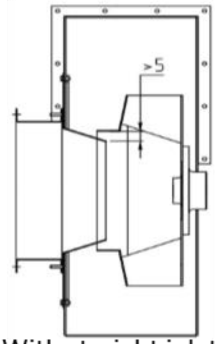
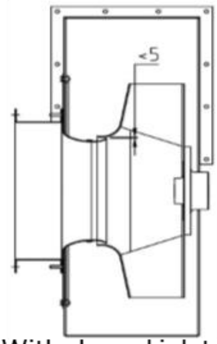
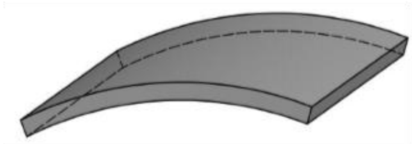
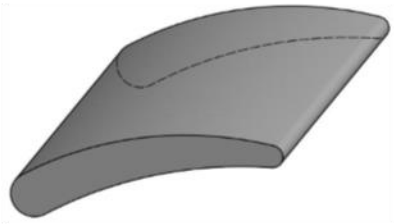
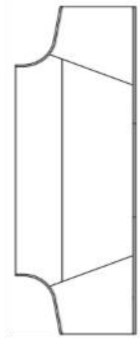
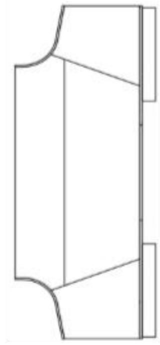
	Simple design	Improved design	Efficiency difference
Airgap	 With straight inlet	 With shaped inlet	5-10 %
Shaped blades	 Uni thickness blade	 Aerodynamic shape	3-5 %
Back blades	 Without back blades	 With back blades	1-2 %

Table 6 - typical design features of centrifugal fans - part 2

By way of an example Figure 5 shows an axial fan. The axial fan consists of a motor, impeller, and wall-ring. When the Axial Fan was measured to determine its eco-design requirements was it undertaken with this wall ring?

The air flow direction is shown by the arrow 1. The air entry, 2, into the wall-ring is sharp. This is not optimum, and it is questionable whether the performance of the overall fan is compromised by the sharp entry into the ring. A better entry condition would be a radius to guide the air into the ring. Was this fan assessed by the manufacture with an appropriate wall-ring but not used in its application?

The tip clearance of this impeller to the wall ring appears large, 3 mm. Smaller gaps increase the performance and efficiency, but are more difficult to achieve in production. Was this axial fan assessed by the manufacturer with this wall-ring?

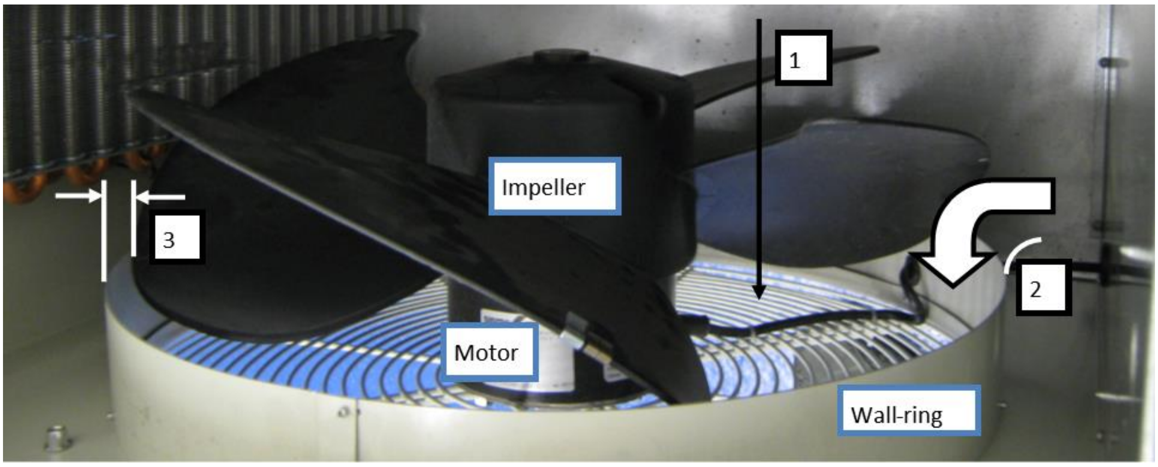


Figure 5 - example of an axial fan

4. Quality Management System:

Market Surveillance Authorities use risk assessments to guide their random checks, in doing so consideration should be given to whether a manufacturer has a third-party or self-certified quality management system.

