KONČAR

MOTORS AND ELECTRICAL SYSTEMS

Cooling Technology Upgrades with **EC FANS**

Revolutionizing Transformer Cooling: EC Motors Advantage

Electronically Commutated (EC) fans represent advanced cooling technology, offering exceptional efficiency. Unlike traditional AC fans, EC fans feature integrated variable speed drives and advanced motor control, enabling precise regulation of speed and airflow. This results in optimized performance, reduced energy consumption, and improved operational efficiency. With their streamlined design and innovative electronics, EC fans have become the preferred choice for a wide range of cooling applications from HVAC systems to industrial equipment. They embody the future of thermal management by combining reliability, energy efficiency, and environmental sustainability. In the field of transformer cooling, our EC motors based on synchronous reluctance technology are redefining efficiency and reliability. Unlike magnet-based alternatives, such as Permanent Magnet Synchronous Motors (PMSMs), these motors generate torque through magnetic reluctance, achieving optimal performance with minimal energy usage and without relying on rare earth materials.

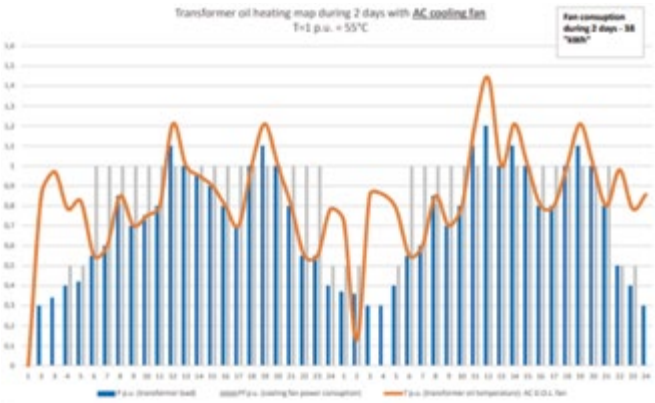
Synchronous reluctance motors offer several advantages over magnet-based counterparts:

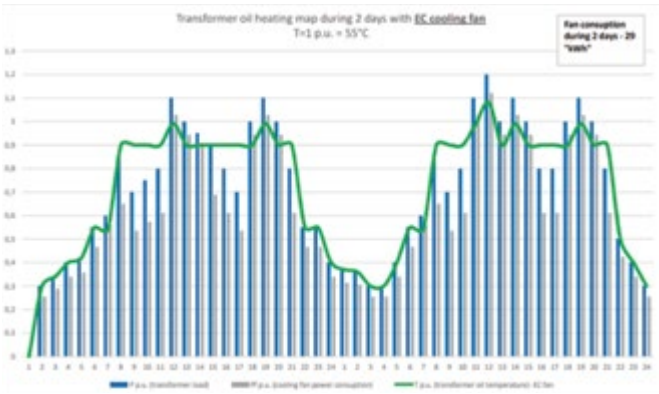
- Firstly, they eliminate the need for magnets, reducing potential supply chain dependencies. This not only streamlines manufacturing but also enhances environmental sustainability by reducing reliance on rare earth materials
- Synchronous reluctance motors exhibit superior thermal performance. Without magnets, they are less prone to demagnetization at high temperatures, ensuring consistent performance and longevity even in demanding operating conditions. This reliability translates into reduced maintenance requirements and enhanced operational uptime for transformer cooling systems
- Simplified maintenance, particularly for bearing replacement, due to their streamlined design similar to that of standard induction motor and absence of magnets, facilitating easier access and reducing downtime
- KONČAR - MES EC motors offer user-friendly design features, such as easy mechanical mounting and electrical connection at user applications. This streamlined process reduces installation time and costs, providing a competitive edge over cooling solutions from other manufacturers
- Integrated electronic drive provide precise control over speed, adapting seamlessly to varying cooling demands. This level of control allows for optimized energy efficiency and quieter operation
- Integration of EC motors with synchronous reluctance technology on our fans retains all other benefits from the standard fan program, including the possibility of IP66 protection, safeguarding against dust and water ingress for added durability in harsh environments and includes wide temperature range of -30°C to +55°C, ensuring reliable operation in diverse environmental conditions

CASE STUDY – TRANSFORMER COOLING OPTIMISATION

Temperature plays a critical role in determining a transformer's operational lifespan. Elevated temperatures are a leading cause of insulation degradation, which directly contributes to premature transformer failure. The insulation system is often the weakest link compromised by factors such as overloading, moisture ingress, substandard insulating materials, and extreme thermal conditions. A properly sized, installed, and maintained transformer is typically designed to operate for 20 to 30 years at its rated (nameplate) load. However, consistent operation above the nameplate rating significantly accelerates thermal aging, reducing service life. This case study presents a comparative analysis of transformer cooling using conventional AC fan systems versus the latest EC (Electronically Commutated) fan technology.

