AxiEco – Best under Pressure

By: Francois Schoombie


Best under pressure:
The pressure-resistant AxiEco series
ebmpapst
the engineer's choice

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Best under pressure:
The pressure-resistant AxiEco axial fan

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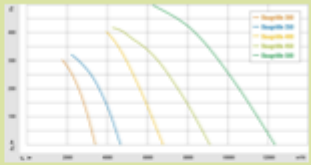
Content

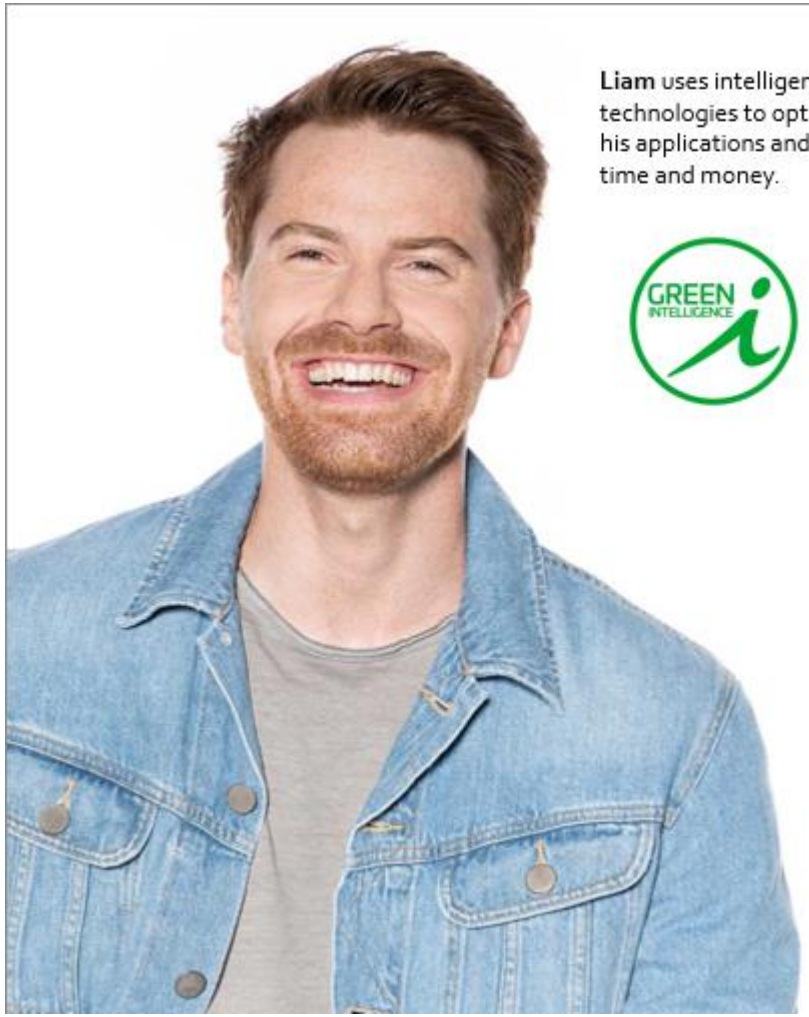
ErP

Design

Technology



SAIRAC



Liam uses intelligent technologies to optimize his applications and save time and money.

GREEN INTELLIGENCE

The ErP Directive, also known as the Ecodesign, sets stringent requirements for fan efficiency.

- By adopting the Kyoto Protocol, the European Union has undertaken to reduce CO_2 emissions by at least 20 per cent by 2020.

- To achieve this climate goal, the EU adopted the EuP Directive (Energy using Products Directive) in 2005.

- It was renamed the ErP Directive (Energy Related Products Directive) in 2009 and its purpose is to investigate the energy-saving potential of numerous products that consume energy and to stipulate minimum requirements.

- Binding limit values for fans were set in March 2011.
(EU Directive 327/2011)

- This affects fans of all designs with electrical power consumptions between 125 W and 500 kW.

- The directive is binding in the 27 EU member states. All fans brought onto the market in Europe are subject to the directive, including those imported into Europe from third countries. The minimum efficiency requirements also apply to fans fitted in devices that are imported into Europe.

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20,779,200 tons of CO_2 since 2012**

GWH SINCE 2012*

46,800

Eco-design for fans have already led to impressive

SAVINGS

Cascading Regulations

The EU has established a clear and working system of cascading regulations with several levels:

= NO LOOPHOLES

= LEVEL PLAYING FIELD

The stages of the directive

The first stage came into force in 2013. A more stringent stage came in 2015 with requirements for fan efficiency. The limit values stipulated in the fan directive are extremely demanding:

- In the first stage, around 30 percent of all available fans were no longer able to satisfy the new regulations.
- In 2015, another 20 percent were no longer able to achieve the required efficiency levels.
- Applicable to Fans of all types (axial fans, centrifugal fans with forward-curved and backward-curved blades, tangential blowers and diagonal fans) with a power consumption between 0.125 kW and 500 kW are affected. This applies to fans that are operated as "stand-alone" devices or are integrated as a component in a device or system.