A good manufacturer will have a third-party certified quality management system. A simple check to consider the accuracy of the compliance statement is to ensure that the certified quality management system includes within its scope design, measurement, and production.

The quality management system may not extend to the development and manufacturing facilities. It may only cover the administration of the company. The scope can be easily checked by inspecting the certificate.

A third-party certified quality management system that includes design, measurement and production will consider that adequate processes are in place. That measurement facilities are calibrated and maintained. That production controls are in place to ensure products are manufactured to controlled designs and that checks are in place to ensure they meet the design specification.

5. Checking Product Information Documentation:

The product information that must be displayed in technical documentation and on manufacturers websites provides data that can be used to check the declared values, see examples below. Test reports can also be used to check the declared values, see example below.

The following is a list of product information requirements as stated in Regulation (EU) 327/2011 Annex 3.1.2.

1) Overall efficiency (η). Rounded to 1 decimal point

2) Measurement category used to determine the energy efficiency (A-D)

3) Efficiency category (static or total)

4) Efficiency grade at optimum efficiency point

5) Whether the calculation of the fan efficiency assumed use of a VSD and if so, whether the VSD is integrated within the fan or the VSD must be installed with the fan

6) Products model number

7) The rated motor power inputs(s) (kW), flow rate(s) and pressure(s) at optimum energy efficiency

8) Rotations per minute at the optimum energy efficiency point

9) The ‘specific ratio’

10) Description of additional items used when determining the fan energy efficiency, such as ducts, that are not described in the measurement category and not supplied with the fan

To evaluate the consistency of the data some additional information is required.

1. Fan type (Axial fan, Centrifugal fan without casing….)
2. Compressibility factor (at pressures below 2000 Pa it can be assumed to be 0, but at high pressure fans, this needs to be known for interpreting the data.
    a. If the data is not available, then the following can be used as a guide:
        i. If above 2,000 Pa then use a factor of 1.02
        ii. If above 3,000 Pa then use a factor of 1.03
        iii. If above 4,000 Pa then use a factor of 1.04
        iv. If above ………………………………………………
        v. If above 10,000 Pa then use a factor of 1.1
3. If the fan is an assembled fan:
    a. Shaft Power (P_a) at efficiency optimum
    b. Impeller efficiency at optimum
    c. Motor efficiency (Could be calculated based on Regulation (EU) 327/2011 if not known)
    d. Drive system (direct drive, low efficiency drive, high efficiency drive)

Example 1: Complete fan

In this example the given efficiency is wrong (smaller than the calculated one, but still OK. Within the given data it is not possible to determine the Fan type. Therefore, a complete evaluation is not possible without further information.

Furthermore the symbols for efficiency (eta$_{sf}$ → eta$_{es}$ | P_e → P_e | p_{sf} → p_{af} | N → n) are not following based on ISO 5801.

	ErP-Compliant	2015	
1	Overall efficiency	η_{es} [%]	70
2	Measurement category	A	
3	Efficiency category	Static	
4	Efficiency grade at optimum energy efficiency point	N [%]	75.1
5	Variable speed drive	with integrated speed control	
6	Year of manufacture	see nameplate	
8	Product's model number	/ AL 400 EC 01	
9	Nominal motor power input at optimum energy efficiency point	P_a [W]	1536
	Volumetric flow at optimum energy efficiency point	q_v [m3/h]	6697
	Static pressure at the optimum energy efficiency point	p_{af} [Pa]	577
10	Rotations per minute at the optimum energy efficiency	n [1/min]	2600
11	The specific ratio	The specific ratio is close to 1 and significantly below 1.11	
12	Information on dismantling, recycling and disposal	Observe the user manual of this product	
13	Optimal lifetime	Observe the user manual of this product	
14	Description of additional items used when determining the fan energy efficiency, such as ducts, that are not described in the measurement category and not supplied with the fan	No special items have been used for determinig the fan energy efficiency, excep the required connection components according to the measurement category.	