Case of cooling 100MVA transformer with comparision of AC and EC cooling fans





Key benefits of EC cooling compared to conventional AC cooling:

LOWER TRANSFORMER OPERATING TEMPERATURE

EC fan technology ensures that transformer temperatures remain consistently below nominal thresholds. As demonstrated in the comparative graph, EC cooled systems maintain a lower average temperature than their AC counterparts. By precisely modulating fan speed and airflow based on thermal demand, EC fans enable smoother and more accurate temperature control. This results in overall temperature reductions of 15–20%, significantly minimizing thermal stress on critical components.

STABILIZED THERMAL CONDITIONS

Unlike conventional cooling systems that may cause abrupt temperature fluctuations, EC cooling provides a stable thermal environment. This minimizes the risk of condensation, mechanical fatigue from thermal expansion and contraction, and degradation of sensitive components, factors that can otherwise shorten equipment lifespan.

HOT SPOT MITIGATION

Thanks to continuous and adaptive cooling, EC fans prevent "hot spot" formation within the transformer. Traditional systems often rely on threshold-based activation, potentially leaving low-load transformers momentarily uncooled. In contrast, EC cooling maintains constant airflow, ensuring uniform heat dissipation and protecting vulnerable insulation zones from localized overheating.

ENHANCED OVERLOAD HANDLING CAPACITY

During overload conditions, EC fans demonstrate superior thermal management. For instance, a 20% overload results in only a 10% temperature increase with EC cooling compared to a 45% rise under AC cooling. Moreover, EC fans can be selected with variable airflow capabilities, allowing customization for anticipated overload scenarios without compromising nominal load efficiency. This adaptive response supports improved transformer resilience during peak demand.

SIGNIFICANT ENERGY SAVINGS

Energy efficiency is a core advantage of EC fan systems. Leveraging high-efficiency IE4/IE5 motor technology, EC fans can reduce power consumption by up to 30% compared to traditional AC fan systems. This translates into measurable cost savings and improved sustainability over the operational lifecycle.

IMPROVED TRANSFORMER EFFICIENCY

Lower core temperatures reduce copper losses by 15–20%, directly enhancing transformer efficiency. Combined with the lower energy draw of EC cooling systems, this contributes to a higher overall efficiency rating, aligning with modern expectations for high-performance, energy conscious equipment.

EXTENDED TRANSFORMER SERVICE LIFE

Above all, consistent thermal management extends transformer longevity. By reducing thermal cycling, eliminating hot spots, and improving insulation stability, EC cooling technology significantly increases the operational lifespan of power transformers, delivering long-term reliability and value.

In conclusion, EC motors utilizing synchronous reluctance technology represent a shift in transformer cooling, boasting unparalleled efficiency and reliability. By eliminating the need for magnets and delivering superior thermal performance, they ensure consistent operation even in the most demanding conditions. Simplified maintenance, user-friendly design, a wide operating temperature range, and integrated control capabilities position them as a forward looking, high-performance solution for next generation transformer cooling systems.

KEY BENEFITS:

- **ENHANCED EFFICIENCY**
- **LOW NOISE OPERATION**
- **CONSISTENT RELIABILITY AND LONG-TERM DURABILITY**
- **SIMPLIFIED MAINTENANCE**
- **USER-FRIENDLY DESIGN**
- **EASY MOUNTING AND CABLE CONNECTION**
- **WIDE OPERATING TEMPERATURE RANGE**
- **SUPPLY CHAIN RESILIENCE**
- **ENVIRONMENTAL SUSTAINABILITY**
- **ADVANCED SPEED AND AIRFLOW CONTROL**
- **PROTECTION AGAINST DUST AND WATER**

Synchronous reluctance motors offer optimal performance with minimal energy consumption, leading to significant cost savings and reduced environmental impact.

