



WHITE PAPER

Axial fans *for applications with high back pressure*

**EC and AC versions
fulfil the current and
future ErP Directive.**

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ebmpapst

engineering a better life

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1. Executive Summary

Axial fans are normally used for situations when strong air flow with relatively low back pressure is required. That is why they have not yet been the fan of choice for ventilation and air conditioning devices that have components that require a high pressure increase. But now that has all changed: the new axial fans are also suitable for applications with high back pressure, meaning that these types of applications can also benefit from their higher air flow rates. They are extremely energy efficient and both the EC and AC variants meet the next stage of the ErP Directive. As there are two different designs, their area of application is broad. The AxiEco Protect with guard grill can be used for evaporators, heat pumps and other ventilation and air conditioning devices, for example. With AxiEco Perform, a plug & play-capable version with an easy-to-install housing and CE marking is also available, offering exceptionally practical installation options.

2. Energy efficient and stable under pressure

Fans function efficiently when their optimal operating range is harmonized with the application's requirements. Fans in evaporators must be able to overcome high back pressure since ice often forms on the heat exchanger and constricts the air channels. This is where motor and fan specialist ebm-papst got to work and developed a new axial fan product range with EC and AC technology in the form of two variants: AxiEco Protect (Fig. 1) and AxiEco Perform (Fig. 2). Both are highly efficient and exhibit unusually high stability under pressure. The air performance curve has a much steeper slope than with comparable axial fans. Therefore, the fans operate at high efficiency even with increasing back pressure (Fig. 3). As a result, even AC designs meet the requirements of the future ErP Directive and manufacturers of air conditioning devices, evaporators or heat pumps can choose which technology they want to use.



Fig. 1: The AxiEco Protect with EC technology (above) and AC technology (below)



Fig. 2: The AxiEco Perform with plastic housing with EC technology (above) and AC technology (below)

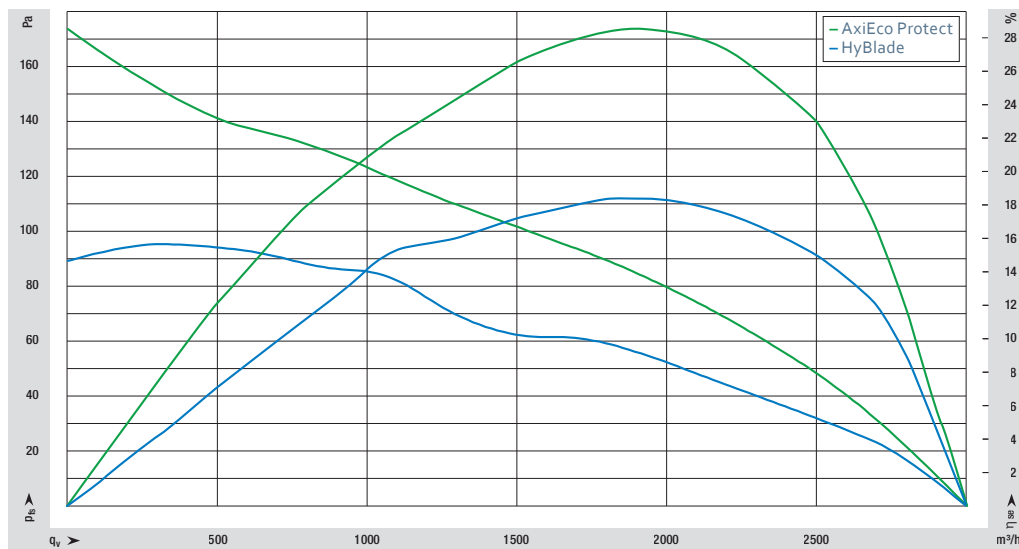
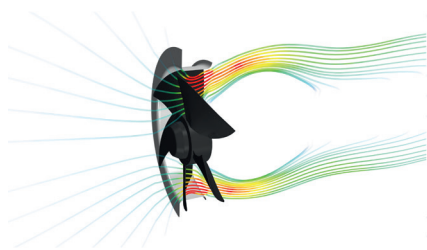


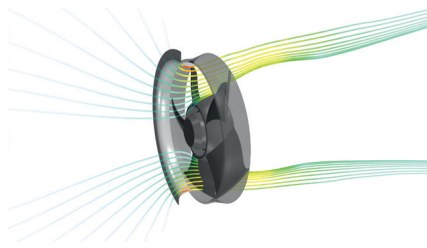
Fig. 3: The air performance curves of the AxiEco Protect are much steeper than the HyBlade.

