ebmpapst

engineering a better life

Fan technology *for the air conditioning and ventilation industry.*

Convince with real values.

AR

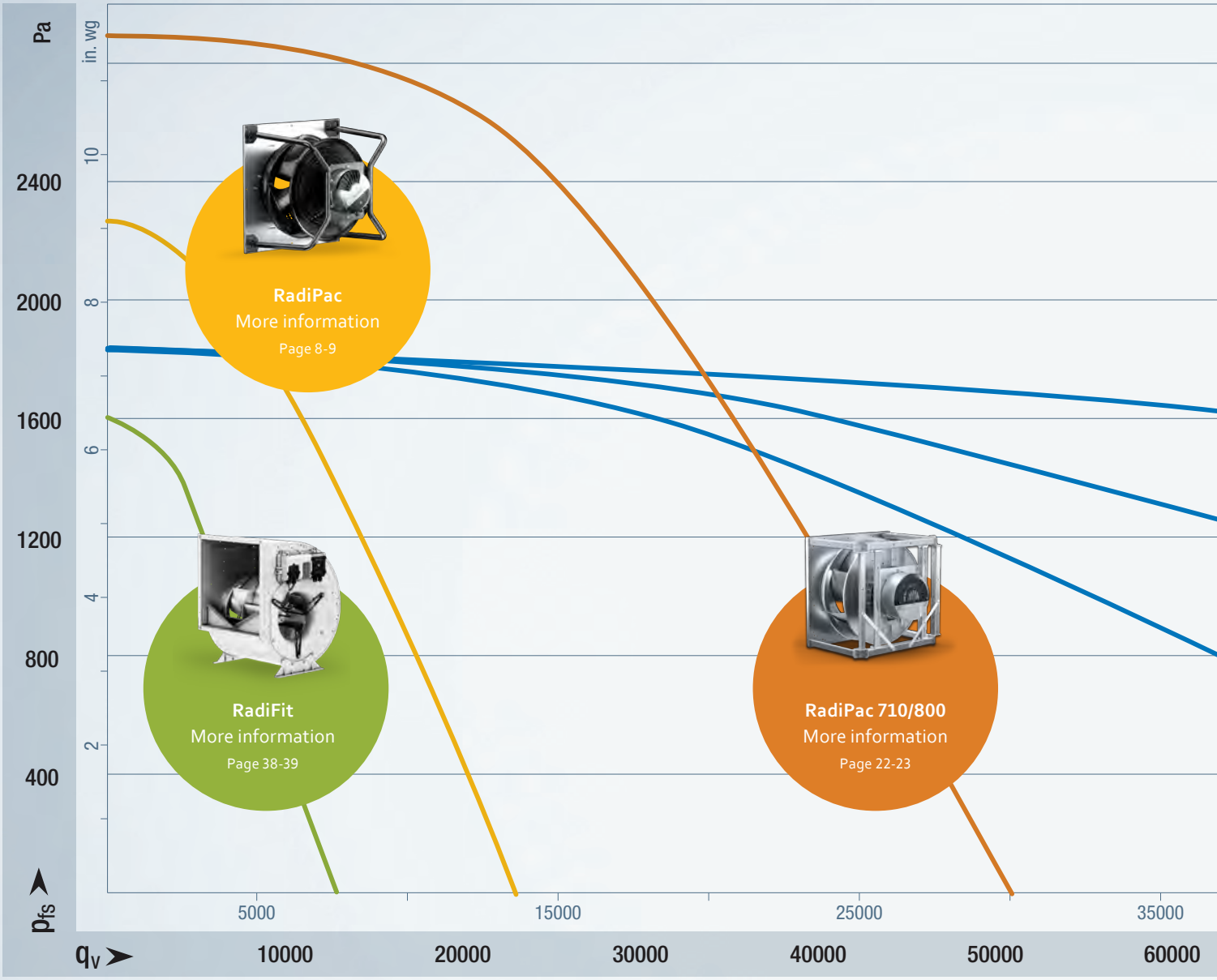
Augmented Reality
Content Inside

Content

First-class performance
right down to the last detail.

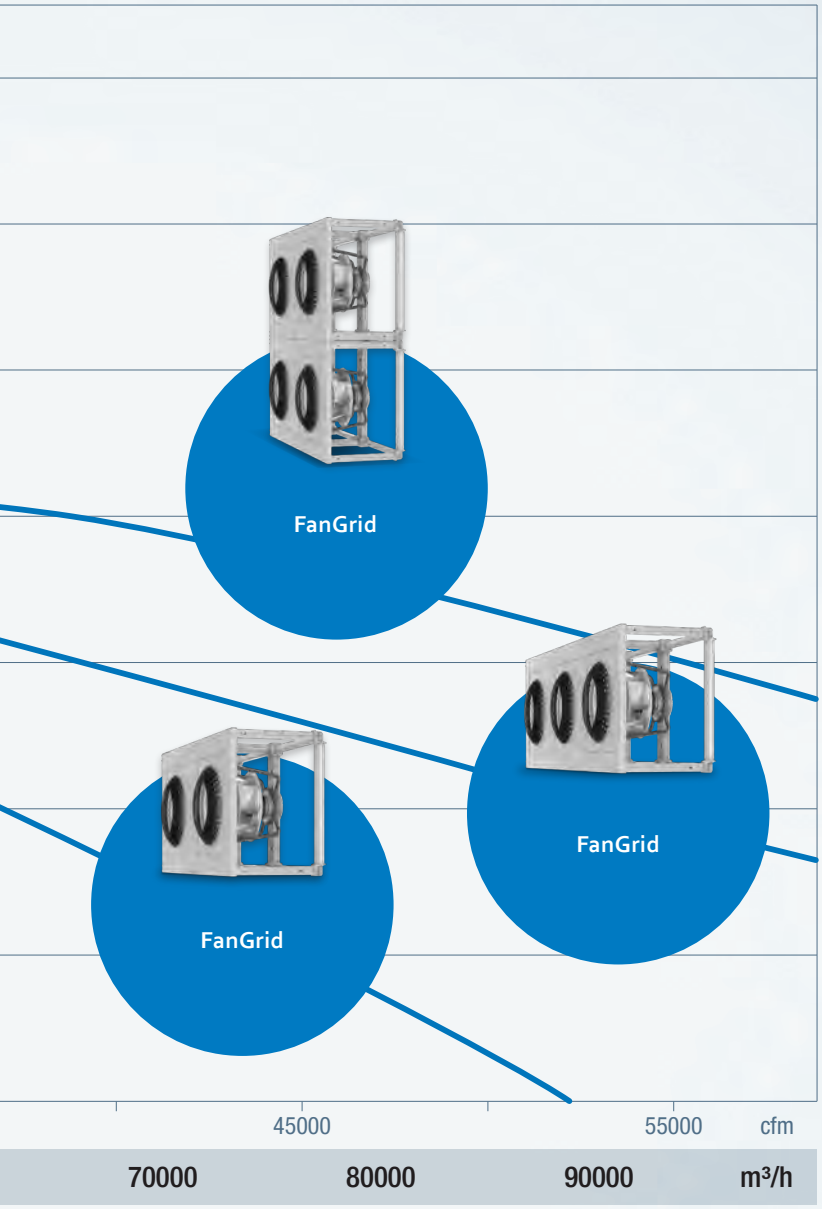
Performance is one of those things. You can only really judge it in relation to something else. Just how powerful is a person, a company, or a fan really? The only way to obtain answers with true value and meaning is to make comparisons, create authentic conditions, and, most importantly of all, to take precision measurements. We at ebm-papst are renowned for doing exactly that. From the very first and right through to the last stage of development and production. That is how we ensure top quality throughout the entire value chain. We prove our abilities and expertise. And lay a solid foundation for a lasting relationship of trust with our customers who know they can always rely on us and grow with us. Both today and in the future.

A quick overview.



The RadiPac is the ventilation technology benchmark. These elements set it apart:

- Air flows up to 40,000 m³/h and pressures over 2,500 Pa (without FanGrid)
- Simple plug & play, as the electronics and motor form a unit and are perfectly coordinated
- Sizes 250 to 1000
- Electronics with configurable control interface for analog and digital signals
- GreenTech EC motor with an equivalent efficiency level to the IE5 without rare earths



Bring ebm-papst to life – *with augmented reality.*

1. Install the app
Install the free ebm-papst Xplore app from the relevant app store. Simply search for the "ebm-papst Xplore app" and download the "Fan technology" module on the app.

2. Scan the images
Point the camera at the images that are marked with this icon and then of we go!

Designing *the future.*

1954
Centrifugal blowers
Belt drive

1974
Backward-curved
Belt drive

1990
Backward-curved
Direct drive
Speed control

2005
ebm-papst plug fan
Direct drive
EC technology

2010
RadiPac with diffuser
Direct drive
EC technology

The performance requirements in the ventilation technology sector have always been changing. Since the 1950s, when the amount of power required to move air at a rate of 10,800 m³/h (3 m³/s) with a back pressure of 1,000 Pa was still around 7.5 kW, the figure has dropped considerably. And then industry-standard, belt-driven centrifugal blower fans, powered by 1, 2 or 3-speed asynchronous motors and with swirl and restrictor plates to vary the air volume, have been replaced by other drive and fan concepts over the course of time.

In Europe, the advantages of direct-drive freewheel centrifugal fans were recognized in the 1990s. Their popularity was also promoted by the fact that they became more affordable as a result of the refinement of variable frequency drive technology for speed adjustment. The outcome was a drive power of around 6 kW to convey the volume of air mentioned above.