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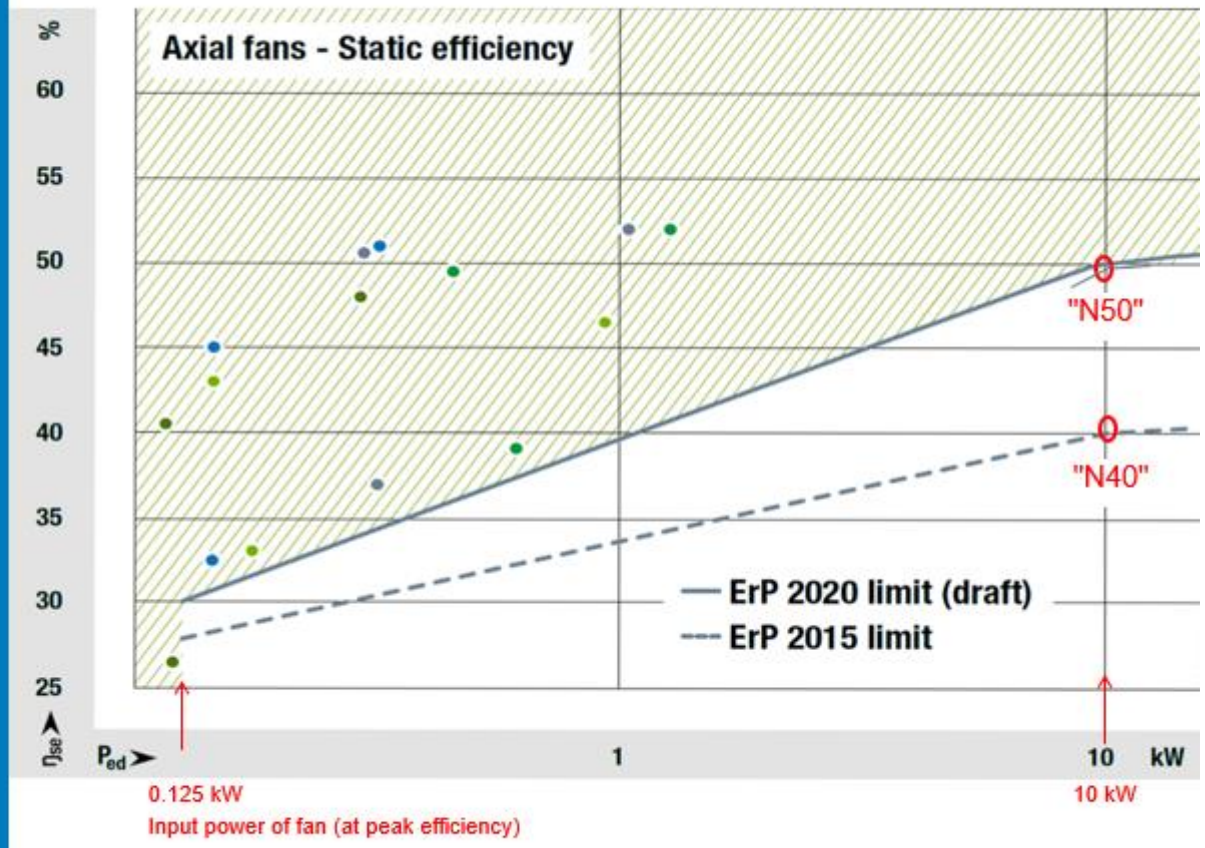
Determining whether a fan conforms to the ErP implementing regulation always involves assessing the efficiency of the fan as a whole, i.e. the entire unit comprising control electronics (if fitted), motor and fan impeller.

When efficiency of retrofit applications are considered, refer to ISO12759



Best under pressure:
The pressure-resistant AxiEco axial fan

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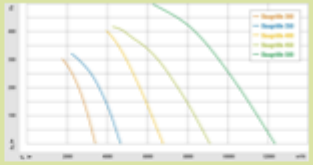
Content

ErP

Design

Technology



Design
AxiEco – Axial type fan

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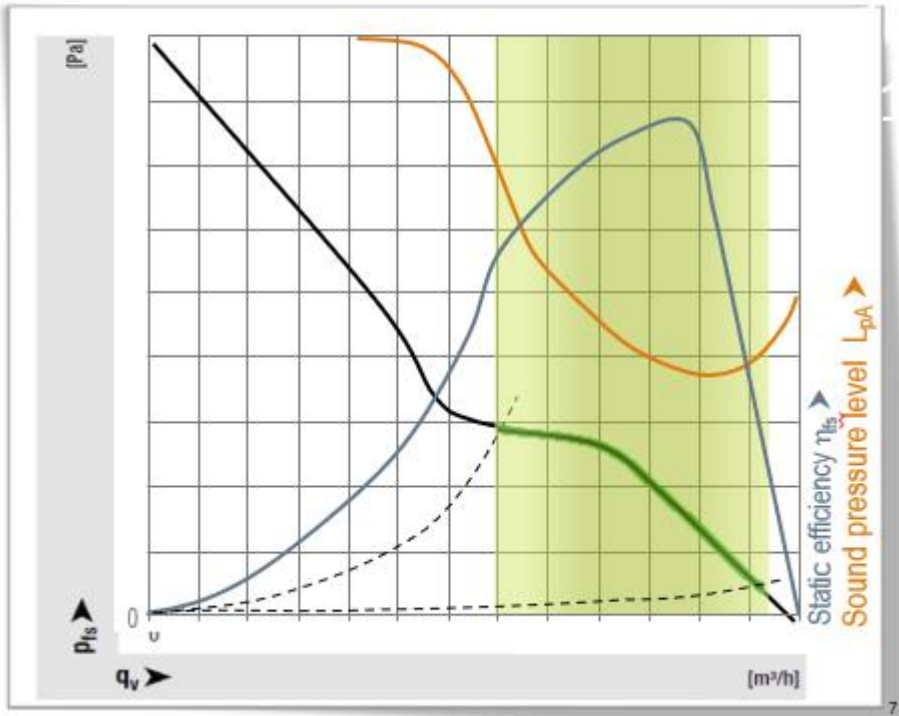