3. Perfectly harmonized to different applications

With many practical design details, the AxiEco Protect series with guard grill has been optimized for ventilation, refrigeration and air conditioning applications. When used in evaporators or heat pumps, the axial fan series makes both service work and compliance with hygiene rules easier. It will never be possible to fully prevent ice formation on heat exchangers and fans. But it is possible to minimize it, which also extends their service life. The developers have made this wish, which is shared by many users, a reality using several measures:



existing solution: HyBlade



new solution: AxiEco Protect

Fig. 4: New flow profile for the AxiEco: No return flow compared to the HyBlade

The new flow profile without return flow (Fig. 4) means that the guard grill does not ice up so quickly. And the impeller with the integrated diffusor ring has been produced in highly resistant plastic, a material that, in and of itself, discourages icing. The fans' guard grill is made of metal, which means that it is highly robust. The reason for this is that mechanical means are usually employed to remove the ice forming on the grill. Drainage channels on the fan blades ensure that, after routine defrosting, melt water can easily drain towards the drip pan provided at the evaporator. This prevents the fan blades from freezing up. At the same time, water is prevented from being slung away when the fan is restarted. The more stringent the hygiene requirements, the more important this feature becomes. Splash water must be prevented from contaminating food stored in open containers whenever possible, for example.

The fans in the new series are available in sizes 300, 350, 400, 450 and 500 mm. With air flows of up to 12,500 m³/h and pressures of up to 500 Pa (Fig. 5), they are ideal for a number of typical applications in refrigeration, air conditioning and ventilation technology, and can be used for exhaust or intake. They can be easily integrated into the application. In the simplest scenario, they are placed directly on the existing short nozzle.

Using the new AxiEco fans can significantly minimize ice build up on the heat exchanger. This extends the service life.

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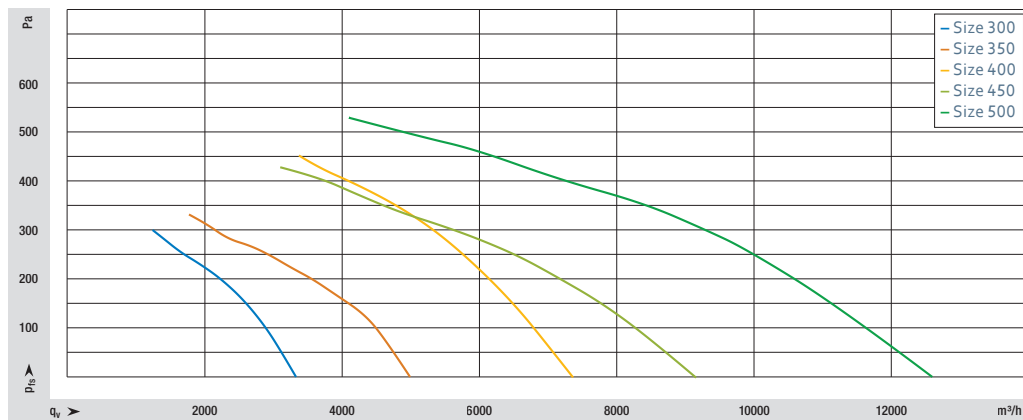


Fig. 5: Air performance curves of the AxiEco Protect axial fans with EC technology.

4. Axial fans in an easy-to-install plastic housing

The two fan types in the AxiEco series cover very different application requirements. For example, the AxiEco Protect fan with guard grill is particularly well-suited for noise-sensitive applications, as its noise emissions are very low. By contrast, the AxiEco Perform fan with housing is recommended when a ready-to-install fan is needed. As a compact plug & play solution with CE marking, the fans are particularly easy to integrate into applications. Users will not have to worry about nozzles or distance to the impeller, nor concern themselves with conducting their own ErP assessment. Its applications range from heat pumps and evaporators to industrial ventilation systems and air compressor cooling. In both the EC and AC design, the fans in the plastic housing also meet the requirements of the future ErP Directive and can be used for exhaust or intake.