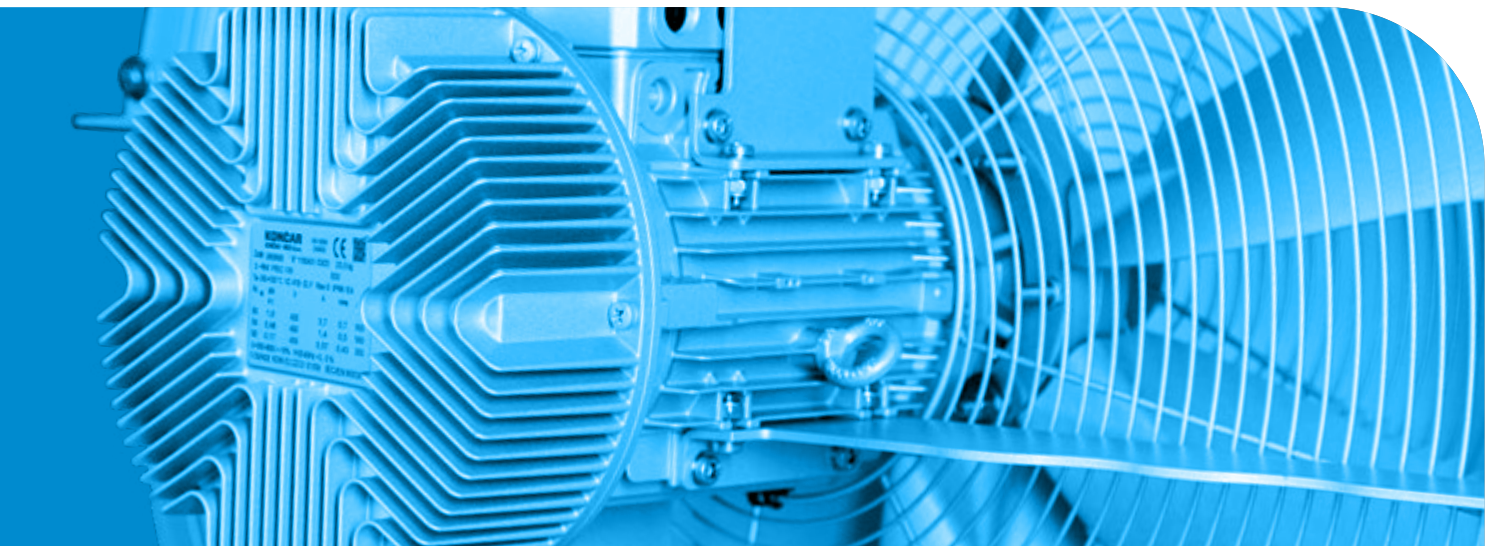
These motors exhibit superior thermal performance, ensuring consistent operation even in demanding conditions and minimizing the risk of downtime.

With a streamlined design and absence of magnets, maintenance tasks, such as bearing replacement, are easier to perform, reducing downtime and associated costs. Regular maintenance can be performed in any electric motor workshop or by onsite maintenance department.

Easy mechanical mounting and electrical connection at user application, simplifies installation and reduces time and cost.

Integrated electronic drive provide precise control over speed, allowing optimized energy efficiency and adaptability to varying cooling demands.

In addition to the benefits already outlined, in-house production of our complete fan assemblies provides a significant advantage in terms of quality assurance. By managing the entire process from manufacturing and assembly to final testing, we maintain full control over every stage of production. This end-to-end oversight ensures that each component meets our stringent quality standards, resulting in highly reliable and high-performing EC motors and fans. Ultimately, this level of control reinforces customer confidence in the durability, consistency, and long-term value of our transformer cooling solutions.



TECHNICAL CHARACTERISTICS:

- 3x 380-480V~, +-10%
- 50-60Hz, +3% -5%
- -30/+55°C (option -40/+60°C)
- Speed (airflow) regulation 0-10V input
- Speed (airflow) regulation over modbus
- Standard fixed speed operation (without airflow regulation)
- IP66 mechanical protection
- Without additional noise from EC motor VSD
- Integrated motor overcurrent protection
- 100-950rpm VAAZ 800 (0.9 - 7.4 m3/s)
- 100-700rpm VAAZ 1000 (1.5 – 10.8 m3/s)
- Up to C5M-h
- Space saving integrated VSD
- Easy instalation

Voltage Compatibility: Operating seamlessly within the range of 380-480V~, with a tolerance of +-10%, ensuring stable performance even amidst fluctuations in power supply.