EC technology appears on the scene
In 2005, ebm-papst started combining GreenTech EC motors with standard centrifugal impellers with backward-curved blades. The results were impressive, even back then: a range of EC freewheel fans capable of moving the reference air volume with a power of around 5.5 kW. The next stage of development saw the improvement of the aerodynamics of the impellers, enabling the first generation of the RadiPac product range to get down to a drive power level of 5 kW. The development of a new, high-efficiency impeller with airfoil blades and improvements to the EC motor drive gave rise to the market launch of the second generation RadiPac product range in 2014.

The RadiPac product range has now entered its third generation, setting new efficiency benchmarks with 4.0 kW – with even more compact dimensions. Thanks to the aerodynamically optimized impeller, the latest RadiPac achieves air flows of up to 20,000 m³/h and pressures of more than 2,000 Pa. And it comes with a configurable control interface and MODBUS RTU as standard.

2014
RadiPac with Airfoil blades
Second Generation
FanGrid module

2022
RadiPac C
Third Generation
Impeller made of
composite material

2023
RadiPac C Perform
Third Generation

EC drive motors with integrated speed control, compact installation dimensions, simple connection, and straightforward commissioning round off this state of the art fan concept.

And we are not finished yet
ebm-papst is already working on ideas for the fan of the future, and has come up with ways of enhancing the efficiency levels still further. Curious? Then get in touch with us!

Bring the timeline to
life with our app.
Scan and start the video.

AR

If you have any questions, please contact:

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It's the benchmark **right down to the last detail.**

The RadiPac product range is a real complete package: ready for mounting, with control electronics that are perfectly coordinated with the motor and are easy to install and put into operation. The infinitely variable speed control typical of EC motors makes it possible to adjust the fan power to exactly the level required.

Impeller

High static efficiency
+ Innovative geometry reduces flow losses
+ Wavy cover plate for the best possible air flow rate

Low noise emissions
+ Optimum outflow characteristics

Low vibration
+ Dynamic balancing reduces bearing load

Robust design
+ Glass-fiber reinforced composite material
+ Permanently high circumferential speeds

Inlet ring

Pre-installed
+ Optimized positioning of nozzle at the factory
+ Pressure tap for air flow control as standard

Low losses
+ Optimized impeller inflow

FlowGrid

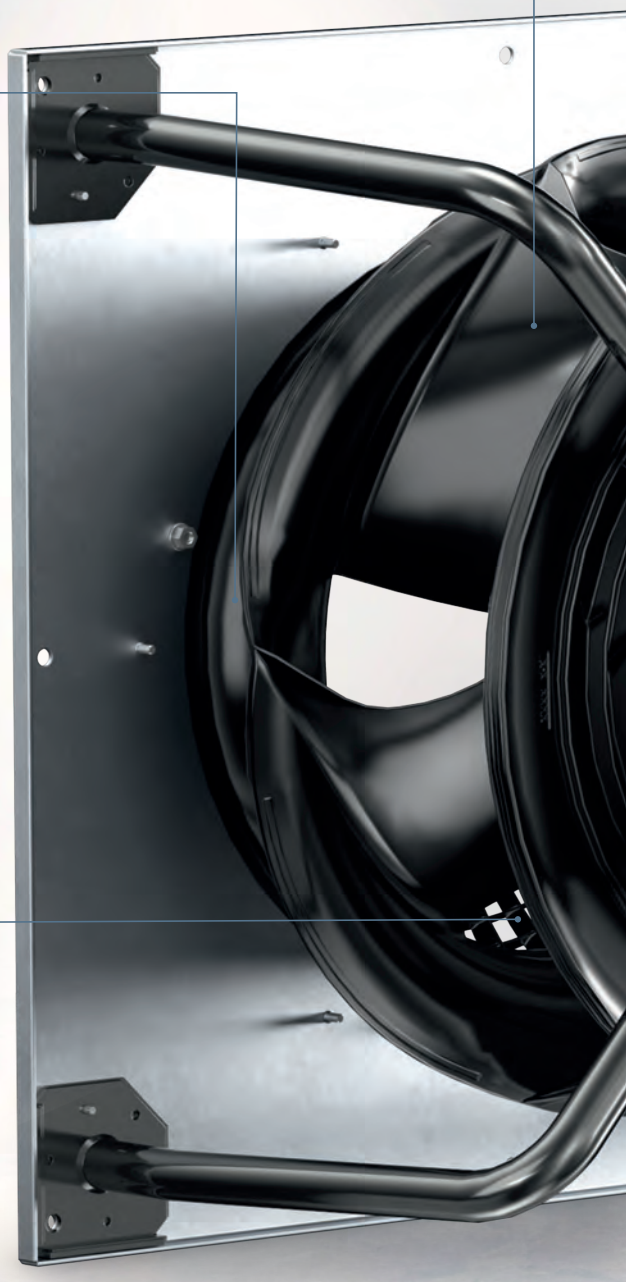
Reduced noise spectrum
+ Low noise level
+ Dramatically dampened blade passing noise
+ Without loss of air performance or efficiency

Compact design
+ Small footprint
+ Fewer insulation measures

Quick installation
+ Through-holes for easy attachment
+ Customized attachments on request

Robust design
+ Resistant composite material

Guard grill function
+ Optionally as a closed version



GreenTech EC motor

Unbeatably compact
+ Impeller directly on motor rotor

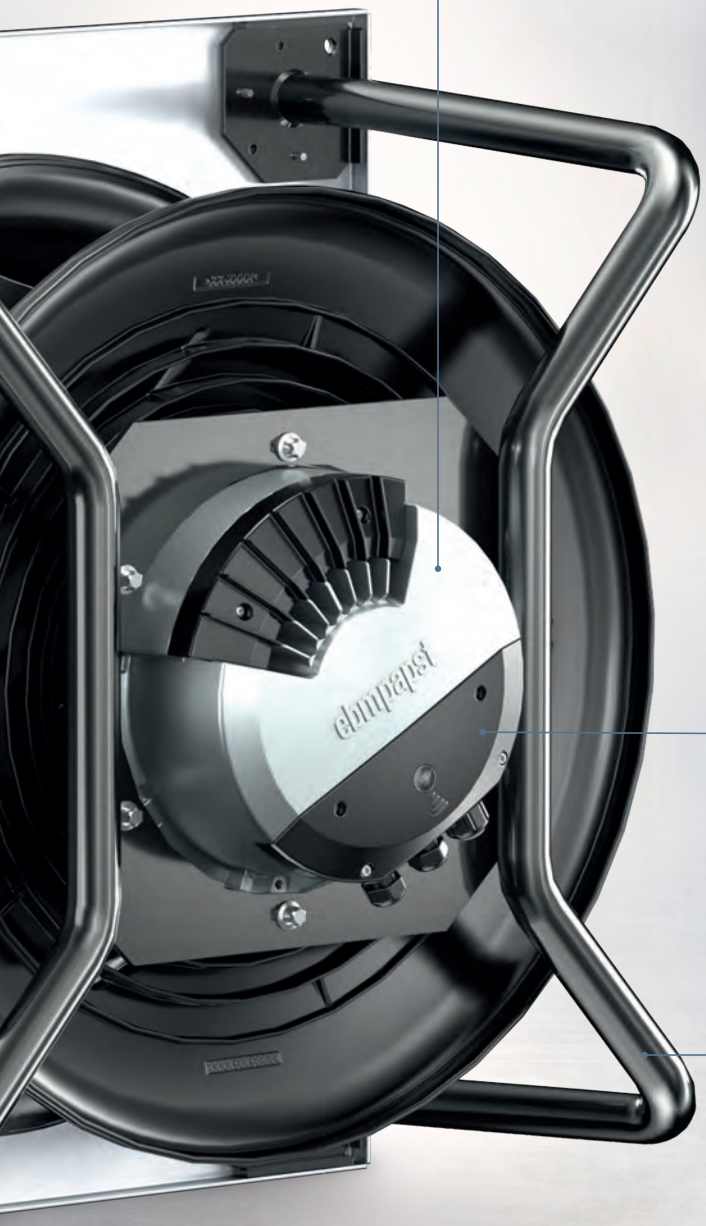
High efficiency
+ Low copper and iron losses
+ Synchronous running prevents slip losses
+ No magnetic hysteresis losses

Economical operation
+ Partial-load operation up to 1:10 at high efficiency

Long service life
+ Maintenance-free bearings
+ Brushless commutation

Safe operation
+ Insulated bearing system

Sustainable
+ Magnets without use of rare earths



Electronics and connection area

Adaptable
+ Configurable control interface
+ Control signal 0–10 VDC and MODBUS RTU
+ Smoothly adjustable speed
+ Active PFC (power factor correction)

Universally deployable
+ Suitable for 50- and 60-Hz grids

Increased operational reliability
+ Integrated resonance detection
+ Integrated locked-rotor and thermal overload protection
+ Environment-resistant cable glands

Simple commissioning
+ Central terminal area separated from electronics
+ No programming effort

Support plate/support bracket

Robust sheet metal design
+ Sendzimir galvanized sheet steel

Simple installation in AHU
+ Complete, ready-to-install system
+ Compactness enables new design flexibility

The RadiPac *that protects itself.*

The challenge:
Centrifugal fans are used in various ventilation units and air conditioners. Depending on the installation situation, previously unforeseeable speed ranges may result in increased vibration levels in the resonant range. There are many reasons for this: a high residual imbalance (e.g. caused by transport and handling), changes in vibration behavior after installation in the customer's unit, and dirt adhering to the impeller. If the fan is operated frequently at excessive vibration levels, the bearings can be damaged and premature failures may occur. Although these vibrations can be measured during commissioning of the system, they cannot simply be eliminated.