Fan assembled?			Complete Fan				
Number	Variable	Symbol	Value	Target value	Unit	Comment	Evaluation
1	Overall efficiency	eta	70	40,0	%	Check if eta=qv*p/P*Cc (Tolerance 1%)	72,7
2	Measurement category		A				
3	efficiency category		static			if 2 is A or C then static if 2 B or D then total	
4	efficiency grade at optimum	N	75,1	34,8			
5	VSD		Yes				
6	Year of manufacture		2016			Needs to be between 2015 and 2021	
7	Commercial registration umber					Not relevant for technical consistency check	
8	Products model number					Not relevant for technical consistency check	
9.1	rated power input at optimum	Pe	1,536		kW	Basis for calculation of line 1	
9.2	flow rate at optimum	qv	6697		m³/h	Basis for calculation of line 1	
9.3	pressure at optimum	psf	577		Pa	Basis for calculation of line 1	
10	rotations per minute	N	2600		1/min	below 8000 1/min	
11	specific ratio		1		-	Check if smaller 1,11	
12	Recycling					Not relevant for technical consistency check	
13	life expectancy					Not relevant for technical consistency check	
14	additional items					Not relevant for technical consistency check	
additional	Fan Type		Axial fan			Specifies type of fan	
additional	compressibility factor	kps	1				
Values for assembled fan							
	Fan Gas Power	Pu	1,07		kW	Volume Flow * Pressure	
	Shaft Power at optimum	Pa	0,30		kW	Given from technical data of impeller	
	fan impeller eff. at optimum	eta r	358		%	Given from technical data of impeller	
	Known motor efficiecy	eta m	40,00		%	If motor efficiency is known, if not = 0	
	calulated motor efficiecy	eta m	82,86		%	If motor efficiency is not known	
	Drive system	high efficiency drive	94,00		%		
Input values for checking							
Red if check failed							

Example 2:

Measurement category is A and efficiency category is static which combination is not appropriate.

Fan assembled?			Complete Fan				
Number	Variable	Symbol	Value	Target value	Unit	Comment	Evaluation
1	Overall efficiency	eta f	70	40,0	%	Check if eta=qv*p/P*Cc (Tolerance 1%)	72,7
2	Measurement category		A				
3	efficiency category		total			if 2 is A or C then static if 2 B or D then total	
4	efficiency grade at optimum	N	75,1	34,8			
5	VSD		Yes				
6	Year of manufacture		2016			Needs to be between 2015 and 2021	
7	Commercial registration umber					Not relevant for technical consistency check	
8	Products model number					Not relevant for technical consistency check	
9.1	rated power input at optimum	Pe	1,536		kW	Basis for calculation of line 1	
9.2	flow rate at optimum	qv	6697		m³/h	Basis for calculation of line 1	
9.3	pressure at optimum	pf	577		Pa	Basis for calculation of line 1	
10	rotations per minute	N	2600		1/min	below 8000 1/min	
11	specific ratio		1		-	Check if smaller 1,11	
12	Recycling					Not relevant for technical consistency check	
13	life expectancy					Not relevant for technical consistency check	
14	additional items					Not relevant for technical consistency check	
additional	Fan Type		Axial fan			Specifies type of fan	
additional	compressibility factor	kpu	1				
Values for assembled fan							
	Fan Gas Power	Pu	1,07		kW	Volume Flow * Pressure	
	Shaft Power at optimum	Pa	0,30		kW	Given from technical data of impeller	
	fan impeller eff. at optimum	eta r	358		%	Given from technical data of impeller	
	Known motor efficiecy	eta m	40,00		%	If motor efficiency is known, if not = 0	
	calulated motor efficiecy	eta m	82,86		%	If motor efficiency is not known	
	Drive system	high efficiency drive	94,00		%		

See Annex B for additional examples including checking consistency of product information to test reports.