Frequency Flexibility: Adaptable to power systems operating at 50-60Hz, with frequency range tolerance of +3% to -5%, guaranteeing precise synchronization with varying grid frequencies.

Variable Speed Options: Tailor airflow precisely to requirements with speed ranges from 200 to 950rpm for VAAZ 800 (1.5 - 7.4 m3/s) and 200 to 710rpm for VAAZ 1000 (3 – 10.8 m3/s), providing optimal cooling efficiency across a wide range of transformer sizes.

Temperature Resilience: Functioning reliably in extreme temperatures ranging from -30°C to +55°C, with the option for enhanced resilience in harsh climates with an extended temperature range of -40°C to +60°C.

Versatile Regulation: Flexible airflow regulation through either 0-10V input or modbus interface, allowing for precise adjustment of cooling performance according to operational demands.

Mechanical Protection: Ensuring durability and longevity with standard IP66 mechanical protection, safeguarding against dust and water ingress even in challenging environments. Our transformer cooling solution offers unparalleled versatility and reliability, empowering your infrastructure with efficient and robust thermal management capabilities.

VAAZ EC 800 control characteristic

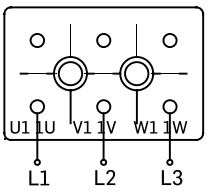
n (1/min)	Q (m3/s)	Pstat (Pa)	P1 (kW)	Ir (A)	Lwa5 dB(A)	Lwa dB(A)	Lpa dB(A)
950	7,4	170	1,78	3,72	89	92	74
720	5,7	95	0,842	2,13	80	83	65,5
580	4,5	65	0,48	1,384	74,5	77,5	59,5
480	4	45	0,31	0,958	69	72	54,4
350	2,9	25	0,17	0,572	61	64	46,6
150	1,3	10	0,085	0,31	48	51	34
100	0,9	5	0,078	0,29	45	48	31

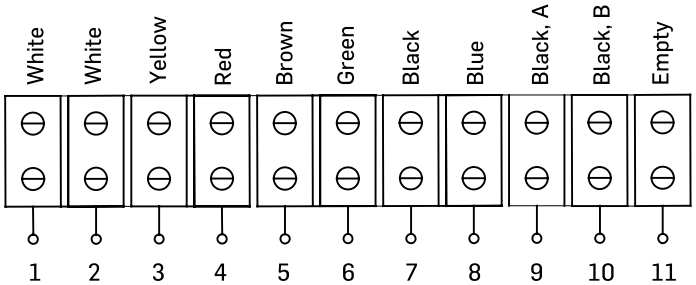
VAAZ EC 1000 control characteristic

n (1/min)	Q (m3/s)	Pstat (Pa)	P1 (kW)	Ir (A)	Lwa5 dB(A)	Lwa dB(A)	Lpa dB(A)
700	10,8	155	2,7	5,183	90	93	75
570	8,7	100	1,471	3,192	83	86	69
480	7,3	75	0,956	2,331	78	81	63
350	5,4	55	0,428	1,27	70	73	55
300	4,5	45	0,3	0,917	66	69	51
150	2,25	17	0,111	0,37	51	54	37
100	1,5	10	0,084	0,31	48	51	34