The solution:
Vibration sensors in the RadiPac centrifugal fans detect the resonance, and the software prevents operation in the detected critical ranges. A test start-up is activated during commissioning. Here, the fan analyses the vibration severity across the entire speed control range and suggests the ranges to be suppressed that have too high a vibration velocity. With simple confirmation, these critical speed ranges will be "passed over" in future operation.

One example:
In its as-delivered condition, every RadiPac centrifugal fan has its own resonant response which can be induced by the unavoidable residual imbalance. (Fig. 1 shows a RadiPac with the typical unique resonance characteristic.) If the fan is to be installed in a ventilation unit, this resonant frequency range may shift, and/or the vibration may increase to an impermissible level. Constant operation in an impermissible range could lead to premature failures (Fig. 2).

The vibration levels can also increase during continuous operation, for example due to dirt on the impeller and the resulting additional imbalance. It is exactly here that the innovative self-detection software of the RadiPac centrifugal fans takes center stage. The operator selects the commissioning routine during initial commissioning. In this procedure, the fan is started up from standstill all the way up to the nominal speed, and the vibration velocity is measured. If the software detects critical vibration velocity ranges, it suggests those speed ranges for suppression. This means that the ranges are passed through, but continuous operation in them is avoided (Fig. 3). Vibration induced by nearby equipment, such as compressors or condensers, can be detected but not avoided (Fig. 4).

Full control
The ebm-papst EC-Control software includes everything you need for commissioning, condition monitoring and vibration analysis. That being said, you can adjust all settings manually, determine your own speed range values for suppression and define subsequent actions.

The most important functions at a glance:
- Simple status monitoring and vibration analysis
- Easy determination of resonant frequencies and suppression of critical speed ranges
- Warning of imbalance

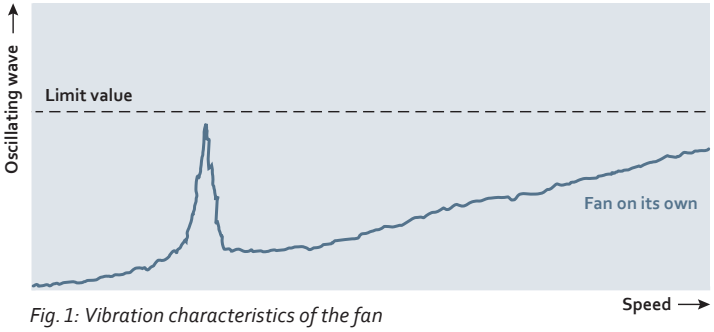


Fig. 1: Vibration characteristics of the fan

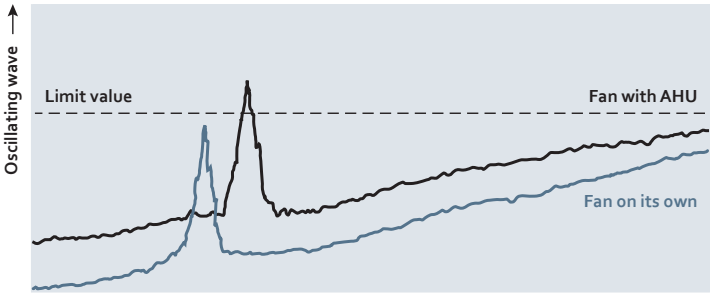


Fig. 2: Vibration characteristics in the AHU

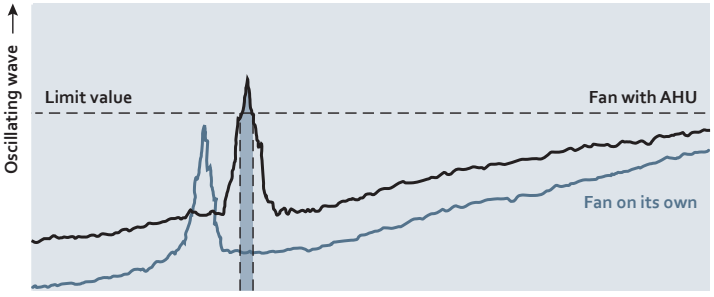


Fig. 3: Vibration behavior with speed range that has been omitted

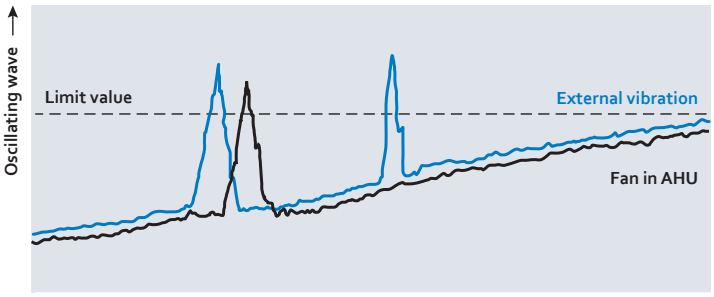
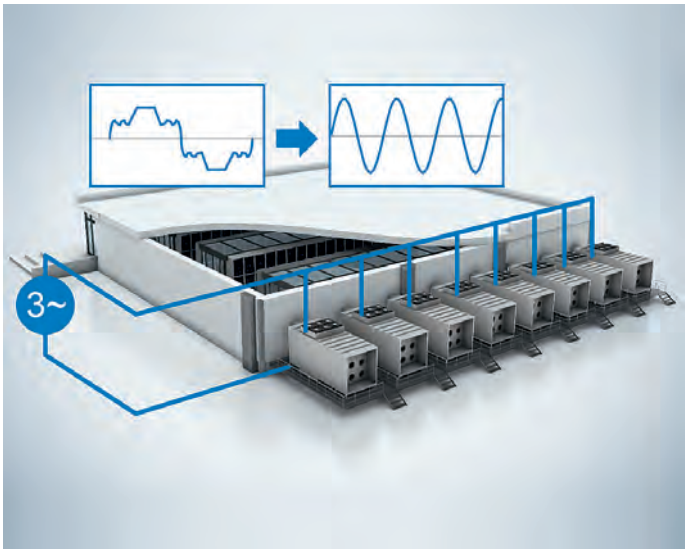


Fig. 4: Vibration characteristics in the AHU with additional external vibration source, e.g. compressor

Minimizing harmonics:
3-phase active PFC.



Minimizing disruptive harmonics
When operating speed-controlled drives, regardless of whether it's an AC/PM motor with variable frequency drive or EC drives, current harmonics are produced in principle. In conjunction with an insufficiently dimensioned power supply, these current harmonics can lead to problems in critical infrastructures. To reduce these current harmonics, appropriate measures must be introduced for the appropriate application.

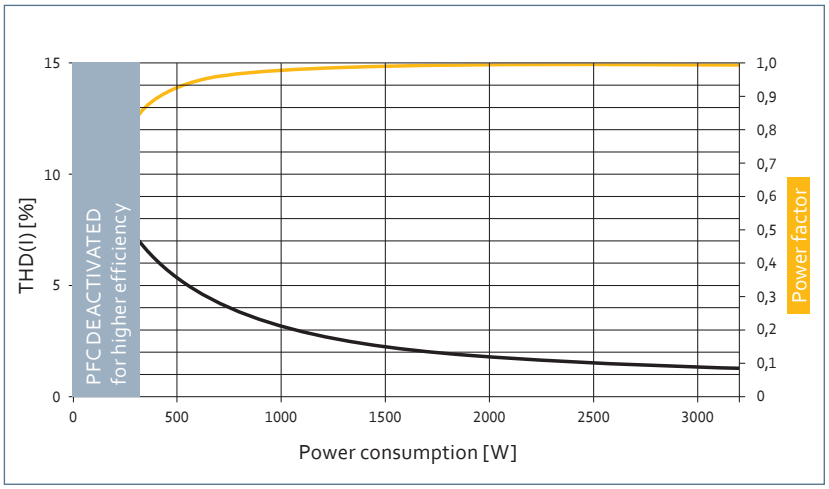
Good news: all external measures are now no longer required. To prevent disruptive harmonics from occurring in the first place, ebm-papst has developed a solution in which the harmonic filter is already integrated: the 3-phase active PFC (power factor correction). Infrastructure components for energy and emergency power supply, e.g. transformers or emergency power generators, can be designed to be smaller and thus more cost-effective. This a topic of particular importance in connection with FanGrid applications or precision air-conditioning units in data centers.

ITEM NUMBER	ACTIVE PFC	INDUSTRY STANDARD
System costs	€ 809,595	€ 809,595
Active PFC fans	+ € 66,000	-
Transformer	+ € 125,000	+ € 187,500
Generator	+ € 380,000	+ € 1,216,000
Total	€ 1,380,595	€ 2,213,095
Saving in €		**€ 832,500**
Saving in%		**37.6%**

Potential for savings when designing a data center
In order to illustrate the potential for savings due to ebm-papst 3-phase active PFC fans, the costs of the industry standard solution were compared to the costs of the 3-phase active PFC fans when designing a data center. In one case, a data center with an IT load of 3 MW was designed with 220 standard fans for cooling, while, in a second case, the same number of 3-phase active PFC fans were used. On account of higher THDU and THD(I) values with the standard solution, it was necessary to greatly overdimension the transformer and the emergency power generators in comparison with the 3-phase active PFC fans in order to avoid exceeding the permissible limit value framework for voltage harmonics.

By altering the design of the data center, it proved possible to significantly cut the costs. The table below compares the costs for both solutions. It becomes apparent that the additional expense for the 3-phase active PFC fans is more than offset by being able to downsize the transformers and generators. In the final analysis, this resulted in a total saving of €832,500 corresponding to around 38% lower costs.