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AxiEco
Protect & Perform

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Difference between Protect and Perform

AxiEco Protect

Guard grill version

- Robust and flow-optimized steel guard grill
- Very good noise characteristics
- Mounted on device using four screws
- Inlet ring from either customer or factory, depending on preference

AxiEco Perform

Housing version

- Plastic housing with guard grill and inlet ring
- Integrated guide vanes to increase efficiency and air throw
- Flexible installation options
- Ready-to-install fan

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AxiEco Perform
A closer look

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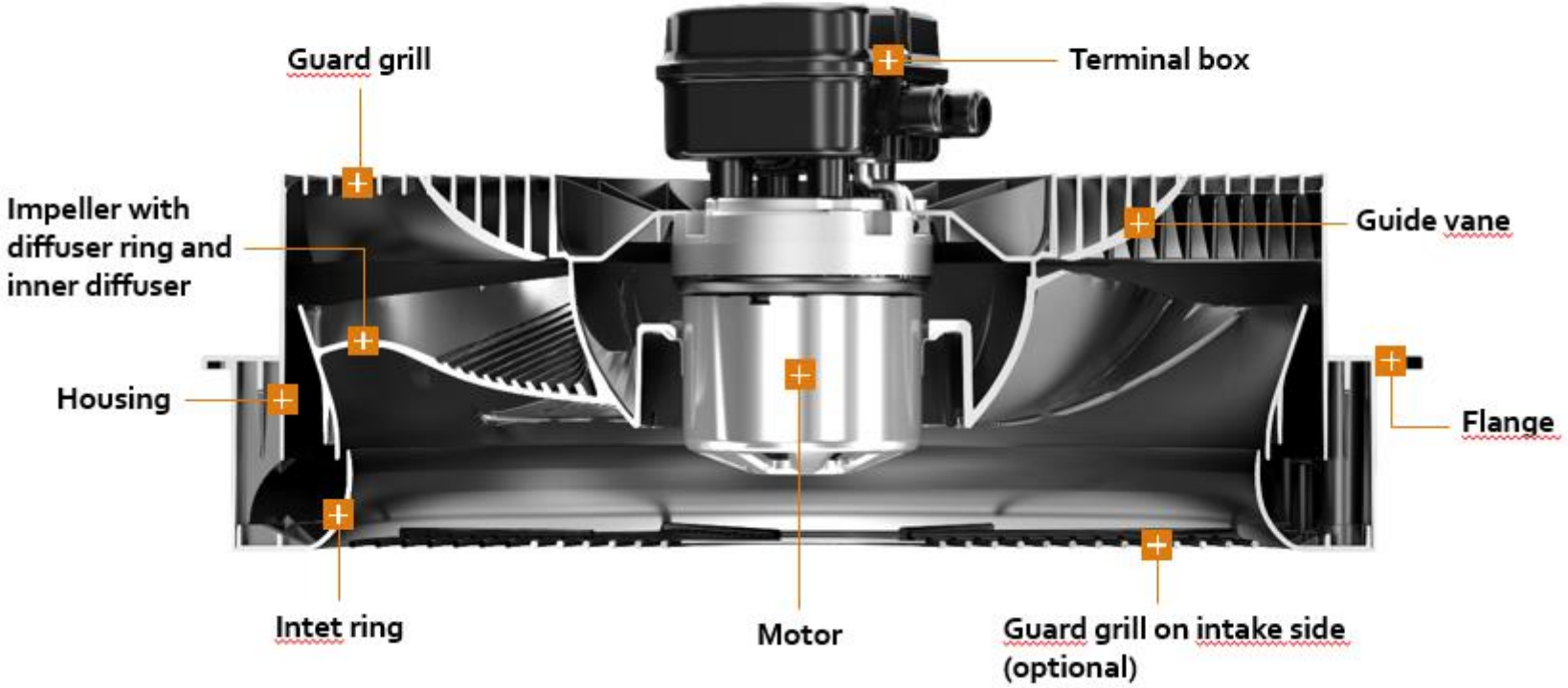
Fan design



AxiEco Protect
with mounted inlet ring

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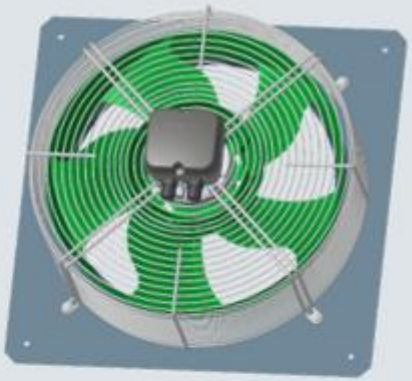
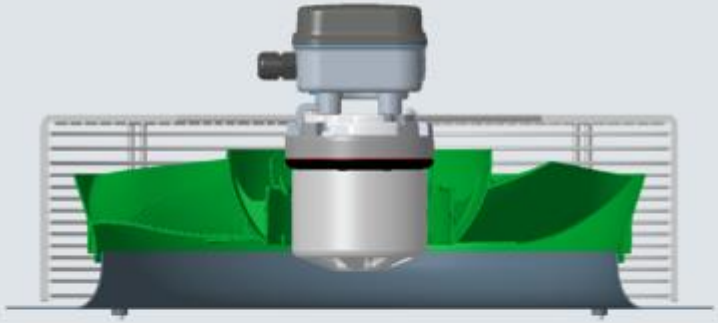
Robust plug & play solution





