

# High-Performance Fans for Oil-Cooled Transformers

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Oil-filled transformers are ideal for handling high loads and are in high demand to support the modernization of the power grid. They are typically used for power generation, transmission and distribution applications and although they are oil-cooled, axial fans are an essential component for managing the thermal load. The airflow profile of an axial fan is ideal for dissipating waste heat to prevent damage associated with overheating and to ensure safe operation of high-power, oil-cooled transformers.



Figure 1: Axial fans mounted for vertical airflow on oil-cooled transformers. Source: ebm-papst Inc.

**Oil-filled transformers are ideal for handling high loads and are in high demand to support the modernization of the power grid.**

As an industry leader in ventilation and drive engineering, ebm-papst Inc. manufactures axial fans with either AC motors or innovative, highly efficient, Green Tech EC (electronically commutated) motors for demanding oil-cooled transformers. The fans are reliable, quiet and energy-efficient. They are available as a complete solution inclusive of their industry-leading HyBlade® impellers, innovative motors, grill guards and venturi housings, which further improve airflow performance. They can be mounted either horizontally or vertically, addressing customer-specific requirements with the level of quality and dependability customers have come to expect from ebm-papst.

## AC Technology

Part of what makes ebm-papst fans unique is they are a complete packaged solution. They offer a portfolio of AC fans that serve as a drop-in replacement for existing transformer designs. Diameters range from 500 mm to 1,250 mm and are plug-and-play ready as a package.

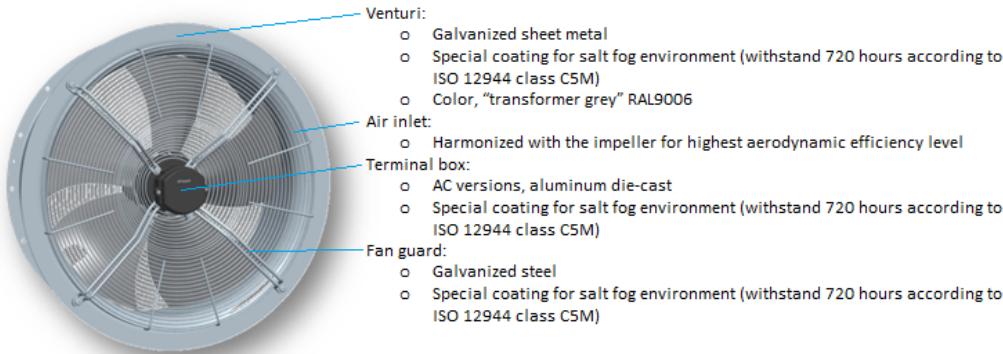


Figure 2: Intake face of axial fan for oil-cooled transformer. Source: ebm-papst Inc.

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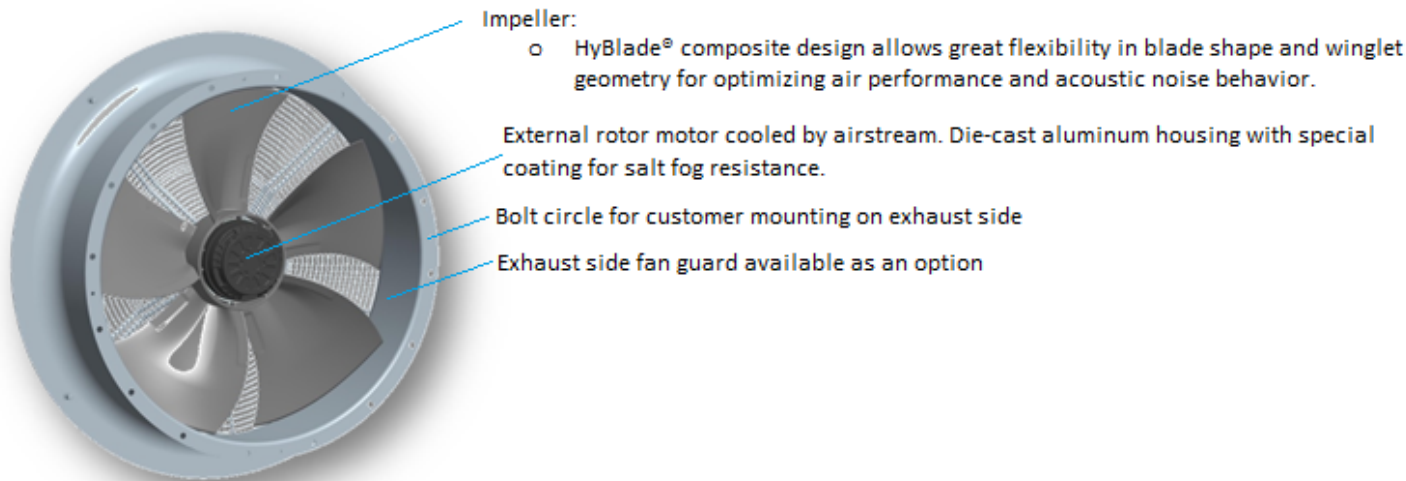


Figure 3: Exhaust face of axial fan for oil-cooled transformer. Source: ebm-papst Inc.