Factors not taken into account in the calculation
The increased amount of space required for an overdimensioned system and the associated construction costs and, if necessary, rental costs were not taken into account in the calculation. In the case of 3-phase active PFC fans, smaller dimensioning of cables and switchgear is possible. So in real terms the cost savings are even higher!



Current harmonics

The result: THD(I) ≤ 5% over a broad power range.

THD(I) stands for Total Harmonic Distortion of Current and indicates the amount of current distortion. The value is defined as the quotient (in%) of the effective value of the harmonic currents relative to the fundamental.

More information in the white paper:
Scan the code or visit
ebmpapst.com/aktivpfc

Setting *standards.*

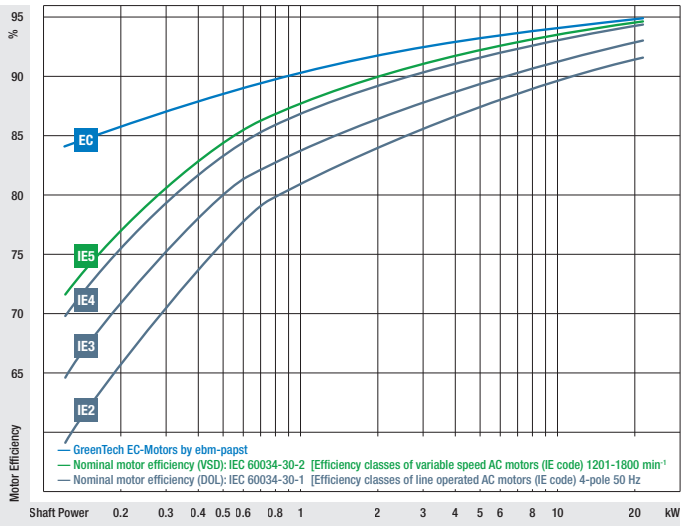
The best way to gain an impression of how fan construction has developed is to take a look at the RadiPac product range. It has long since become established in ventilation and air conditioning applications and undergone significant improvements in terms of energy efficiency and noise emissions. Repeated aerodynamic enhancement has yielded a high level of impeller efficiency. Together with highly efficient EC motors that clearly surpass the requirements of efficiency class IE5 (as per IEC TS 60034-30-2:2016) for standard motors, this all adds up to the best freewheel fan units in the world: RadiPac.

Full utilization of potential energy savings
The high-performance impellers of the latest RadiPac generation C are made of high-performance, glass-fiber reinforced composite material, with the injection molding used enabling the complex shape. This blade geometry drastically reduces flow losses. The rounded flow contour at the blade inlet and the blade trailing edge, which tapers toward the back, contribute toward this. A wavy cover plate ensures the best possible air flow rate through the impeller. Further flow machine components like the inlet ring have been revised so that they work perfectly together.

Advantages for installation and transportation
From size 450 upwards, the fans also take the form of a mechanical cube design. This has clear benefits for the user in terms of installation, safe transportation and less packaging waste. It also permits simple floor-mounting with a horizontal or vertical motor shaft. For even quieter operation, the fan can be provided with rubber vibration-absorbing elements for isolation. Aside from a few exceptions, the sizes are available with the popular support bracket design for simple installation.

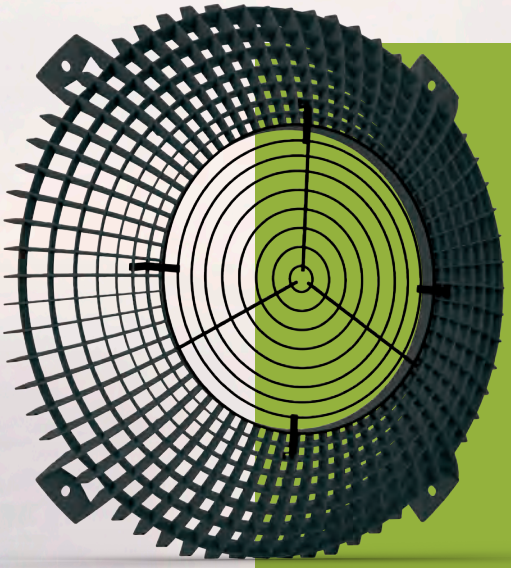
Simple commissioning
Practical experience has shown that modern EC fans have a far superior energy efficiency to the AC drives still frequently used in ventilation and AHUs. And commissioning the RadiPacs with GreenTech EC technology is easy too. Thanks to perfect coordination of the actuation electronics and EC motors, there is no need for costly adjustment work or for any extra grounding and shielding.

Ecologically sustainable operation
The ecodesign directive for fans (EU 327/2011) sets down minimum efficiency standards for fans driven by an electric motor. The directive applies to a drive power of between 125 W and 500 kW. An efficiency level is specified for each fan type. All EC fans from the ebm-papst RadiPac range exceed the relevant requirements, making them fit for the future.



ELECTRICAL POWER CONSUMPTION	MINIMUM EFFICIENCY
0.125 kW	42%
0.5 kW	48.3%
1 kW	51.5%
3 kW	56.5%
5 kW	58.5%
10 kW	62%

Minimum efficiency requirements for RadiPac EC centrifugal fans according to the ecodesign directive



Convincing! Reduction in sound pressure level and far less blade passing noise thanks to the FlowGrid air inlet guard. The additional guard grill prevents potential contact with the impeller.

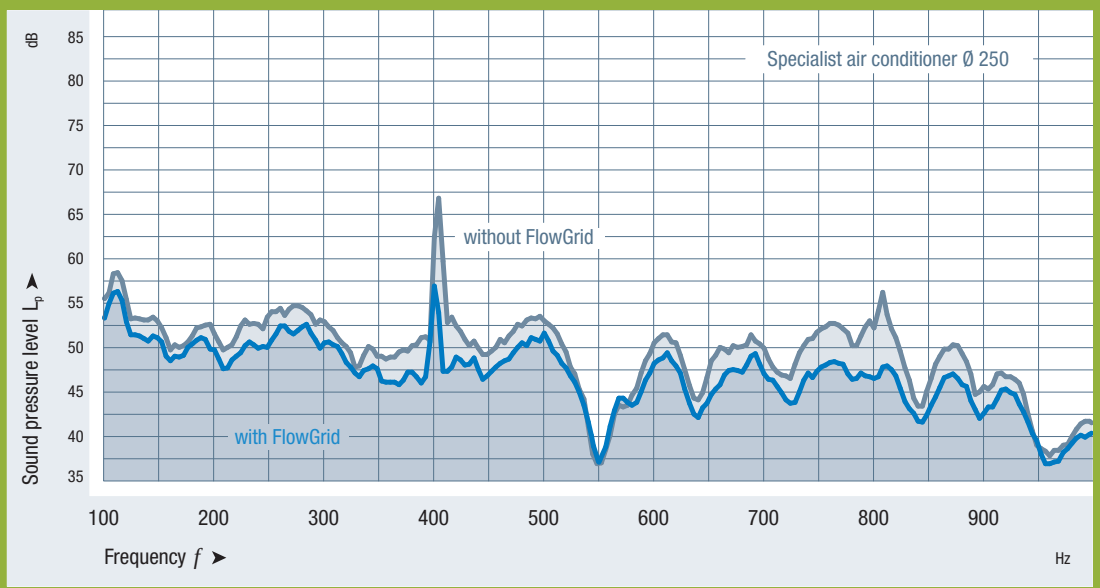
Optimizing
individual components.

ebm-papst's systematic approach does not stop the company closely scrutinizing every single product component. This enables ebm-papst to discover potential that might otherwise be overlooked - as the following examples prove.

Resource-preserving EC motor
The GreenTech EC motor developed by ebm-papst does a lot to help conserve resources and ensure a secure future supply. In contrast to other permanent magnets in internal rotor motors, this line-operated, permanently excited synchronous motor with electronic commutation (also known as BLDC or PM motor) provides a comparable level of efficiency without the use of rare-earth magnets. And so RadiPac is not just more efficient and user-friendly, it is also the most sustainable fan solution for AHUs from a single supplier.

The FlowGrid air-inlet guard that reduces noise
The confined space in the fan intake area often gives rise to greater or lesser degrees of turbulence. As such turbulence leads to a considerable increase in noise level, ebm-papst has developed a special air inlet guard that acts like a rectifier on the air intake. It drastically reduces the amount of noise-inducing turbulence in the intake flow. Whatever the structural conditions and installation situation in the housing, the fans then attain noise values that are almost comparable with operation under laboratory conditions.

Simple and safe installation
The high-performance impeller is mounted directly on the rotor of the external rotor motor. This saves space and allows the entire rotating unit to be balanced in a single clamping operation. The electronics and motor form one unit, making installation easy, as the integrated control electronics take the place of an external variable frequency drive.



Guaranteeing *reliable planning.*

Guaranteeing reliable planning
Air handling unit planners often find themselves disappointed with the fans following installation: The power data from the selection software fails to match the air flow and energy efficiency. Reliable planning is not possible. Selecting a RadiPac is a different matter altogether, as the data provided are actual measured values with allowance for the installation conditions.

Broad efficiency spectrum
The actual installation conditions in AHUs were taken into account when developing RadiPac fans. In particular, we optimized the impeller's outflow characteristics and reduced the deflection losses in the air handling unit. In addition, a wide optimum efficiency range enables the fans to work in a wide operating range with a low power consumption.