6. Factory Acceptance Testing:

If there is still some doubt regarding the test data, then a product could be tested at a manufacturer's facility with the Market Surveillance Authority or their representative present.

For large industrial fans factory acceptance test (FAT) testing can be part of the commercial contract. There should be consideration of the impact of additional FAT, or in parallel FAT, by Market Surveillance Authorities on the commercial contract. FAT can be used by a Market Surveillance Authority to gather test results which can be used to verify compliance of the fan under investigation.

7. Third Party Assessment:

If all other checks are inconclusive or are in doubt, then the last action would be to purchase a product and assess in house or by an accredited third party.

8. Measured, declared, and verified values:

Fans are measured in accordance with international standards:

> **EN ISO 5801** – Fans – Performance testing using standardised airways (International Standard, 2017). This fully describes the methods of measurements of all fans within the scope of Regulation (EU) 327/2011. It further explains the margin of error that occurs in a measurement, reference section 17 - Uncertainty Analysis.
>
> **EN ISO 13350** – Fans – Performance testing of jet fans (International Standard, 2015). In the case of Jet Fans, category E, see Frequently Asked Questions to Commission Regulation (EU) 327/2011 dated 30th March 2011.

Measurement tolerances of the variation between manufactured items are also specified in international standards:

> **EN ISO 13348** – Fans – tolerances, methods of conversion and technical data presentation (International Standard, 2007).

Regulation (EU) 327/2011 is supported with a standard adding clarity to terms, definitions, and some aspects of the regulation. It has been produced by standards committee CEN TC156 WG17 fans in response to European Commission Mandate M/500 (DG Energy, 2012):

> **FprEN 17166** – Fans - Procedures and methods to determine the energy efficiency for the electric input power range of 125 W up to 500 kW (European Standard, Final draft 2019). *N.B: The standard is in final draft awaiting voting at the time of publication of this guide.*

Manufacturers of fans will measure, or calculate, a representative model of the fan they place on the market to determine the performance and efficiency. Where the determined efficiency is greater than the limit, they will make the necessary declaration of conformity and place the product on the market and make available the necessary Product Information.

The performance characteristic of subsequently manufactured individual fans will vary. The standard EN ISO 13348 gives an indication of the likely variation.

Annex A – Installation and measurement categories:

Measurement category A -

The fan is arranged with free inlet and free outlet conditions

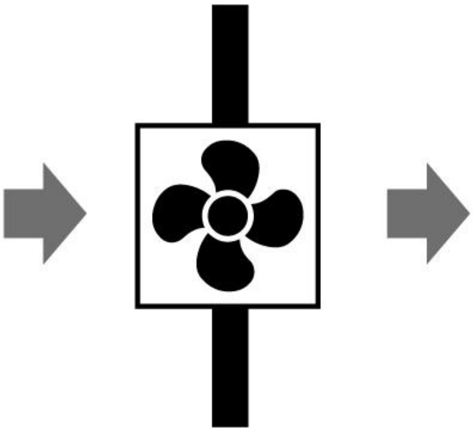
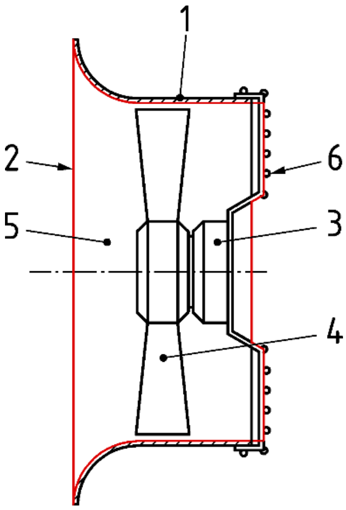