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The pressure-resistant AxiEco axial fan

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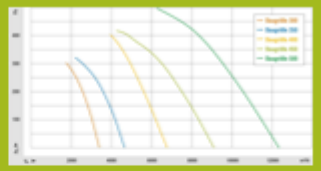
Content

Sectors

Design

Technology



Technology
of the AxiEco

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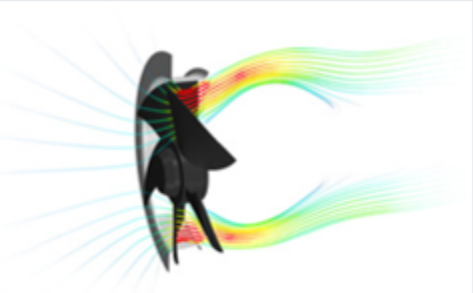
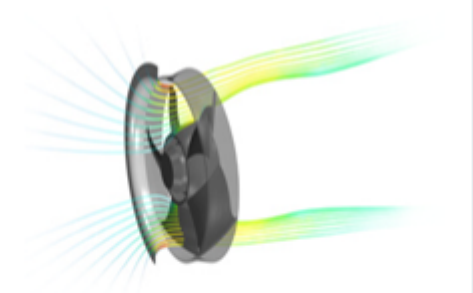
What makes the outflow characteristics of the AxiEco so special?

- AxiEco has less turbulent flow and no backflow
- No backflow means less ice formation on the guard grill
- Less ice formation means a longer operation time between two defrost cycles



Existing solution: HyBlade



New solution: AxiEco

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Air throw distance
of the AxiEco Perform

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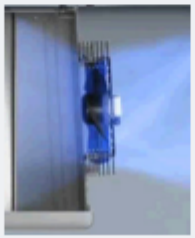
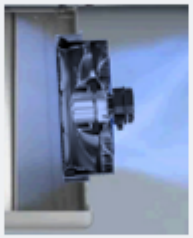
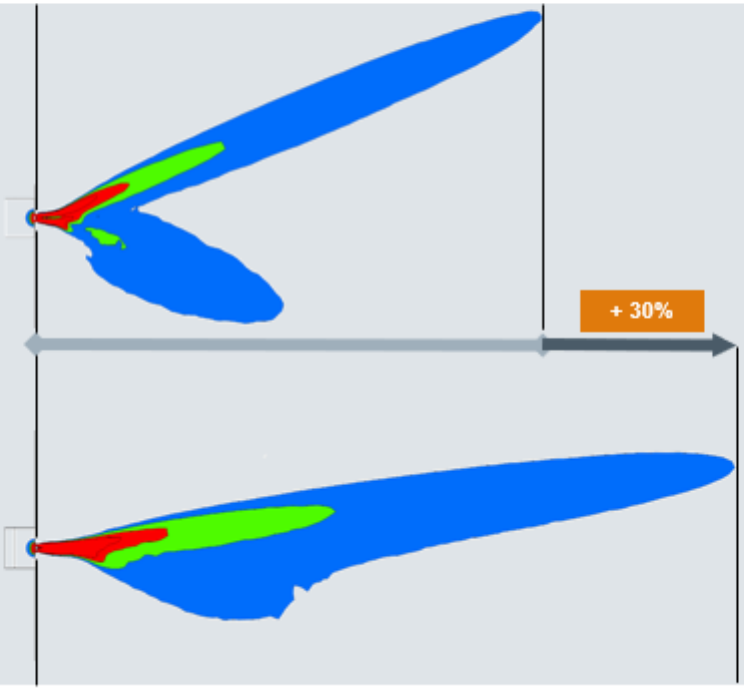
Comparison of air throw (CFD simulation)

HyBlade with
guard grill
and short nozzle
Size 350
AC 4pole



AxiEco Perform
Size 350
AC 4pole





Air speed
at the same
operating point

[m/s]

< 2.0
...
≥ 1.5

< 1.5
...
≥ 1.0

< 1.0
...
≥ 0.5

< 0.5

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Air throw distance
the AxiEco Perform