CONNECTION DIAGRAMS

380-480V +-10%
50/60Hz +3, -5%



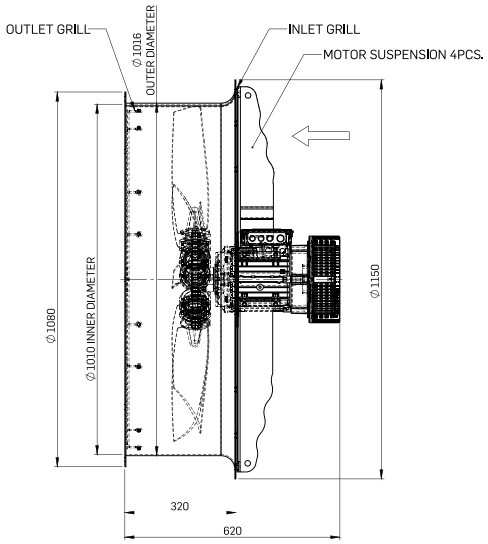


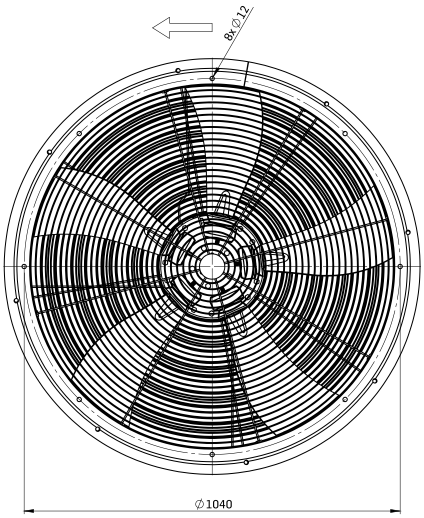
1-2 - Status relay
3 - 24VDC output
4 - 10VDC output
5 - Digital input 1 - START/STOP
6 - Analog input 0-10V
7 - Digital input 2
Emergency max airflow.
8 - GND
9 - MODBUS RTU A
10 - MODBUS RTU B
11 - Insulated terminal.
For MODBUS cable shield.

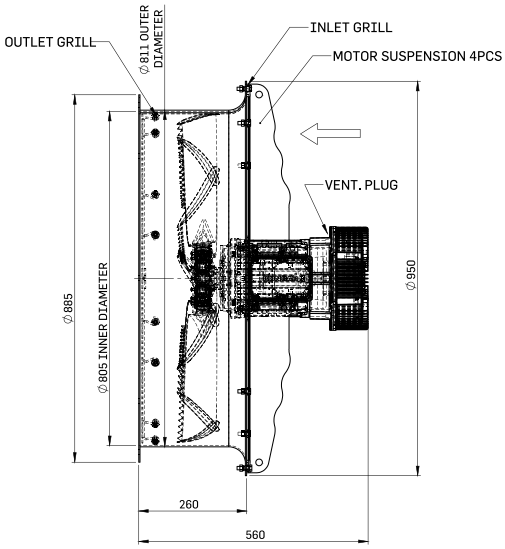
COMPLETE TEMPERATURE CONTROL SOLUTION

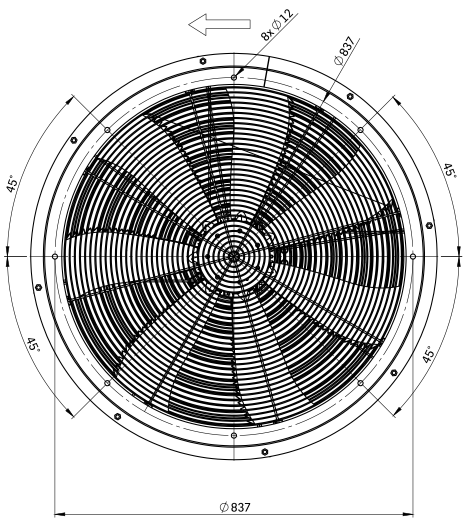
In addition to our high-efficiency EC fans, we offer preprogrammed PLCs with dedicated software for intuitive cooling control and fast setup, eliminating the need for complex programming or custom configuration. For a fully integrated solution, we also provide preassembled electrical cabinets equipped with all essential control components. Additional elements can be included based on specific customer requirements.