Figure 6 - category A

Example 1 – Axial Fan with wall-ring or bell mouth housing



Key:

1	Stator (housing)
2	Boundary of fan
3	Motor
4	Impeller
5	Stator (inlet bell)
6	Protective element (guard)

Figure 7 - axial fan

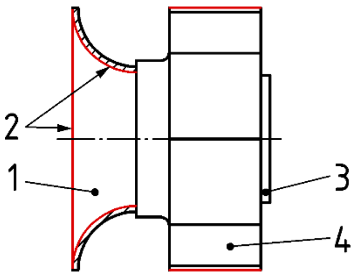
Figure 8 - typical axial fan for use in installation category A arrangements

Axial fans of this type should be measured in a category A arrangement using static pressure in the calculation, see 3) below.

Examples where axial fans are used in a type A category,

- Air-conditioning,
- Heat-pumps,
- Refrigeration plant; condensers, unit coolers, blast chillers, etc.
- Dehumidifiers
- Wall-fans in pig and poultry
- Uni-directional ventilation unit (Roof Fan)
- Unit Heaters
- Cabinet cooling – industrial control cabinets
- Computer, IT equipment cooling
- De-stratification units

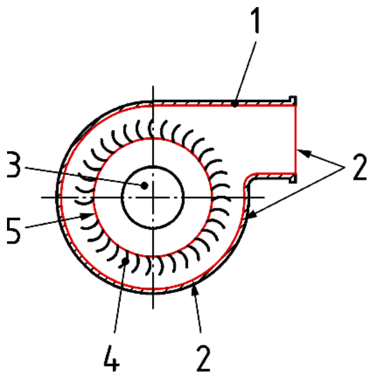
Example 2 – centrifugal fan



Key

1	Stator (inlet ring)
2	Boundary of fan
3	Motor
4	Impeller

Figure 9 - backward curved fan without scroll



Key:

1	Stator (housing)
2	Boundary of fan
3	Motor
4	Impeller
5	Stator (inlet ring)

Figure 10 - forward curved fan with scroll housing

Figure 11 - typical backward curved fan

Figure 12 - typical forward curved fan

Examples of where forward curved fans are used in a category A arrangement:

- Fan Coil Units
- Bi-directional ventilation units (heat recovery unit)
- Uni-directional ventilation units (in-line duct fans)
- Air-Handling Unit

Examples of where backward curved fans are used in category A arrangement:

- Close control units
- Bi-directional ventilation units (heat recovery unit)
- Uni-directional ventilation units (in-line duct fans)
- Air-Handling Unit
- Uni-directional ventilation unit (Roof Fan)

Measurement category B -

The fan is arranged with a free inlet and with a duct attached to the outlet

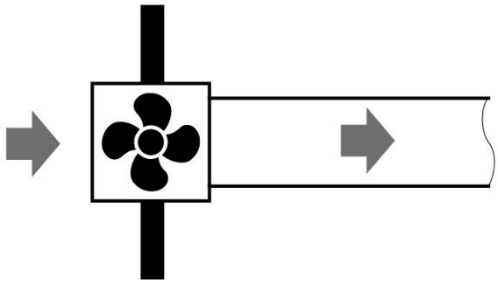
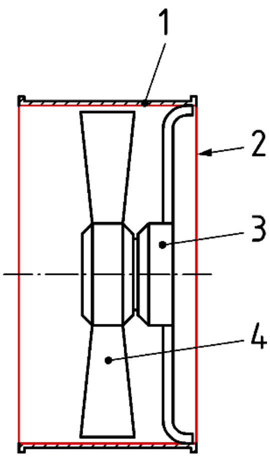