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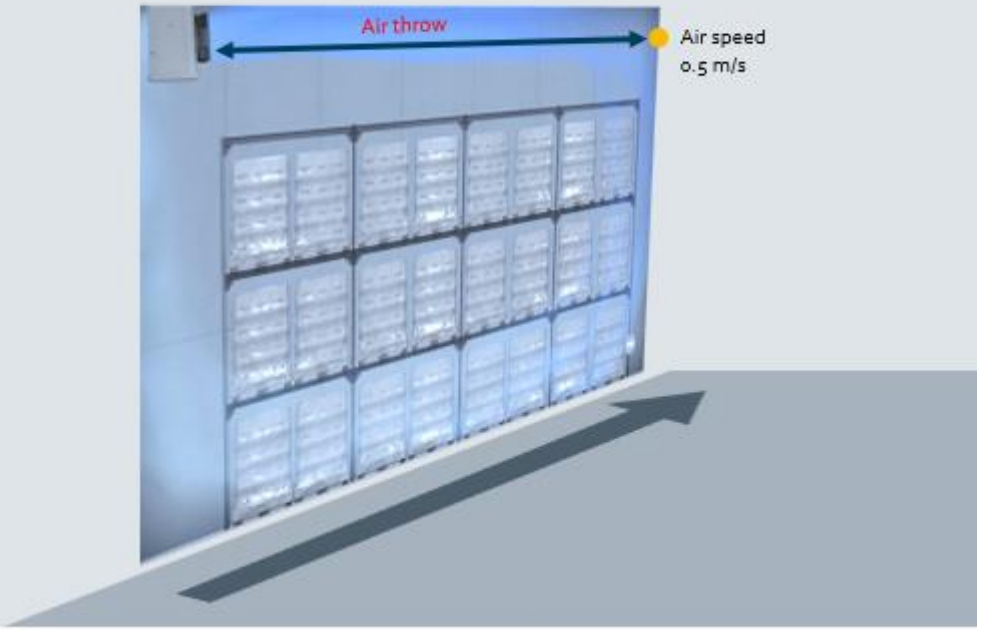
The actual air throw distance depends on

- Fan type
- Fan diameter
- Operating point of fan
- Number of fans in the evaporator
- Design of the heat exchanger (e.g. fin spacing)
- Degree of ice formation on heat exchanger
- Distance of the evaporator to walls and ceilings
- Floor plan of cold store
- Arrangement of goods in cold store



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Technology
of the AxiEco

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How does the AxiEco fight off ice formation?

- Greater pressure reserves than conventional axial fans, thus, longer operation time / fewer defrost cycles
- No tip gap between impeller and fan housing, which makes it unlikely that the impeller will freeze on
- Optimized flow profile ➔ less ice formation on the guard grill

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Technology
of the AxiEco

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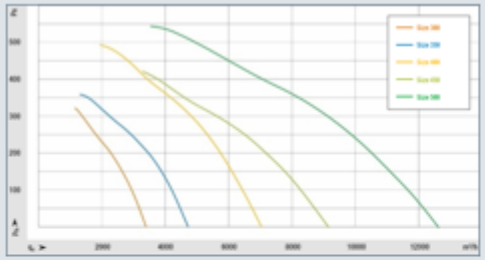
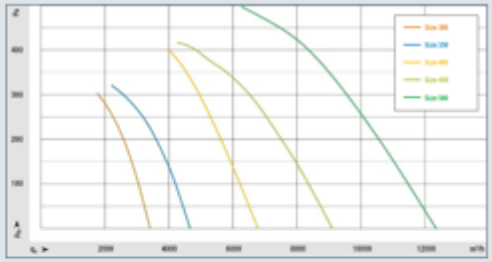
Details

Why is the AxiEco's high power density advantageous?

Since the AxiEco can be operated at higher speeds, it achieves a higher air performance per area.
Compared to other axial fans, this means that fewer or smaller fans are required to deliver the same air performance.



AxiEco Protect with EC motor
measured with guard grill



AxiEco Perform with EC motor
measured with guard grill

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Technology
of the AxiEco

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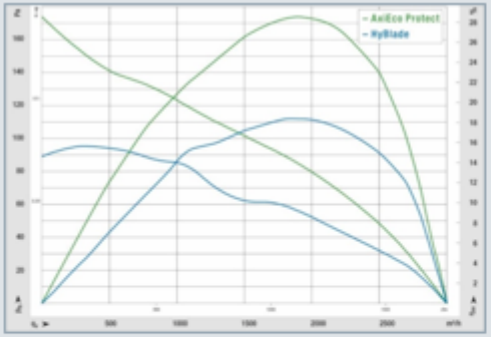
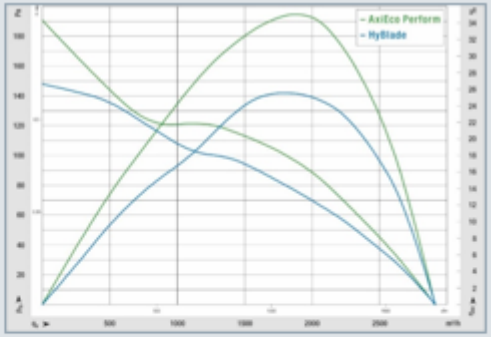
How does the AxiEco increase efficiency?

Thanks to the new impeller geometry in conjunction with the diffuser ring, considerably higher efficiency levels are achieved compared to conventional axial fans such as HyBlade. The guide vanes of the AxiEco Perform also increase its efficiency.



AxiEco Protect
compared to HyBlade (size 350, AC 4pole)



AxiEco Perform
compared to HyBlade (size 350, AC 4pole)

Technology
of the AxiEco

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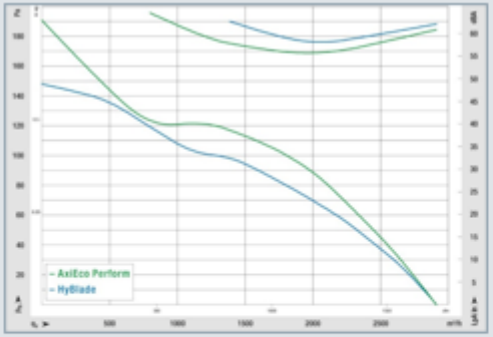
Why is the AxiEco so incredibly quiet?