5. Aerodynamic design increases efficiency and air throw



Fig. 6: The fan has an optimal throughflow thanks to the inlet ring that immerses in the impeller and thanks to the impeller's larger outlet opening.

Optimized aerodynamics lie at the heart of the fan's design and are what help to increase efficiency and pressure: the impeller, integrated diffuser ring and hub form a compact unit and the blade tips pass over straight into the integrated diffuser ring. This eliminates the tip gap between the nozzle and the impeller, which also prevents air from flowing over the tips of the blades, as seen in conventional axial fans. The new design both increases efficiency and reduces noise. The integrated diffuser ring also functions as a diffuser that is directly integrated into the impeller. It increases the pressure, resulting in reduced outlet losses and less noise. Thanks to the inlet ring that immerses in the impeller and a larger outlet opening, the fan has an optimal flow (Fig. 6).

AxiEco fans can be used in a wide variety of products from **heat pumps and evaporators** right up to industrial **ventilation systems** or for cooling **air compressors**.

Aerodynamic optimizations ensure greater efficiency and a high pressure increase.

The AxiEco Perform – the housing version – also features an aerodynamically optimized housing with integrated guard grill and guide blades. Cavities in the housing corners improve the flow; the guide blades ensure that the swirl in the out-flow field of the fan, and thus the dynamic losses, are reduced to a minimum. The air throw is also greater than conventional axial fans. In a direct comparison, the AxiEco Perform exhibited an air throw that was around 25% greater than a corresponding HyBlade fan (Fig. 7) when being measured. This enables an even distribution of cold air in large refrigerated warehouses for example, often meaning that fewer fans are required.

In terms of exhaust-based applications, an optional guard grill can be attached to the intake side of the housing. If the fans are used for evaporators, an air bag that closes the air outlet opening during the defrosting process and when the fan is switched off can be easily installed. It is fixed to the cylinder-shaped housing using the standard tensing belt. The air bag keeps the trapped heat in the evaporator housing during the defrosting process. This significantly reduces the defrosting time and makes for a low final defrosting temperature, thus saving a considerable amount of energy.

6. Confirmed by TÜV: Optimized evaporator output

Tests were carried out at TÜV SÜD Industrie Service GmbH in the Center of Competence for refrigeration and air conditioning technology to evaluate ice formation behavior. The axial fans of types HyBlade, AxiEco Perform and AxiEco Protect were subjected to the test; each of them was installed in the same evaporator. Measuring cycles were defined to determine the characteristic ice formation behavior when using the different axial fans. The results of the investigation show that the measured refrigerating capacity is larger when operating the evaporator with the AxiEco Perform than with conventional axial fans. In addition, it also showed that the heat exchanger ices up more slowly when using the AxiEco Perform. This extends the service life between two defrosting cycles. There is also virtually no ice formation on the fan itself, which means that there is practically no risk of freezing.

The AxiEco Perform has an **approx. 25 % greater air flow** than the HyBlade.

TÜV SÜD Industrie Service GmbH test results prove that, when operating the evaporator, the **measured refrigerating capacity is much higher** when using an **AxiEco Perform** than when using conventional axial fans.

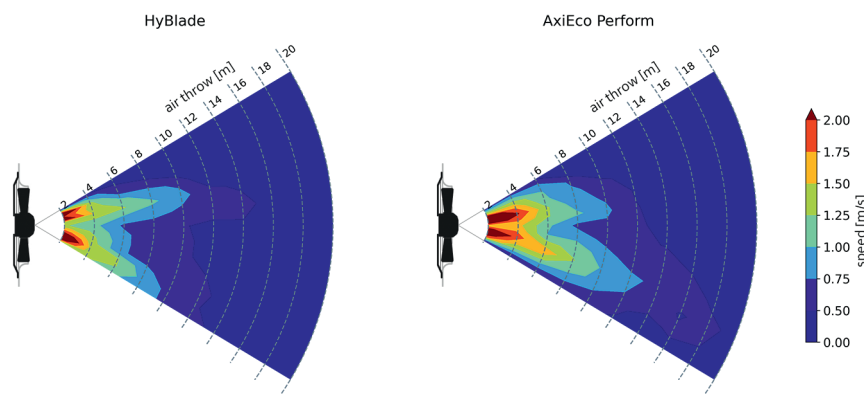


Fig. 7: The air throw of the AxiEco Perform (right) is approx. 25% higher than the HyBlade (left).