MECHANICAL DIMENSIONS

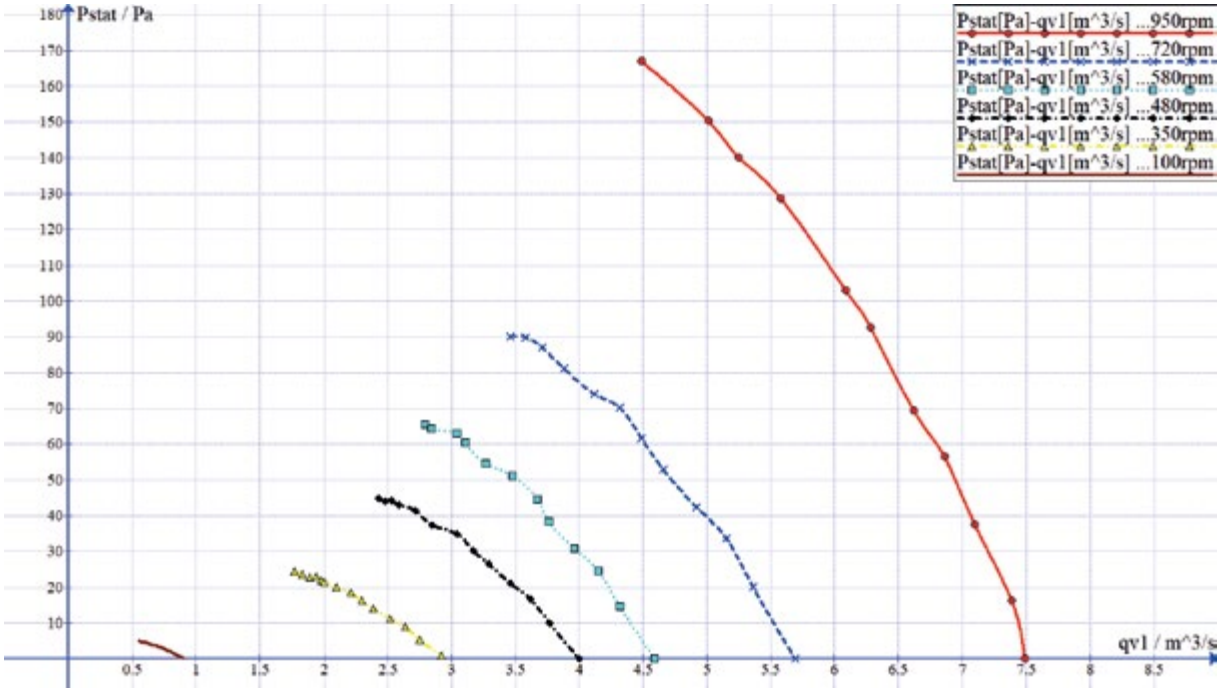




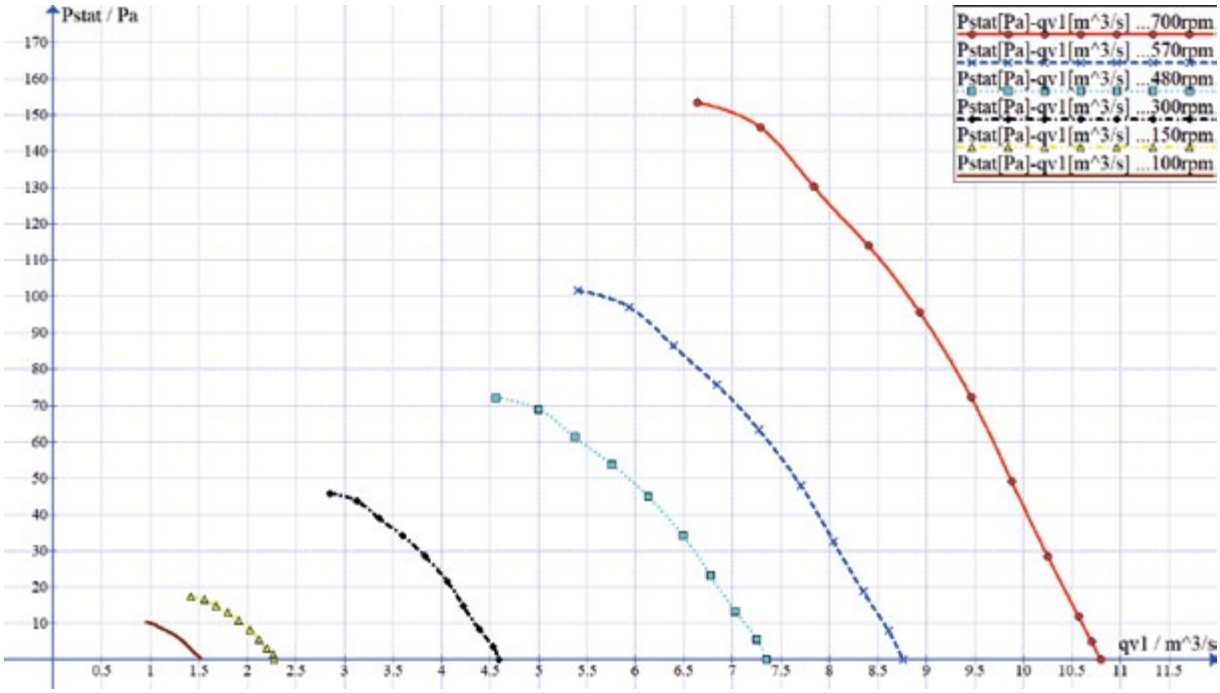


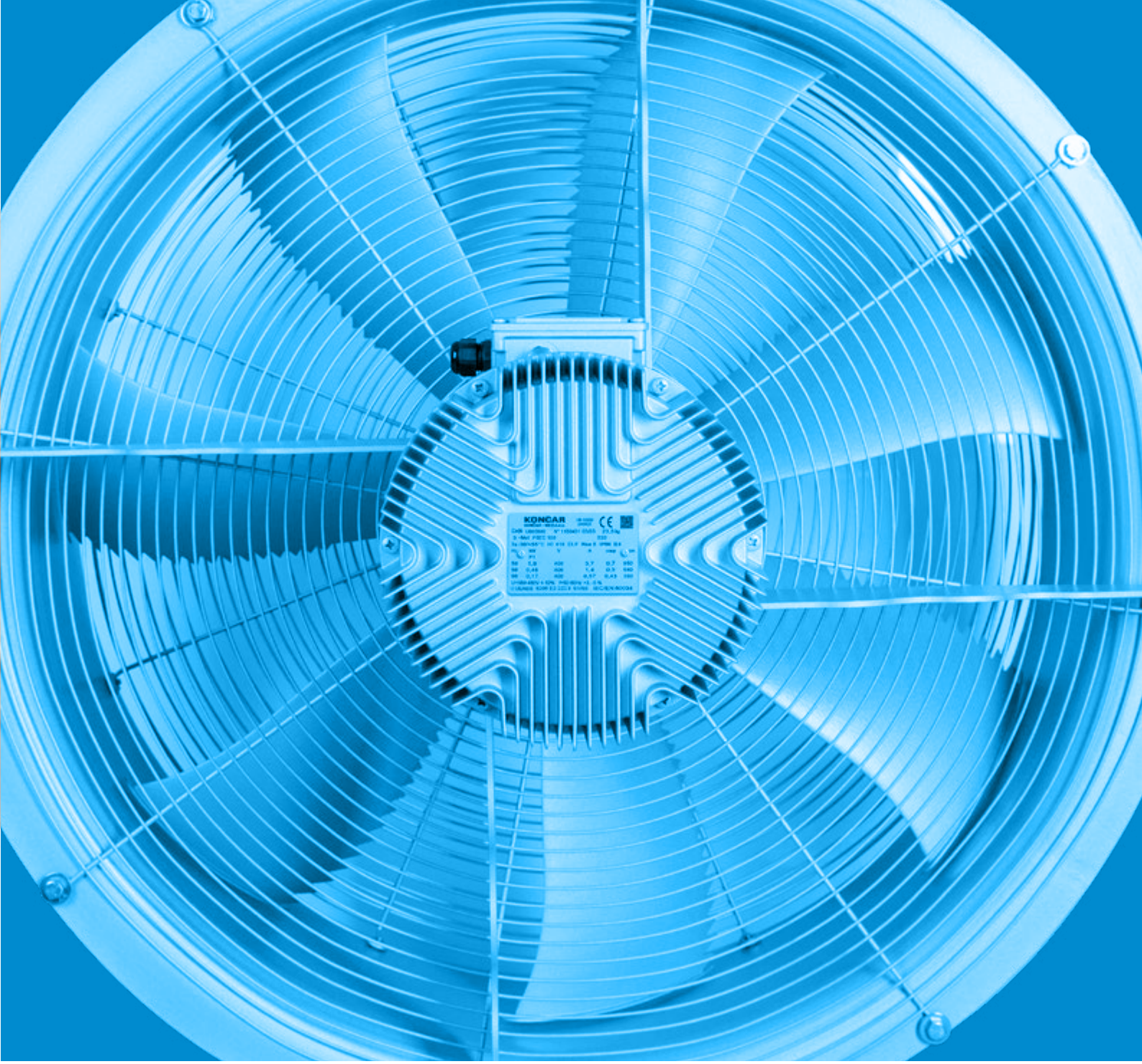


PERFORMANCE CURVES EC FAN 800



PERFORMANCE CURVES EC FAN 1000





KONČAR

MOTORS AND ELECTRICAL SYSTEMS

Fallerovo šetalište 22
HR-10000 Zagreb

SALES

Tel. +385 1 3667 278
E-mail: mes-export@koncar.hr; mes-sales@koncar.hr

www.koncar.hr/en/koncar-motors-and-electrical-systems

DIZAJN: www.michel.hr
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