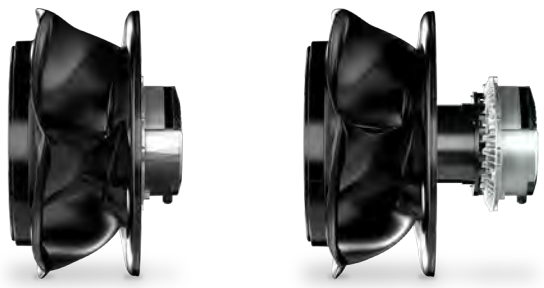
Well-balanced concept
The optimum interaction of all fan components forms the basis for the broad high efficiency range. For example, the GreenTech EC motors used have efficiencies well over 90%, significantly above the values stipulated by the IE5 efficiency class.

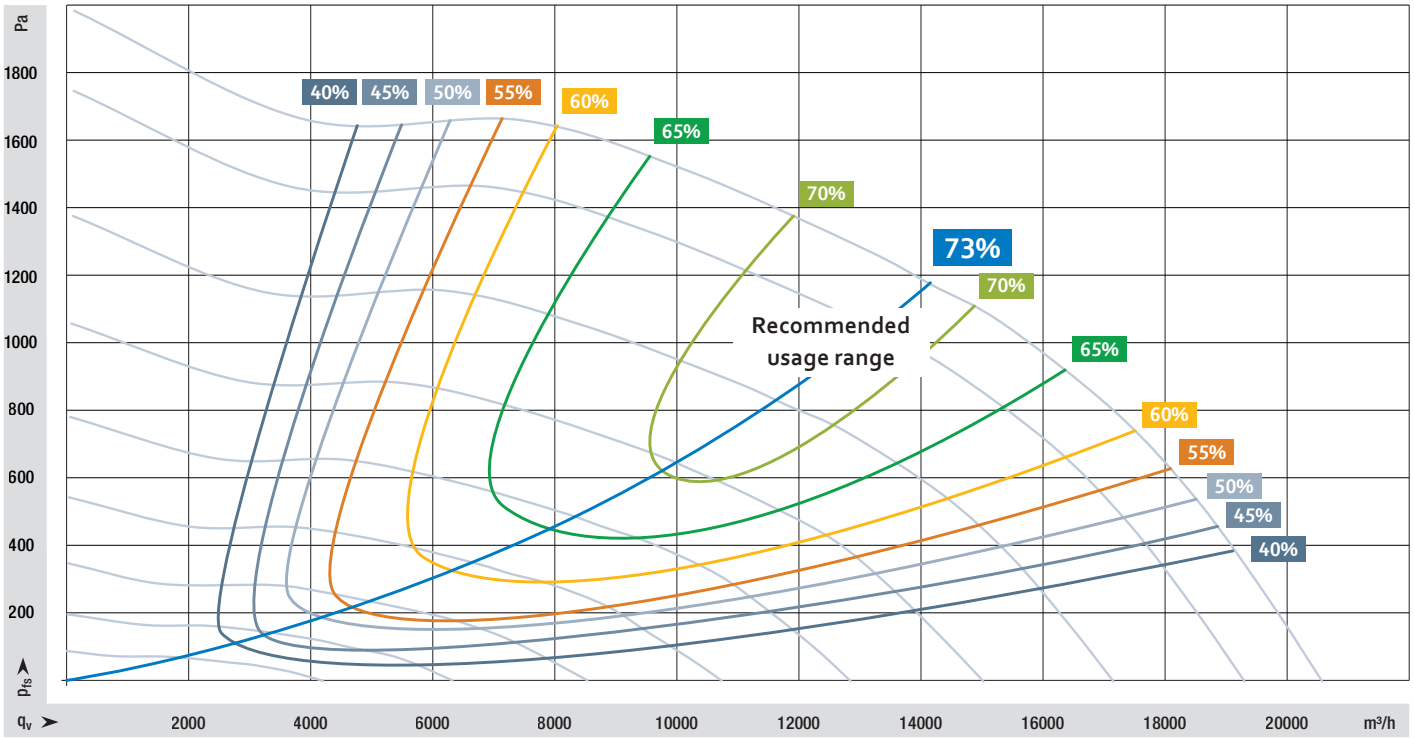
Ideal inlet ring design
The inlet ring of the new RadiPac fans from ebm-papst is perfectly adapted to the high-performance impeller with its aerodynamically optimized blade channel. This lessens turbulence right at the air inlet, reduces flow losses and eliminates one of the causes of noise nuisance. ebm-papst has also modified the transition from the inlet ring to the impeller cover plate to produce a clearly defined gap flow. As a result, the turbulence in the air flow, which would narrow the effective flow cross-section, is reduced at this point as well.

Innovative blade contour
With the one-part impellers, spatially wound 3D blades with optimum resistance made from high-performance glass-fiber reinforced composite material ensure greater efficiency with their mechanical design and aerodynamic characteristics. The shape of the high-performance impeller has led to a reduction in weight while increasing its stability. The high rigidity of the high-performance impeller also enables high circumferential speeds.

Low-loss through-flow
The rounded flow contour at the blade inlet ensures intake to the blades and the wavy cover plate without losses, for the optimum air flow rate. The five backwards-curved, spatially wound 3D blades direct the air flow efficiently through the blade channel before it leaves the high-performance impeller low in turbulence due to the blade trailing edge, which tapers toward the back. The specially shaped impeller base plate largely routes the air outflow in an axial direction. This reduces both the deflection losses in the air conditioner and the pressure drop in the installed unit. At the same time it has the effect of lowering the noise level.

Optimized motor position
In order to suit different installation situations, the new centrifugal fans are available in a standard and short version. For the most powerful standard types, the impeller is attached to the motor in such a way that it has no negative influence on aerodynamic efficiency. In the short version, the motor is immersed in the impeller. These fans are more compact and work much more efficiently than previous comparable models despite their slightly shorter axial installation dimensions compared to the standard version. Furthermore, the complete, rotating unit, consisting of rotor and impeller, is balanced dynamically at two levels during production, which guarantees operation with extremely low vibrations.



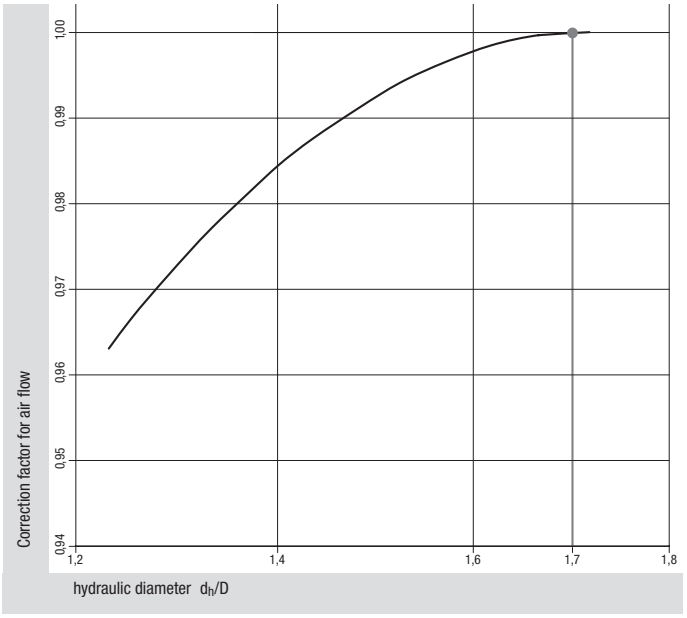


The isolines of the static overall efficiency show: RadiPac with broad, efficient usage range. Furthermore, they provide information about the efficiency levels in partial-load operation.

Creating *authentic operating conditions.*

The fans in AHUs have to operate in more or less confined spaces. This leads to a reduction in air performance that has to be taken into account when selecting the right fan. ebm-papst has developed a way of tackling the problem: Measurements were taken on fans of various sizes in AHUs with different dimensions. Based on the measurement results a relationship was then established between the impeller diameter and the installation space available. This is illustrated in the following.

The air flow correction values shown were determined from an extensive series of measurements taken on our in-house chamber test rig. Both square and rectangular outflow cross-sections were studied. For this reason, use is made of the hydraulic diameter to determine the correction values. The new RadiPac fans are known to be less vulnerable to tight installation situations. In the case of square cross-sections of more than than 1.7 times the impeller diameter, no deduction has to be made from the characteristic curves given in the catalog.



Air flow correction values for RadiPac sizes 250–1000

The app shows you the dimensions of the AHU.

AR

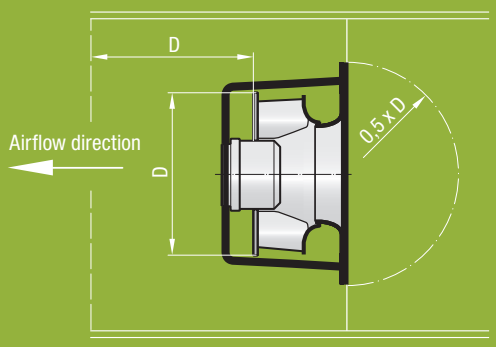
Installation of freewheel fans *according to the AHU association.*

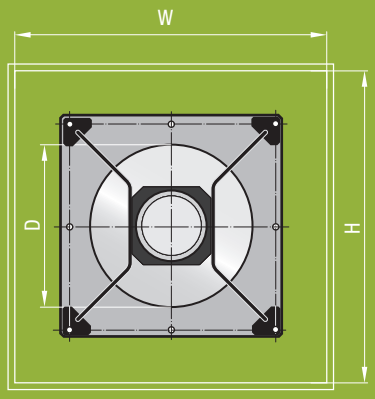
Effects of installation space:
Tight installation in a square AHU may lead to a reduction in air performance.