The innovative impeller geometry with a diffuser ring and internal diffuser in conjunction with the inlet ring ensure optimum flow with little turbulence, and therefore lead to a low noise level.



Details

AxiEco Perform
compared to HyBlade (size 350, AC 4pole)

Technology
of the AxiEco

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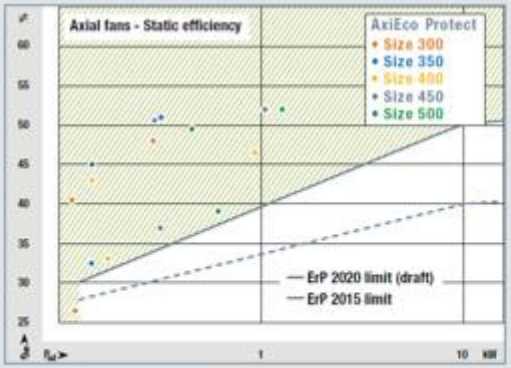
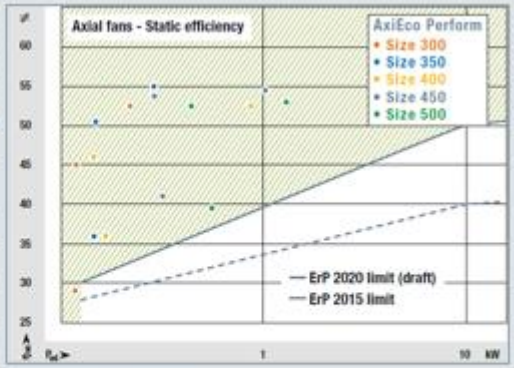
Details

How do I benefit from the AxiEco's ErP conformity?

The ErP Directive (EU Regulation 327/2011 for the implementation of the EU Ecodesign Directive 2009/125/EC concerning fans) sets out the minimum efficiency levels for fans as determined by the EU. With the next stage, which is expected to come into application in 2022, these minimum efficiency levels will be increased even further. The AxiEco already meets these higher minimum efficiency levels, ensuring that equipment manufacturers are on the safe side and are ideally equipped for the future.



AxiEco Protect



AxiEco Perform

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Technology
of the AxiEco

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What are the advantages of using EC motor technology?

AxiEco Protect with EC-Motor

AxiEco Perform with EC-Motor

- higher efficiency compared to AC motors
- lower energy consumption and therefore less waste heat
- reduced power loss and therefore longer service life
- demand-based speed control via a 0 - 10 V signal
- depending on the motor version, there is also a MODBUS interface for controlling and monitoring the motor

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Technology
Efficient EC motors above IE5 limits

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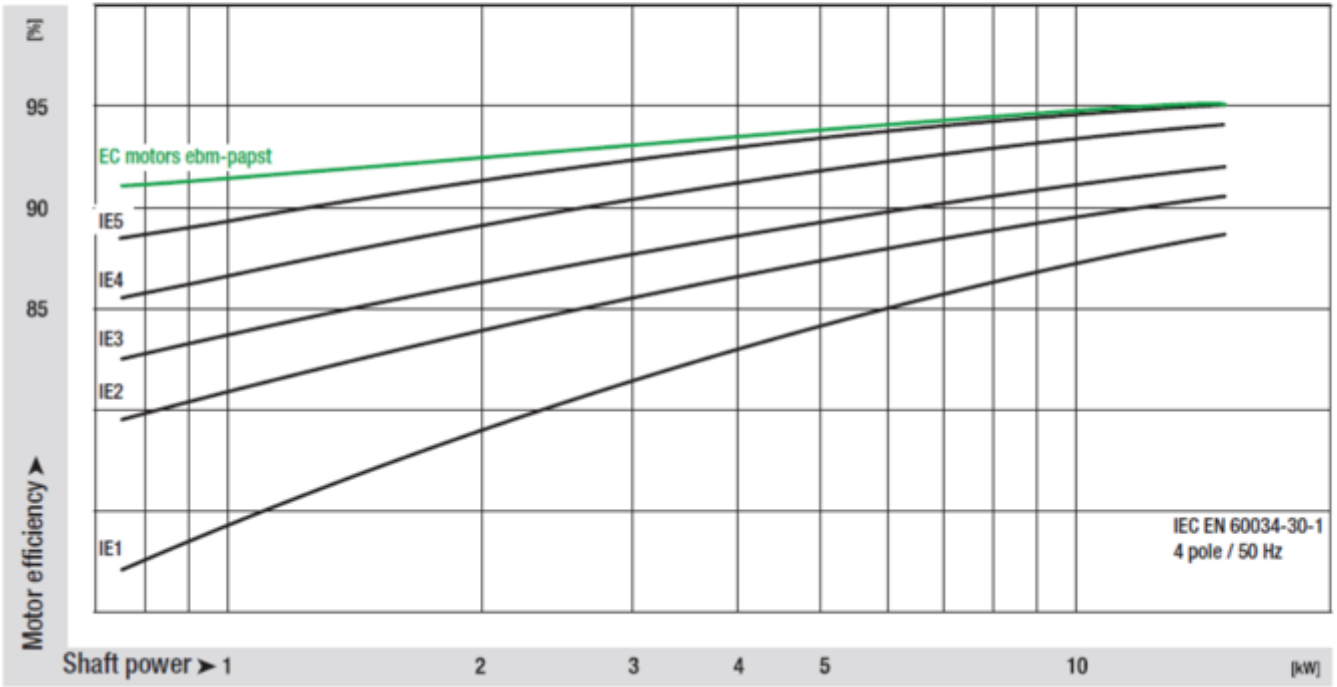