Figure 13 - Category B

Example – Axial fan with short case housing



Key

1	Stator (housing)
2	Boundary of fan
3	Motor
4	Impeller

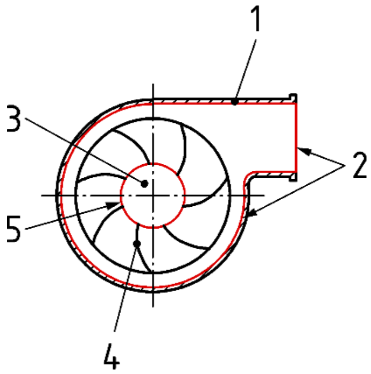
Figure 14 - an axial fan

Figure 15 - a typical axial fan with short casing

Examples of an axial fan in a category B application,

- General ventilation of buildings and construction sites
- Dust extraction applications (note dust conveying fans are excluded)

Example – centrifugal fans with housing, either radial, forward curved, or backward curved



Key

1	Stator (housing)
2	Boundary of fan
3	Motor
4	Impeller
5	Stator (inlet ring)

Figure 16 - centrifugal fan with housing

Figure 17 - a typical centrifugal fan

Examples of a centrifugal fan with a housing in a category B application,

- General ventilation of buildings and construction sites
- Dust extraction applications
- Extraction hoods
- Air-Handling Units (where fan located directly at outlet of AHU)

Measurement category C -

The Fan is arranged with a ducted fitted to the inlet and with a free outlet

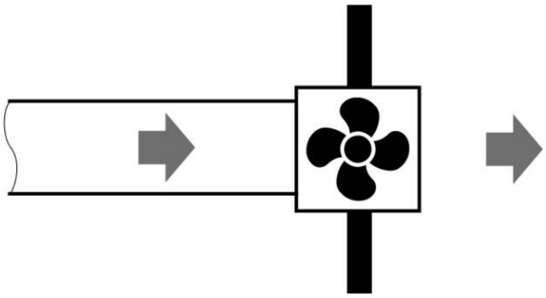
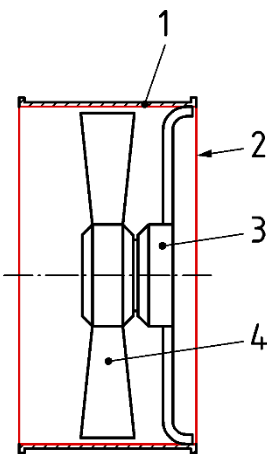


Figure 18 - Category C

Example – Axial fan with short case housing



Key:

1 Stator (housing)

2	Boundary of fan
3	Motor
4	Impeller

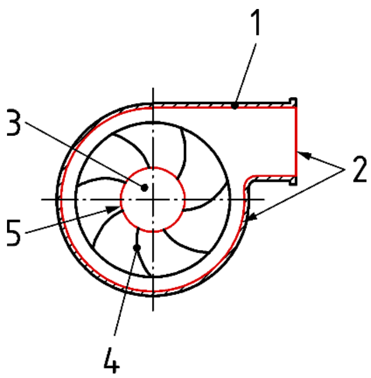
Figure 19 - an axial fan

Figure 20 - a typical axial fan with short casing

Examples of an axial fan in a category C application,

- General ventilation of buildings and construction sites
- Dust extraction applications

Example – centrifugal fans with housing, either radial, forward curved or backward curved



Key

1	Stator (housing)
2	Boundary of fan
3	Motor
4	Impeller
5	Stator (inlet ring)

Figure 21 - centrifugal fan with housing

Figure 22 - centrifugal fan with housing

Examples of a centrifugal fan with a housing in a category C application,

- General ventilation of buildings and construction sites
- Dust extraction applications
- Extraction hoods

Measurement category D -

The fan is arranged with ducts fitted to both inlet and outlet

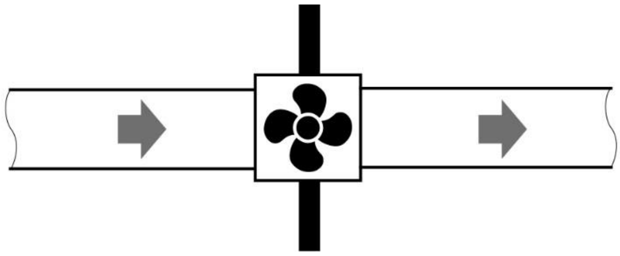
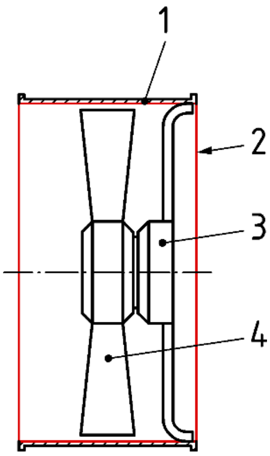