W Unit width
D Impeller diameter of the fan
H Unit height

Calculation:
d_h hydraulic diameter

$$d_h = \frac{2 \times W \times H}{W + H}$$





The AHU quality association makes a recommendation (01/2017) about installation losses for freewheel fans:

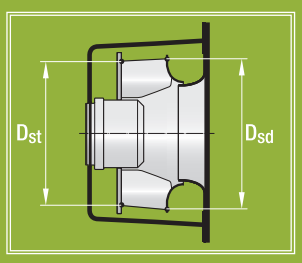
D Impeller diameter
A Distance from the unit wall

As per the definition, use the mean impeller diameter D here: This is the mean value of the blade outlet diameter at support plate (D_{st}) and cover plate (D_{sd}):

For asymmetrical fan arrangements in the AHU, the mean value of the wall distance is used for the calculation.

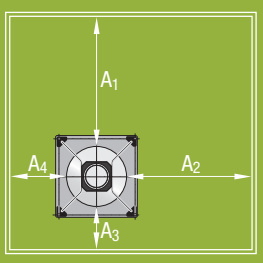
$$D = \frac{D_{sd} + D_{st}}{2}$$

$$D \geq 1$$



$$A = \frac{A_1 + A_2 + A_3 + A_4}{4}$$

$$A \geq 0.2 \times D$$

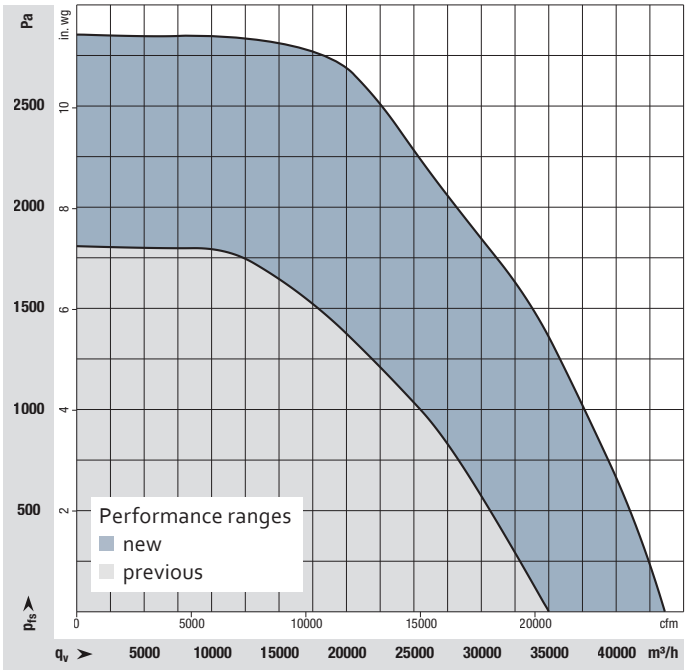


(For this, A must always be ≥ 0.2 x D. The deductions from the valid norms must be observed.)

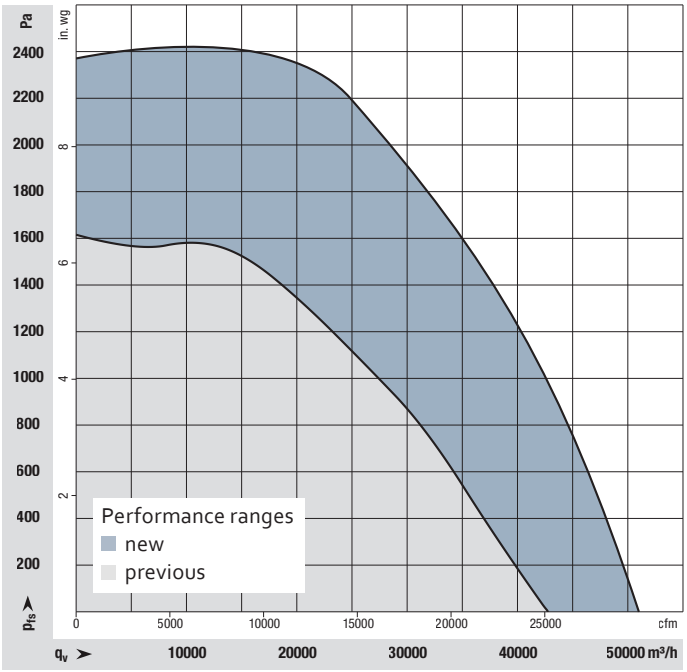
Demonstrating *a clear lead*.

Comparison
Both our systematic approach and our determination to carry on perfecting every last product component make themselves felt, proven, for example, by expanding the RadiPac product range with sizes 710 and 800 with robust metal impeller. When comparing them to the previous sizes, it is clear how much the application range is increasing. Of course, measurements were taken in installation conditions closely resembling real usage conditions.

Here, the RadiPac sizes 710 and 800 have a new GreenTech EC motor without rare-earth magnets and achieve air flows up to 40,000 m³/h and pressures up to 2,500 Pa. The new GreenTech EC motor in size 280 represents the strongest in its class and its high efficiency levels even exceed the ecodesign requirements for fans.



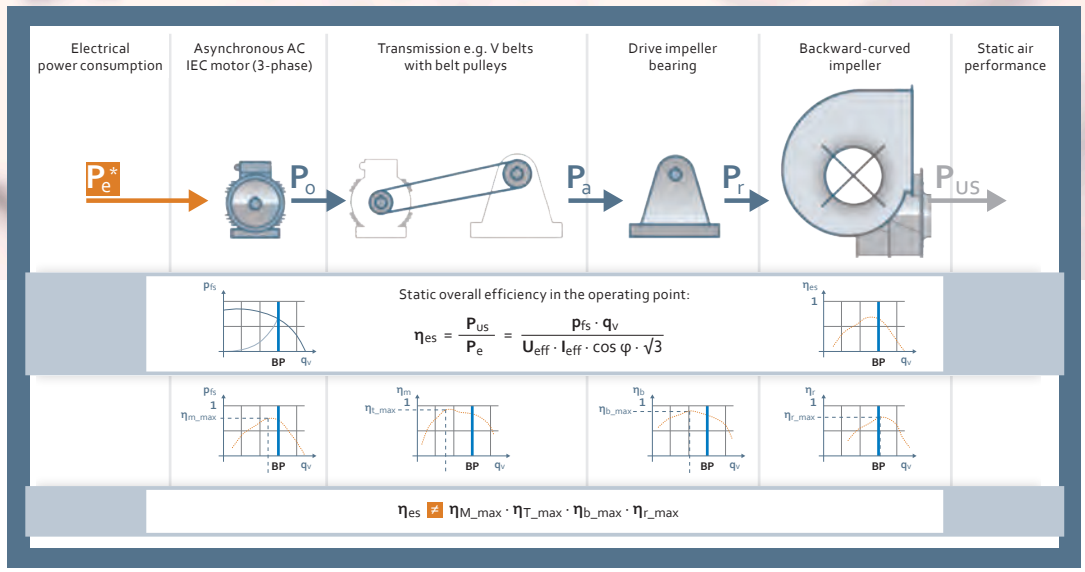
The map shows a direct comparison between size 710 fans and the previous sizes.



The map shows a direct comparison between size 800 fans and the previous sizes.

Would you like more information about our RadiPac fans? ebmpapst.com/radipac

Providing correct values.



Multiplying the individual efficiency values of all fan components yields an incorrect overall efficiency value.

At ebm-papst, not just the products have to satisfy top quality standards. ebm-papst also sets itself extremely high targets when it comes to measuring all performance data.

ebm-papst values are measured, not calculated
That certainly cannot be said of all fan manufacturers. Regrettably. When all is said and done, selecting the right fan is crucial to ensuring the dependability and efficiency of air handling units. This means that equipment manufacturers have to be able to rely on the product documentation of the fan manufacturer and thus the assured product properties right from the planning stage. But how do these product data actually come about? And how reliable are they?

Documentation
Both in its catalogs and in its user-friendly fan selection software, FanScout, ebm-papst presents performance data that were conscientiously and rigorously measured for every single type. This involves mounting the units on chamber test rigs conforming to ISO 5801 and subjecting them to aero-acoustic measurements. Following measurement, the data are validated. This ensures that all the information given in the documentation really does reflect the correct values.

Production
In addition to accurate product documentation, it is important to have a manufacturing process that can guarantee that the products will actually have the documented properties. And so the production sequence is accompanied by monitoring and checking mechanisms to reliably detect any excess tolerance. Therefore, the properties obtained in practice are exactly the same as those stated in the documentation. Every fan produced by ebm-papst undergoes a functional test at the end of the production process.

With all these efforts to achieve accurate documentation and reliable production, ebm-papst can guarantee you always get the right figures. All the fans supplied will be dependable components in AHUs and will always fulfill the demands placed on them.

Determination of overall efficiency
Another important point to note: The true efficiency of a measured fan is not simply the product of the maximum individual efficiency levels of the motor, drive, control system and impeller. Which is why fan performance data based on calculations are not generally realistic.

They always tend to be far too optimistic! This is because the maximum efficiency levels of the motor, drive, control system and fan impeller used for calculation are normally taken from catalogs.
It cannot however be assumed that every component will always attain its maximum efficiency level in actual operation. Multiplying the optimum individual efficiency levels will yield a far more favorable overall efficiency than is possible in real operation.

This error produces performance values that are often much better than those attained in practice. To obtain authentic values, ISO 12759:2010 "Fans – Efficiency classification for fans" expressly recommends that planning be based on measured values.