Technology
Efficiency Chain

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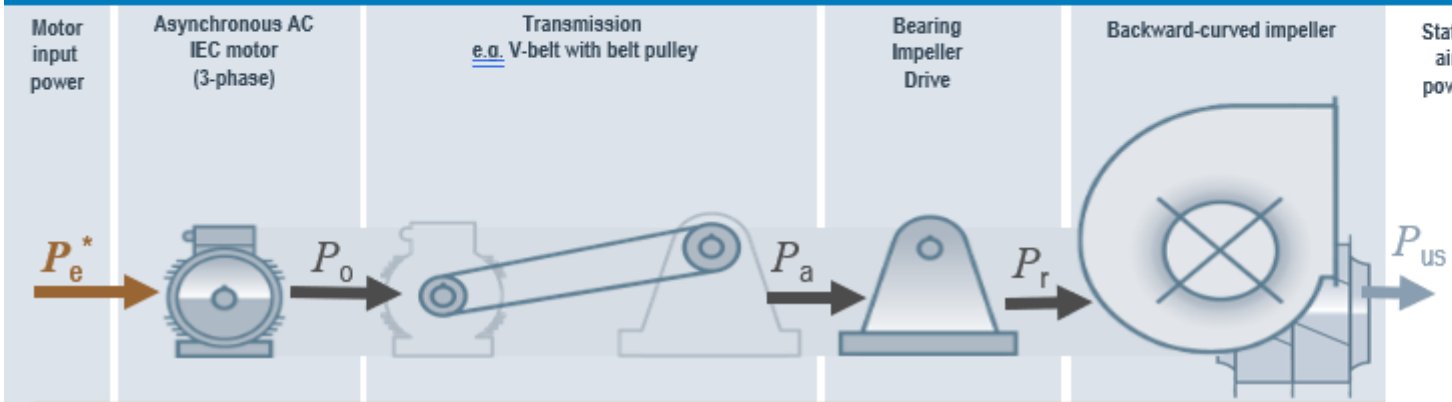
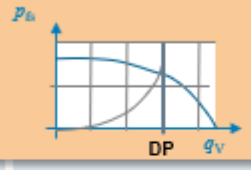
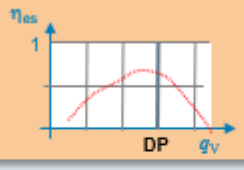
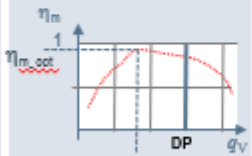


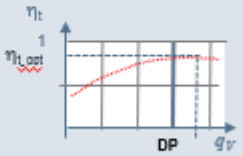
Static overall efficiency in duty point (DP):

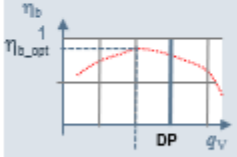
$$\eta_{es} = \frac{P_{us}}{P_e} = \frac{p_{fs} \cdot q_v}{U_{RMS} \cdot I_{RMS} \cdot \cos\varphi \cdot \sqrt{3}}$$

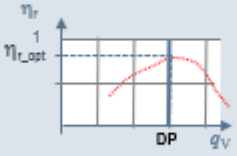












$$\eta_{e(s)} \neq \eta_{m\_max} \cdot \eta_{T\_max} \cdot \eta_{b\_max} \cdot \eta_{r(s)\_max}$$

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Technology
Efficiency Chain ISO12759 comparison

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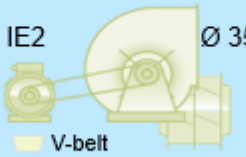
Given:

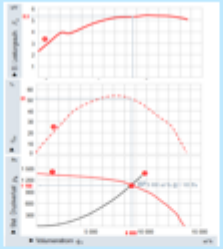


Static duty point: q_V = **8 800 m³/h** @ p_{fs} = **1 100 Pa**

→ Static air power: $P_{us} = q_V \cdot p_{fs}$ = **2 690 W**

→ Dynamic air power: $P_{ud} = q_V \cdot p_{fd}$ = **200 W**

→ Fan air power P_u = **2 890 W**

	Calculation based on components	Calculation as per ISO 12759 *	Measuring result
Efficiency impeller + housing η_r		75.7 %	
Fan shaft power P_a	3.5 kW	3.82 kW	
Efficiency belt drive η_t	95.2 %	95 %	
Motor shaft power P_o	3.68 kW	4.02 kW	
Motor efficiency (IE2,4-pole) η_m	86.6 %	86.8 %	
Motor input power P_e	4.25 kW	5.14 kW *	5.3 kW
Overall efficiency η_e	68.0 %	56.2 %	54.5 %
Overall static efficiency η_{es}	**63.4 %**	**52.3 %**	**50.7 %**

* with C_m = 0.9

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Technology

Efficiency Chain ISO12759 comparison with VSD

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Drive control electric input power → P_{ed}

External VSD → η_c

Motor input power → P_e

Asynchronous AC IEC motor (3 phase)