**HyBlade® Impellers**

HyBlade® impellers provide for weight reduction, noise reduction and significantly improve fan efficiency. They feature a strong aluminum core with an external sheath of fiberglass-reinforced plastic with a profiled blade geometry and winglets. The aerodynamically optimized plastic blade shape provides performance and noise benefits, while the corrosion-resistant aluminum core ensures a permanent connection with the rotor. The fan blades are UV-resistant, lightweight and built to last.

**Balancing Quality**

To prolong the life of the fan while ensuring consistency and reproducibility, ebm-papst dynamically balances its fans in two planes to quality grade level G 6.3 according to DIN ISO 1940.

The company’s standard balance quality grade, G 6.3, allows for a vibration velocity of no more than 6.3 mm per second, which meets industry requirements for industrial fans, flywheels

and aircraft gas turbine rotors. Should a higher balancing quality level be required, ebm-papst can dynamically balance fans to suit the needs of specific applications by request.

**Venturi Housing**

The rugged housing design consists of hot-dip galvanized sheet steel with a durable coating that is resistant to salt spray as per DIN EN ISO 12944, class C5M (color RAL 9006: transformer grey). The overall design has an IP55 rating for top protection against low-pressure water jets and dust. The housing also features an integrated venturi nozzle on the intake that improves airflow performance.

The venturi housing provides for a crucial advantage over fans operated with only a basket grill. The fan housing helps by reducing air performance losses associated with turbulence. The housed fans can also be installed vertically or horizontally, and may be mounted by either the intake or outlet side of the housing depending on the desired airflow direction. The fan housing also provides for easy handling and storage during transport.

**Installing the axial fan in a housing is a perfect way to significantly increase air performance.**

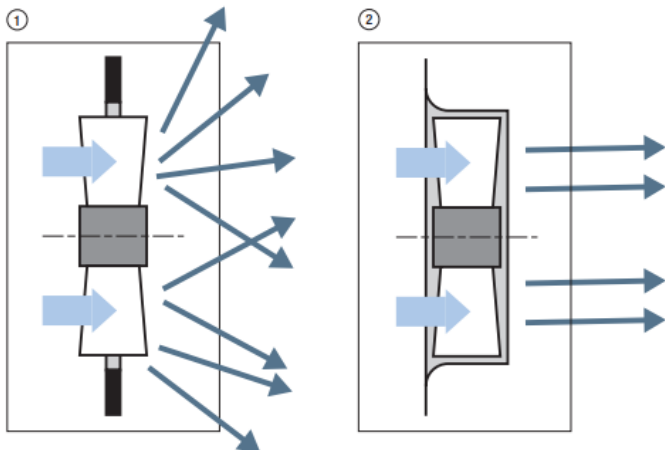
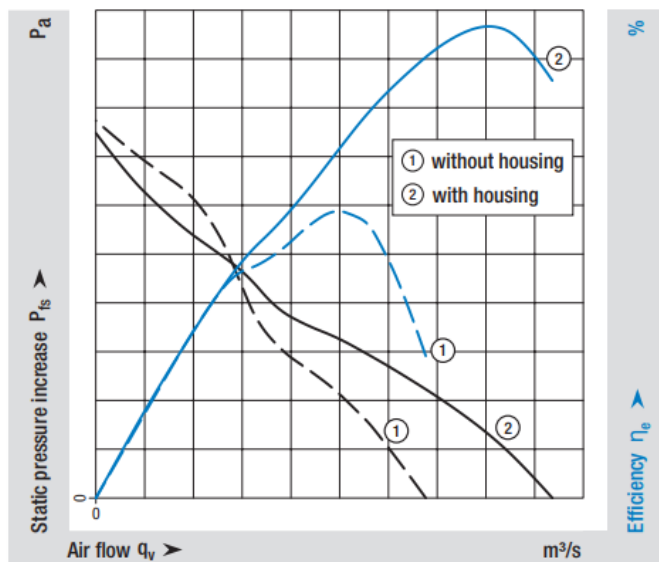


Figure 4: The venturi housing improves air performance and increases system efficiency. Source: ebm-papst Inc.