As good as it comes
ebm-papst always provides the correct values. Because ebm-papst measures and supplies the minimum configuration of a complete, ready-to-install fan. As all components of this are ideally matched to one another, static overall efficiency levels well in excess of 60% are obtained. The values have been measured and stored in the FanScout. Better figures from other suppliers should always be treated with caution.

ebm-papst bases the product documentation for all fans on measurements taken on certified, high-precision chamber test rigs. Permanent internal monitoring of the test facilities used and the values obtained guarantees constant product quality and fan reliability.

Aero-acoustic chamber test rig

The ebm-papst aero-acoustic chamber test rig permits simultaneous recording of the air performance data and noise levels of fans. For this, the fans are installed in the test chamber with free inlet and free outlet in accordance with installation type A. The chamber test rig or combination test stand consists of two low-reflection half chambers with a high-impedance floor, corresponding to accuracy class 1 for acoustic measurements. Air performance measurements can be taken with an air flow of up to 100,000 m^3/h and a static pressure increase of up to 3,000 Pa.

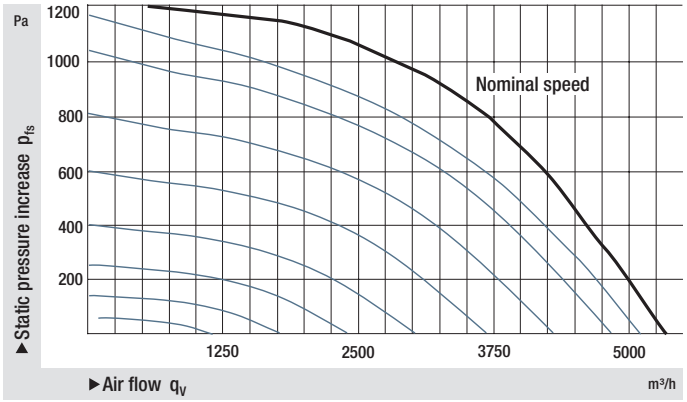
The fan curve is determined on the chamber test rig. To do so, the unit under test is operated at constant speed with continuous throttling of the air flow. The noise level, the air flow, the static pressure increase, the speed and the reaction torque required for determination of the power consumption are recorded in the various operating statuses. A fan curve is made up of at least ten operating points. This measurement is then repeated at different speeds. The curves obtained in this way yield the so-called fan map.

Precise *documentation*.

PHYSICAL QUANTITY	MEASURING RANGE/UNIT	MEASUREMENT ACCURACY
Pressure increase p_{fs}	0 to 3,000 Pa	0.5% of measured value
Air flow q_v	100 to 100,000 m³/h	1% of measured value
Air power P_u	kW	1.2% of measured value
Power consumption P_e	0 to 30 kW	0.5% of measured value
Torque M	0 to 200 Nm	1% of measured value
Overall efficiency η_{es}	%	1.3 percentage points
Speed N	0 to 99,999 rpm	1 rpm
Air density	approx. 1.2 kg/m³	0.1% of measured value
Sound power LwA	from 30 dB(A)	1 dB(A)

Test stand design and tests in accordance with ISO 5801 – Industrial fans, performance measurement on standardized test stands DIN EN ISO 3744, DIN EN ISO 3745, ISO 13347-3 – Acoustics standards

Measurement quantities and measurement accuracies attained with the aero-acoustic test stand



Regular checking

To ensure that the measurements are always accurate and reproducible, test facilities and test equipment undergo regular checks. It is standard practice at ebm-papst for Quality Assurance to routinely monitor test equipment with measurement quantities traceable to national and international standards (German Calibration Service DKD, German National Metrology Institute PTB). Determination of the air flow and regular leak testing are based on ISO 5801.

Since the middle of 2014, calibration of the air flow measuring instruments and traceability to the national standard of the PTB have also formed part of the quality assurance process. The applicable range is from 100 m³/h to 40,000 m³/h with a reference measuring instrument accuracy of ±0.5% of the measured value. Internal validation provides both assurance for the company and information for customers. The documentation is available for viewing at all times.

TÜV Süd confirms that the test stand corresponds with all requirements of DIN EN ISO 5801 in an air flow range of 500 m³/h to 39,000 m³/h and a pressure increase up to 3,000 Pa. The Fraunhofer Institute in Stuttgart approved the acoustic properties of the combination test rig. The institute confirmed the Class 1 rating for the ebm-papst noise measurement chamber.


ZERTIFIKAT ◆ CERTIFICATE ◆ 证书 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Herewith is granted the right to the company

ebm-papst Mulfingen GmbH & Co.KG

in

D-74673 Mulfingen

for the operated aero-acoustic fan test rig

„Kombiprüfstand 100"

located in

D-74673 Mulfingen

for the volumetric flow range of 500 m³/h to 39,000 m³/h and a pressure range up to 3,000 Pa,

based on the positive results of the completed inspection regarding compliance with the requirements of the Standard

DIN EN ISO 5801:2018-04

to identify this with the following TÜV SÜD Certification Mark.

TÜV SÜD

This certificate is valid until 2025-03-31

Certificate Registration Number: 13/11/11

Certification Body for products Refrigeration and air-conditioning Munich, 2022-03-27

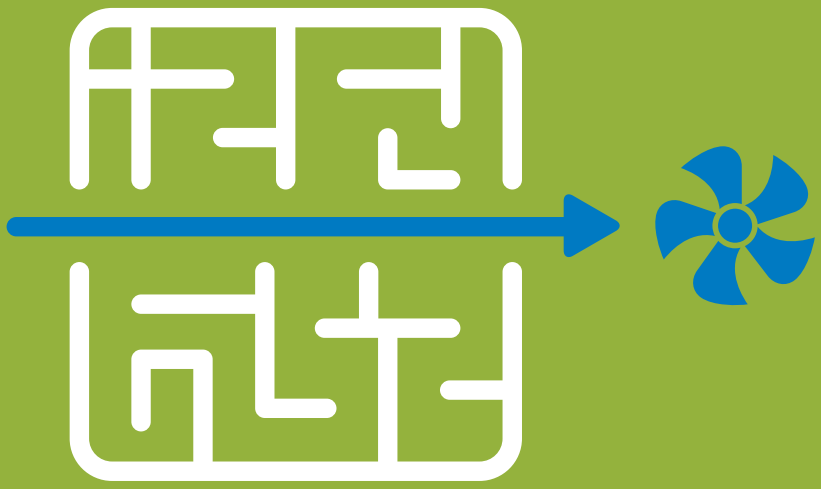
TÜV SÜD INDUSTRIE SERVICE GMBH, WESTENDSTRASSE 199, D-80686 MÜNCHEN

With FanScout, your complex search for the right fan solution will have a quick and happy ending. Because as soon as you open FanScout, you are already practically where you want to be. All you need for the perfect result are the requirements of your application – for example, air flow, static pressure, and the planned operating time.

FanScout then guides you through an overview of the best possible fan and FanGrid solutions, which you can compare with each other clearly and intuitively. And to make your decision even easier, FanScout also takes life cycle costs into account – from acquisition to operation and service. This saves you time and helps you to find out all about the right fan.

The most important functions at a glance:

- Compare product data at a glance and find the best fan or FanGrid solution quickly and easily
- Results can be filtered by operating point, nominal data, dimensions and other parameters
- Direct comparison of air performance curves and sound power diagrams
- Calculate life cycle costs via energy, product and installation costs
- Sustainability analysis based on CO_2 emissions
- Expert mode with efficiency curves, FEI or iso line
- Operating instructions and data sheets available for direct download
- Browser-based software without time-consuming installation or updates



The simplest way to the **best result.**

With FanScout from ebm-papst.

Precise data. Better decisions.
With ebm-papst FanScout, you get reliable and highly accurate data because our software is based on real measured values. Not only is the performance of the individual fan components measured but also that of the fan as a complete system.

Validation measurements have shown that the FanScout does not exaggerate when stating the efficiency. For this purpose, 15 reference points were selected for the measured fans and recorded on the certified chamber test rig. Comparing the measured air performance data with the data from FanScout shows that the calculated values from FanScout are almost identical to those measured under real conditions. And this means that ebm-papst fans as delivered tend to have an even higher efficiency than shown in FanScout. This gives you real certainty in the planning process.

Further information and contact details can be found at:
ebmpapst.com/fanscout

Tolerance limitation.

It is a widely known fact that ebm-papst attaches tremendous importance to the quality of its fans. But there is more to it than that: Another essential aspect is being sure to make fans that attain the specified performance values during operation, whatever their date of manufacture.

Guaranteed product precision

It is inconceivable to manufacture a technical product without any tolerances. These stem for example from dimensional deviations in assemblies or parts, such as the diameter of enameled wire, or in electronic components. But it is possible to limit tolerances and to ensure that they are not exceeded. That is the job of a company's Quality Assurance department. The greater the potential deviations and the resultant performance deficits, the greater the safety allowances that have to be made when selecting the fans. Accuracy classes and permissible deviations from the documented operational parameters are defined for this purpose in EN 13348 - "Technical Terms of Delivery for Fans". The so-called limit deviations are divided into Classes 0 to 3. For fans smaller than 10 kW, for example, the standard allows accuracy class 3.