Without or with a transmission and bearing block

Backward or forward-curved impeller with housing

(Static) air power → $P_{u(s)}$

ErP directive 2009/125/EG, EU regulation 327/2011

Overall optimum (static) efficiency sold in components:

$$\eta_{e(s)} = \eta_m \cdot \eta_T \cdot \eta_b \cdot \eta_{r(s)} \cdot C_m \cdot C_C$$

Overall optimum (static) efficiency sold as a complete unit:

Systems without VSD: $\eta_{e(s)} = \frac{P_{u(s)}}{P_e}$

Systems with VSD: $\eta_{e(s)} = \frac{P_{u(s)}}{P_{ed}} \cdot C_C$

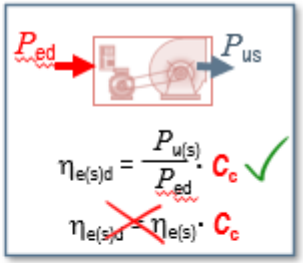
Energy saving potential through VSD

ebm-papst EC data sheets :

Based on measurements (certified according DIN EN ISO 5801:11-2011):

$$\eta_{es} = \frac{P_{us}}{P_{ed}} \cdot C_C$$

At point of optimum efficiency, with variable speed drive indicated, efficiency category "static"



P_{ed} Drive control electric input power

Variable Speed Drive incl. sine filter "EC – Motor"

Synchronous DC motor with bearings

Backward-curved impeller

Nozzle

P_{us} Static air power

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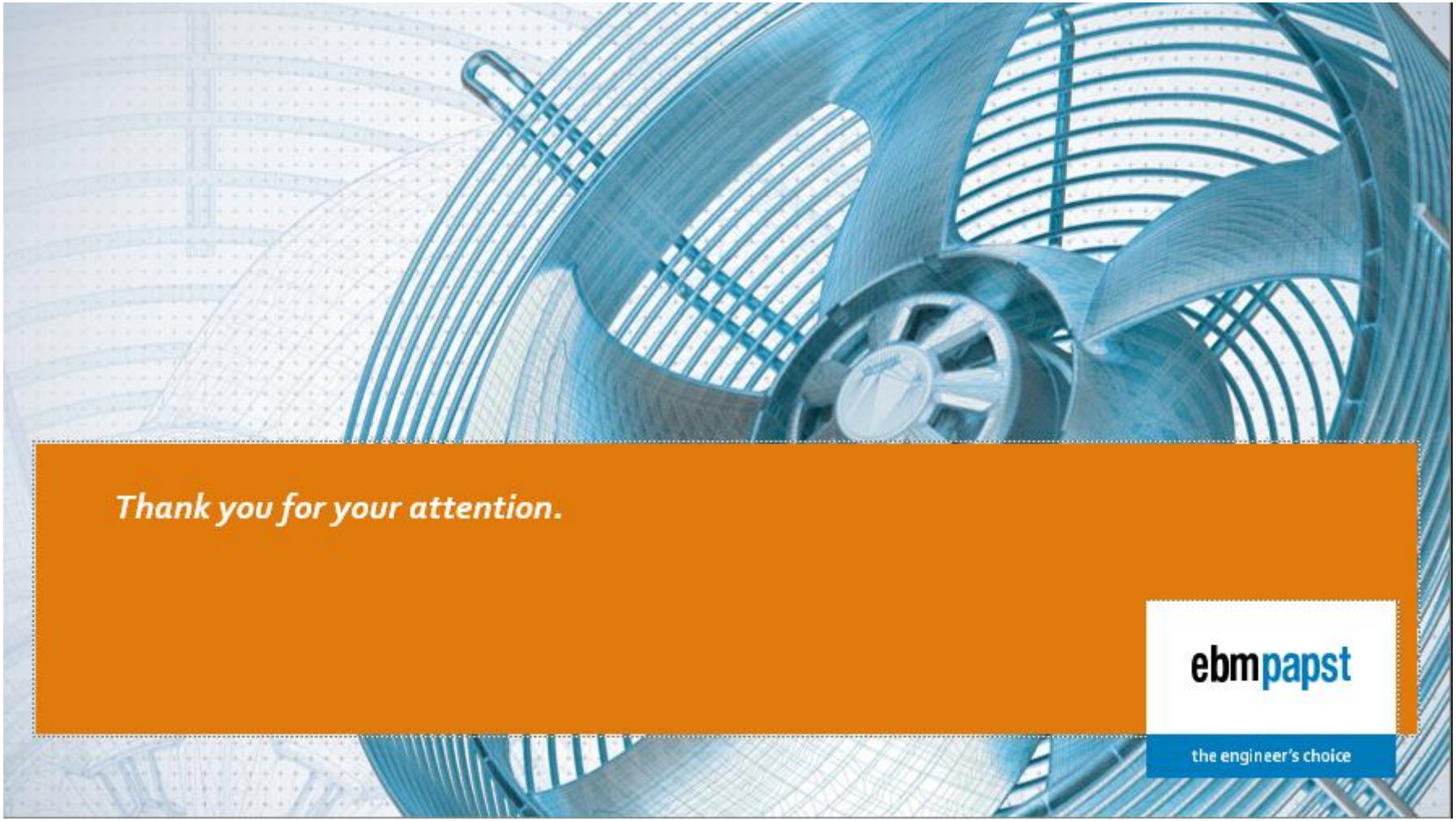
Thank you for your attention.
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