### Green Tech EC Technology

In addition to traditional AC induction motor technology, ebm-papst offers highly efficient Green Tech EC motor technology, which addresses a gap in the oil-cooled transformer market.

Green Tech EC motors are grid-powered, permanent magnet, synchronous motors with electronic commutation that are similar to brushless DC electric motors. An integrated electronics unit performs power conversion/inversion with frequency and amplitude modulation to provide precise adjustable speed control.

The EC fans are optimized for partial-load operation down to 10% of their rated speed. Continuously adjustable speed control is possible via open loop control using a 0 to 10 V DC analog input, pulse-width modulation (PWM) or Modbus RTU serial protocol.

ebm-papst transformer fans also feature external rotor motors, where the spinning rotor with permanent magnets is on the outside of the stator and coils. A fan using an external rotor motor with standard ferrite magnets can attain higher torques and levels of efficiency in a shorter package than an internal rotor motor of greater length using rare-earth magnets. The ability to attach the impeller directly to the rotor of the external rotor motor results in this space savings and allows the entire rotating assembly to be balanced in a single procedure.

The EC motors operate well above efficiency requirements of super premium efficiency (IE4) motors. They carry certifications for worldwide use (e.g., UL, CSA, Eurasian Conformity, China Compulsory Certificate). Power supply requirements are 380 to 480 V AC, 50/60 Hz. ebm-papst Green Tech EC axial fans are universally deployable with simple commissioning. They are a dependable forced air cooling solution with air performance of up to 27,500 cfm.

### Energy Savings and Noise Reduction

Transformers are increasingly used near residential areas, where strict requirements related to noise must be met. During peak demand times, all fans must typically run at rated speed to handle the thermal load of transformers working at full power. During off-peak times when cooling requirements drop, systems using conventional AC induction fans traditionally switch some of them off.

The fans that are still running continue to work at full power, which is not ideal from the perspective of overall system efficiency or lifetime. This is where EC technology has a significant advantage. Green Tech EC fans provide the more effective option of keeping all fans in operation



Figure 5: A high-performance fan for oil-cooled transformers.

Source: ebm-papst Inc.

at reduced speed while maintaining a high motor efficiency — even down to a fraction of the rated speed. Keeping all fans running results in a more uniform air flow through a transformer's radiators while still providing both a larger power reduction and a larger noise reduction than is achieved by on/off fan operation. Transformer hot spots created where fans are turned off are eliminated. Overall, it is a more economical system of operation that results in improved transformer and fan service life. The diagrams below illustrate the potential energy savings and noise reduction in comparison to on/off operation.

An added benefit to using an EC speed controllable fan is that fan selection may be made with the intention of having an air flow reserve should cooling demand exceed typical peak requirements or to compensate for a failed fan. To avoid wasting power, the fans could be set below their rated speed during normal operation and only boosted to maximum speed for these atypical situations.

### Rugged Design

ebm-papst fans have a long service life and are suitable for deployment in high salinity coastal areas. The incorporation of a hot-dip galvanized sheet-steel housing with a salt-spray resistant coating, UV-resistant composite blades and an extremely durable motor with an IP 55 rating provides for an extended service life even when subjected to harsh environments.