7. Variable installation options

The sophistication of the housing design makes the fan easier to install and enables a number of potential installation methods (Fig. 8). For example, for intake operation, the fans can be installed „on top“, i.e. on top of the customer's device, or „semi-top“ (recessed into the device). For exhaust operation, the entire fan unit is simply installed the other way around in the customer's device using the central flange and is fitted with the guard grill on the intake side, which is available as an option. When used in ventilation pipes, the central flange makes it easier to install the fan directly on the pipe system. This makes it easy to integrate the fans into ventilation applications.

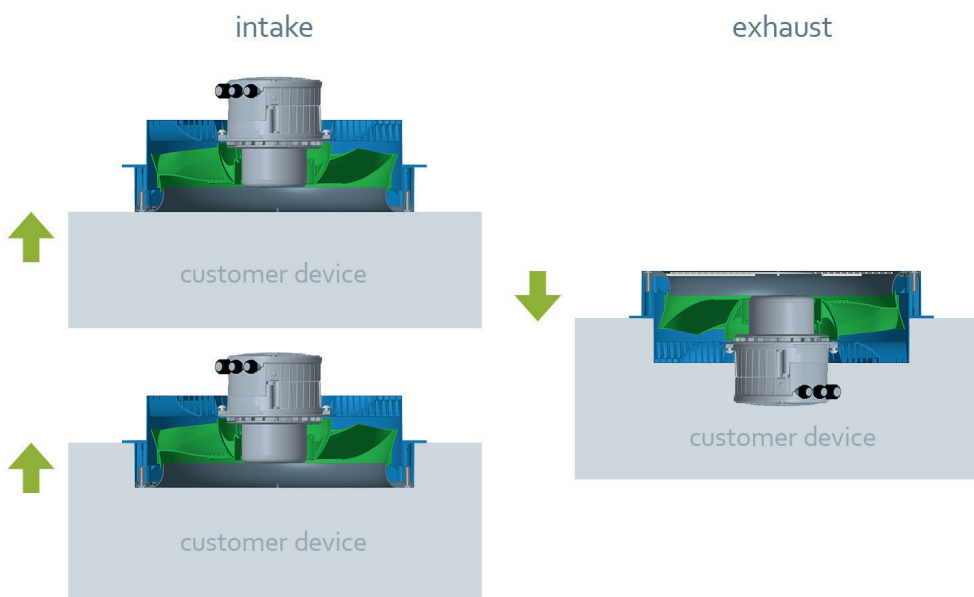


Fig. 8: Different installation methods for intake and exhaust operation.

8. Advantages of EC technology

The new AxiEco fans satisfy the requirements of the next ErP stage, regardless of which motor technology they use. However, the fans with EC motors offer many more advantages. In comparison to AC motors, EC motors function with considerably higher efficiency. They also generate less waste heat, an important advantage for chilling applications. It is also possible to control and monitor the fans based on the requirements using a 0-10 V signal or MODBUS. These features help the EC fans to work very efficiently, particularly in the partial-load range, and significantly reduce energy consumption. This facilitates individual adaptation to particular cooling requirements. Typical examples include the maturing of cheese and the ripening of sensitive fruit and vegetables in storage, and varying day and night operation. The new features enable needs-based air flow to be easily set in ventilation applications. In addition, the high speeds of the EC motors enable much higher air performance and thus higher power densities, which are very welcome in many industrial applications.

About ebm-papst

The ebm-papst Group, a family-run company headquartered in Mulfingen/Germany, is the world's leading manufacturer of fans and drives.

Since the technology company was founded in 1963, it has continuously set the global industry standard with its core competences in motor technology, electronics, digitization and aerodynamics. With over 20,000 products in its portfolio, ebm-papst provides the best energy-efficient, intelligent solution for virtually every ventilation or drive-engineering task.

In fiscal year 2020/21, the "hidden champion" generated revenues of € 2.129 billion. The group employs roughly 15,000 people at 29 production sites (in Germany, China and the USA, to name but a few) and in 51 sales offices worldwide.

ebm-papst sets the benchmark with their fan and drive solutions which are used in almost all industries, such as ventilation, air conditioning and refrigeration, heating, automotive, information technology, mechanical engineering, household appliances, intralogistics and medical engineering.