Figure 23 - Category D

Example 1 – Axial Fan with short case housing



Key:

1 Stator (housing)

2 Boundary of fan

3 Motor
4 Impeller

Figure 24 - an axial fan

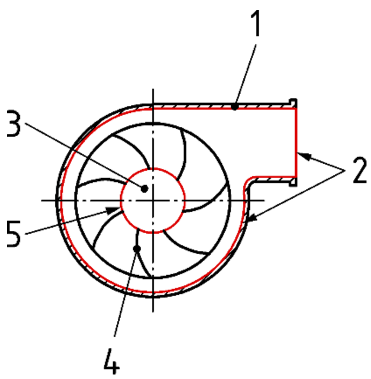
Figure 25 - example of an axial fan typically measured using category D arrangement

N.B: this fan is designed to be used with a duct on the inlet and outlet is not used with ducts but has free inlets and/or outlets then it will perform differently. It should not be used in such a way or the manufacturer shall have measured it in the alternative category, A, B or C and declared the different efficiency 1), measurement category 2) and static or total 3) and stated these values on the Product Label.

Examples of an axial fan in a category D application,

- General ventilation of buildings and construction sites
- Dust extraction applications

Example – centrifugal fans with housing, either radial, forward curved, or backward curved



Key:

1 Stator (housing)
2 Boundary of fan
3 Motor
4 Impeller
5 Stator (inlet ring)

Figure 26 - centrifugal fan with housing

Figure 27 - centrifugal fan with housing

Examples of a centrifugal fan with a housing in a category D application,

- General ventilation of buildings and construction sites
- Dust extraction applications

Annex B – Examples of product information to test reports consistency checks:

Example 3:

Example of data shown in manufactures datasheet

Product information Reg 327/2011 Annex I.3.2	data
(1) overall efficiency (η)	29.0
(2) measurement category	A
(3) efficiency category	static
(4) efficiency grade	40
(5) calculation of efficiency assumed use of VSD	no
(6) year of manufacture	2019
(7) manufacturer name or trademark	[redacted]
(8) product's model number	[redacted]
(9) the rated motor power inputs(s) (kW), flow rate(s) and pressures(s) at optimum energy efficiency	0.173 kW
	3,000 m^2/h
	60 Pa
(10) rotationas per minute at the optimum energy efficiency	910 rpm
(11) the specific ratio	1.00
(12) recycling/disposal	see instructions
(13) Maintenance	see instructions
(14) additional components	none

Comment: based on the declared 0.173 kW input power the Target Value is 28.9 % and the declared efficiency is 29%. The Production Information declaration appears to be correct

Example of data added to ERP consistence check sheet

Correct

Fan assembled?			Complete Fan				
Product Information	Variable	Symbol	Value	Target value	Unit	Comment	Evaluation
1	~~Overall efficiency~~	~~eta~~	29	28.9	%	Check if eta=qv*p/P*Cc (Tolerance 1%)	28.9
2	Measurement category		A				
3	efficiency category		static			if 2 is A or C then static if 2 B or D then total	
4	efficiency grade at optimum	N	40	40.0			
5	VSD		No				
6	Year of manufacture		2019			Needs to be between 2015 and 2021	
7	Commercial registration umber					Not relevant for technical consistency check	
8	Products model number					Not relevant for technical consistency check	
9.1	rated power input at optimum	Pe	0.173		kW	Basis for calculation of line 1	
9.2	flow rate at optimum	qv	3000		m³/h	Basis for calculation of line 1	
9.3	pressure at optimum	psf	60		Pa	Basis for calculation of line 1	
10	rotations per minute	N	910		1/min	below 8000 1/min	
11	specific ratio		1		-	Check if smaller 1,11	
12	Recycling					Not relevant for technical consistency check	
13	life expectancy					Not relevant for technical consistency check	
14	additional items					Not relevant for technical consistency check	
additional	Fan Type		Axial fan			Specifies type of fan	
additional	compressibility factor	kps	1				