### Oil-Filled Transformer Market Requirements

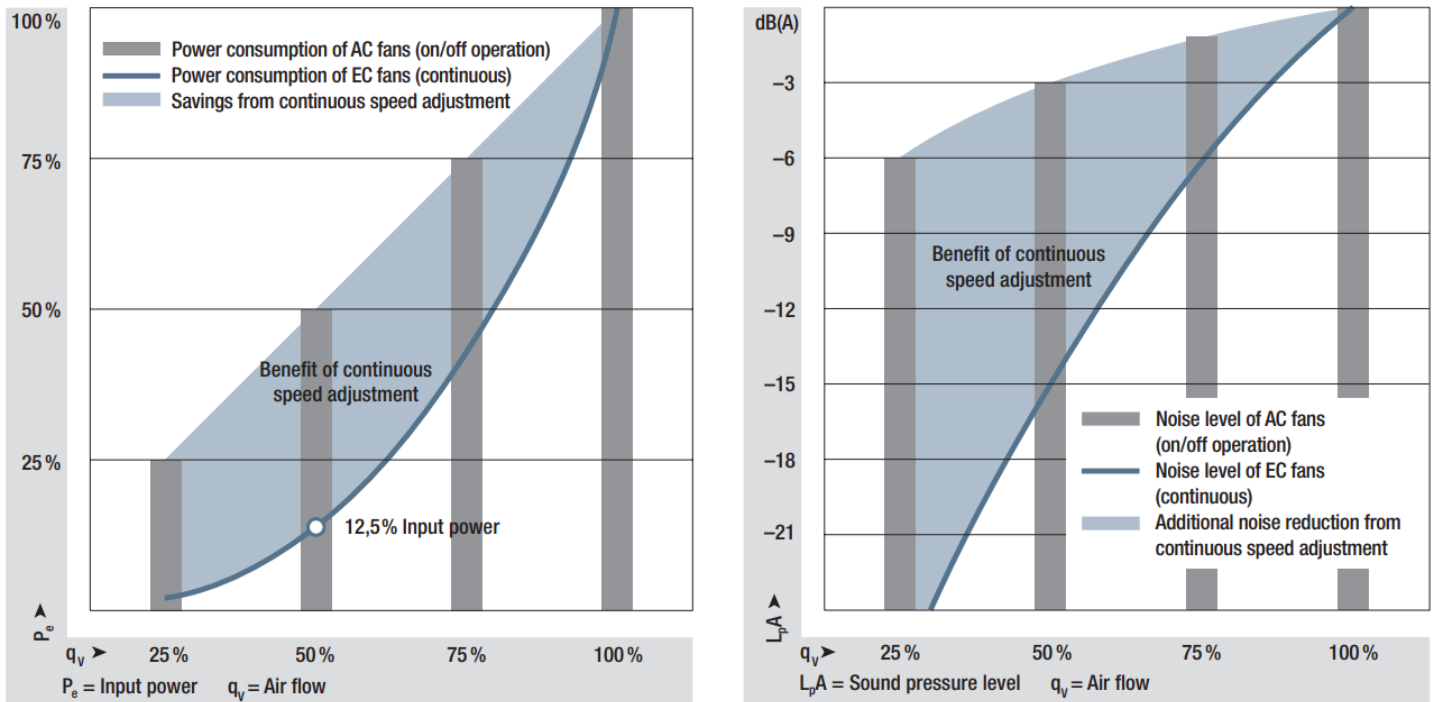
[Global Market Insights Inc. reports](#) that the oil-filled transformer market was valued over \$33 billion in 2017 and is set to witness the annual installation of 600,000 units, with the anticipated market size to exceed \$45 billion by 2024. The adoption of distributed and renewable energy networks along with the subsequent upgrading of existing power networks will drive market value, while non-remote residential installations will force manufacturers to address noise requirements.

### Conclusion

ebm-papst's AC and high-performance Green Tech EC axial fans are complete, packaged solutions that satisfy the requirements of high-power, oil-cooled transformers. Innovative EC technology addresses a gap in the market place, fulfilling a need for noise reduction, extended service life and efficiency gains, while their AC fans are a drop-in replacement for existing transformer designs. ebm-papst can also devise customized solutions.

To learn more about ebm-papst's complete packaged solutions, download their brochure "[Fans for oil-cooled transformers](#)" and [contact a representative](#) today.

Energy savings and noise reduction in part load operation.



**Reduced energy consumption:** The bars show the power consumption of fans that are switched on stepwise as needed. Air performance is reduced by 50% when half of the fans are switched off. The blue line shows the power consumption of all fans with smooth speed adjustment at the required air flow (50% air flow = only 12.5% input power).

**Lower noise generation:** While switching off half the fans (50% decrease in air flow) only reduces noise generation by approx. 3 dB, a speed reduction resulting in 50% less air flow achieves an improvement of 15 dB.

Figure 6: Graphs illustrating possible energy savings and noise reduction with continuous speed adjustment. Source: ebm-papst Inc.

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**ABOUT EBM PAPST INC.**

A worldwide leader in fan and motor technology, ebm-papst Inc., in Farmington, CT., is the US subsidiary of the parent company established in 1963 in Mulchingen, Germany. ebm-papst has a presence in every major market worldwide, providing local service and support with more than 50 subsidiaries globally. Founded in 1981, ebm-papst Inc. has been a true success story in North America. Our highly-skilled and experienced team of professionals is ready to tackle any air moving challenge and offer solutions that best meet our customer needs. Our investments in R&D projects lead to innovative technologies that set new industry standards.

With a comprehensive portfolio of more than 15,000 products, we offer the right solution for almost every air technology and drive engineering task. Our markets include Agriculture, Air-conditioning, Alternative Energy, Appliance, Automotive, Commercial Refrigeration, Data Center, Heating, Industrial & Medical, IT/Telecom, LED, Transportation, and Ventilation. Product offering also consists of integrated assemblies that incorporate components for fan trays and blower boxes, as well as client-based contract manufacturing requirements