Example 4:

Example of data shown in manufactures datasheet

Product information Reg 327/2011 Annex I.3.2	data
(1) overall efficiency (η)	29.0
(2) measurement category	A
(3) efficiency category	static
(4) efficiency grade	40
(5) calculation of efficiency assumed use of VSD	no
(6) year of manufacture	2019
(7) manufacturer name or trademark	[redacted]
(8) product's model number	[redacted]
(9) the rated motor power inputs(s) (kW), flow rate(s) and pressures(s) at optimum energy efficiency	0.173 kW 3,000 m^2/h 60 Pa
(10) rotationas per minute at the optimum energy efficiency	910 rpm
(11) the specific ratio	1.00
(12) recycling/disposal	see instructions
(13) Maintenance	see instructions
(14) additional components	none

Comment: comparing the Product Information declaration to the actual fan test report shows the Product Information has not been reported correctly. Entering the input power at the recorded peak efficiency shows that the Target Value is 29.2%, but the fan only achieves 26.0%

Example of data shown on the test report

	Volume Flow		Fan Pressure	RPM	Voltage	Current	Power	Efficiency
	m^3/h	l/s	Static (Pa)		V	A	W	%
1	4880	1356	0	942	232	0.72	158.5	0.0
2	4695	1304	7	937	231	0.74	163.1	5.6
3	4474	1243	14	935	232	0.76	168.4	10.3
4	4241	1178	21	931	232	0.77	171.8	14.4
5	4000	1111	30	929	231	0.78	174.9	19.1
6	3738	1038	39	922	231	0.8	178.4	22.7
7	3469	964	48	919	232	0.82	185.3	25.0
8	3247	902	54	913	232	0.84	189.1	25.8
9	3008	836	60	910	231	0.85	193	26.0
10	2748	763	65	904	231	0.87	196.8	25.2
11	2460	683	68	900	231	0.88	200.5	23.2
12	2012	559	68	896	231	0.88	200.8	18.9
13	1745	485	79	885	231	0.93	212.8	18.0
14	1239	344	102	860	231	1.02	234.2	15.0
15	150	42	135	810	232	1.19	273.5	2.1

Fan assembled?			Complete Fan				
Product Information	Variable	Symbol	Value	Target value	Unit	Comment	Evaluation
1	Overall efficiency	eta	29	29.2	%	Check if eta=qv*p/P*Cc (Tolerance 1%)	25.9
2	Measurement category		A				
3	efficiency category		static			if 2 is A or C then static if 2 B or D then total	
4	efficiency grade at optimum	N	40	40.0			
5	VSD		No				
6	Year of manufacture		2019			Needs to be between 2015 and 2021	
7	Commercial registration umber					Not relevant for technical consistency check	
8	Products model number					Not relevant for technical consistency check	
9.1	rated power input at optimum	Pe	0.193		kW	Basis for calculation of line 1	
9.2	flow rate at optimum	qv	3000		m³/h	Basis for calculation of line 1	

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About EVIA

The European Ventilation Industry Association (EVIA)'s mission is to represent the views and interests of the ventilation industry and serve as a platform between all the relevant European stakeholders involved in the ventilation sector, such as decision-makers at the EU level as well as our partners in EU Member States. Our membership is composed of more than 40 member companies and 6 national associations across Europe, realising an annual turnover of over 7 billion euros and employing more than 45,000 people in Europe.

EVIA aims to promote highly energy efficient ventilation applications across Europe, with high consideration for health and comfort aspects. Fresh and good indoor air quality is a critical element of comfort and contributes to keeping people healthy in buildings.