RadiPac is first class

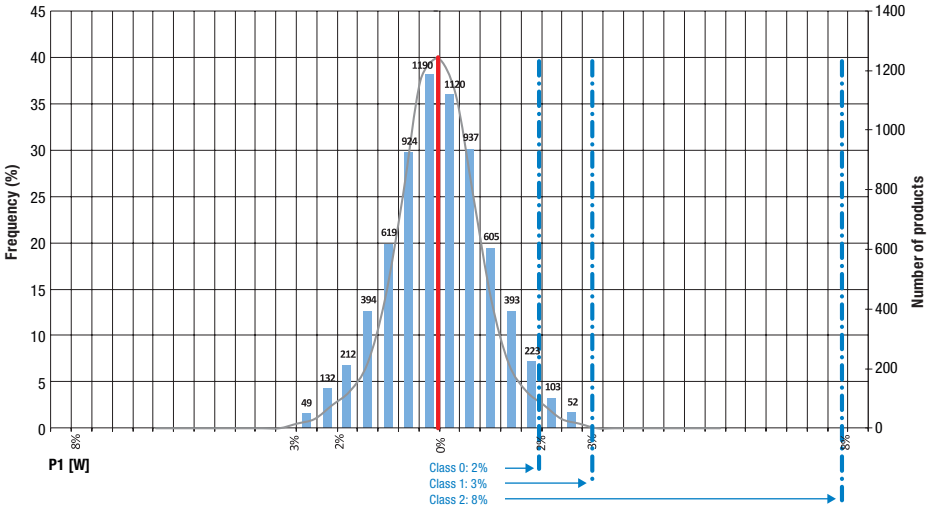
RadiPac fans are checked for performance deviations at the end of the production process in their as-delivered condition. This quality assurance measure documents all the electrical performance data as well as compliance with the permissible manufacturing tolerances. Evaluation based on a size 500 RadiPac fan shows that ebm-papst attains accuracy class 1. This means that the fan information given in the catalog or in the FanScout selection software is not allowed to deviate from the actual drive power by more than 3%. With regard to overall efficiency, the maximum figure is just 2%.

Very reliable planning

Based on the deviations from both product documentation and production, the actual power consumption of the fan will be lower than documented and the overall efficiency consequently higher. So there is no danger of any unpleasant surprises when it comes to commissioning your AHUs. Therefore, it is not necessary to preemptively over-size the fan, getting rid of the additional costs involved.

Evaluation of RadiPac product range: The accuracy classes define production-related deviations from fan performance data. According to this, the RadiPac product range attains Class 1.

Evaluation is based on performance measurements on 6,953 fans of size 500.



OPERATIONAL PARAMETERS	LIMIT DEVIATION IN CLASS			
	0 (AN1)	1 (AN2)	2 (AN3)	3 (AN4)
Air flow q_v	±1%	±2.5%	±5%	±10%
Static pressure increase Δp_{stat}	±1%	±2.5%	±5%	±10%
Drive power P_{ed}	±2%	+3%	+8%	+16%
Static efficiency η_{stat}	-1%	-2%	-5%	– (–12%)
Sound power level db(A)	+3 dB(A) (+2 dB(A))	+3 dB(A)	+4 dB(A)	+6 dB(A)

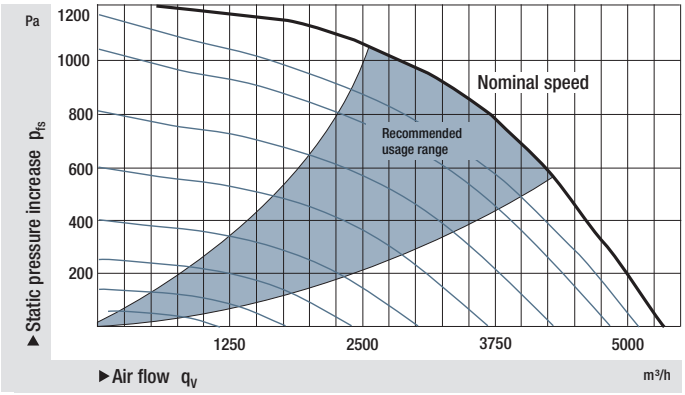
* - Other designations and slightly different values in ISO 13348

Making *efficiency possible.*

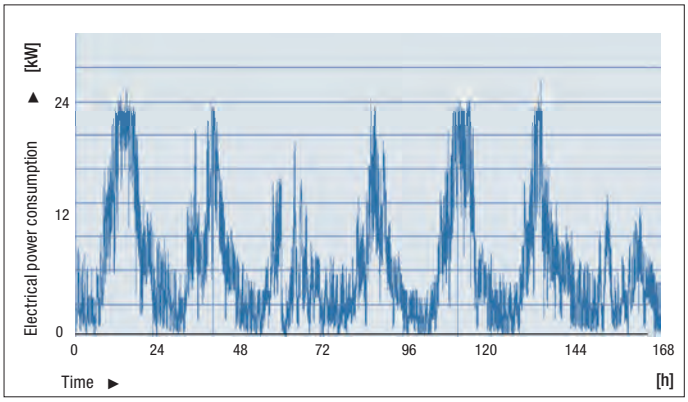
A glass-fronted office complex, a summer's day with temperatures of 35°C in the shade, fully occupied rooms, maximum demand for ventilation and cooling and scheduled maintenance or servicing still a long way off: That could be a description of the most extreme situation for an air handling system. Calculated over the course of an operating year, the maximum load situation only occurs on a few days in commercial, municipal and industrial applications. But the necessary cooling or heating output and the minimum air exchange rates do then have to be reliably attained. The maximum load situation is thus the definitive factor for the dimensioning of an air handling system and the fans – but it is not the most important with regard to the operating time as a whole!

Frequent partial-load operation

An information brochure (dena guide with the title "Ventilation technology for industry and commerce"), issued by the German energy agency dena, gives the following recommendation: "In the short term, the operating point may change on account of the time of day, production fluctuations and weather conditions. Over the medium term, seasonal influences or the degree of production capacity utilization, and in the long term increasing filter resistances etc. can bring about changes. In such cases it would be a mistake to have the design operating point (least favorable conditions and maximum output requirement) at the point with the best efficiency. It is better to have the operating point for the most frequently occurring situation at the point with the best efficiency. The best solution is to perform optimization on the basis of the expected load cycle and to select the fans for which the annual energy costs are the lowest."



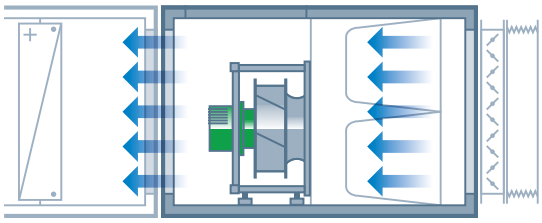
Characteristic curve of a centrifugal fan with a broad useful range.



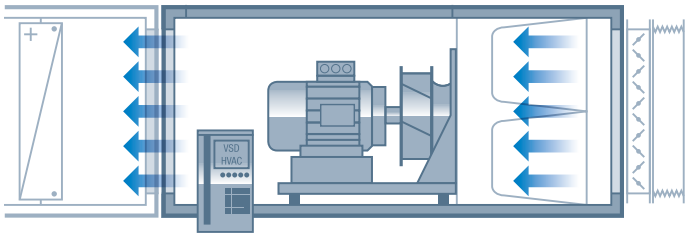
Power consumption of an AHU over the course of a week.

Cutting *operating costs.*

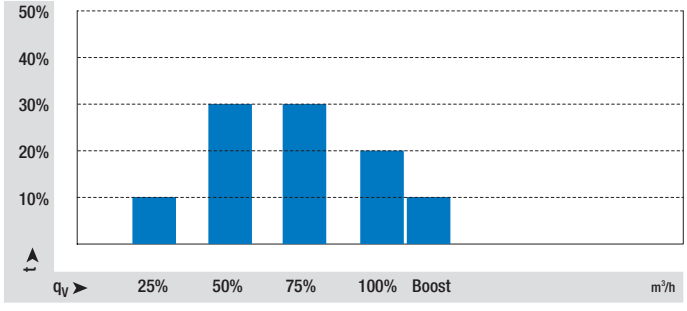
RadiPac saves on operating costs
A technology is called for that is capable of adapting the air flow as smoothly as possible to the actual demand. This feature is already integrated into RadiPac for operation in AHUs. Its control characteristics over a broad speed range guarantee outstanding efficiency and thus help to cut operating costs. This can be seen from a comparison of an AC fan with frequency converter to a GreenTech EC fan. For the load profile shown, the efficiency advantage of the EC fan is around 28%. Alongside reduced power consumption, other major benefits include lower assembly and installation costs, reduced weight and the space-saving design. With a view to obtaining the right values in partial-load operation when using AHUs, the partial load case is therefore of great significance for planners and operators for minimizing operating costs. And RadiPac EC centrifugal fans provide the ideal solution.



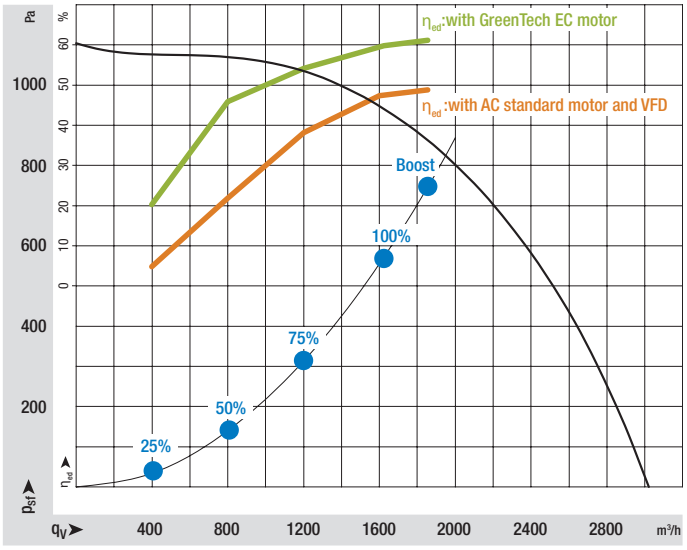
GreenTech EC fans

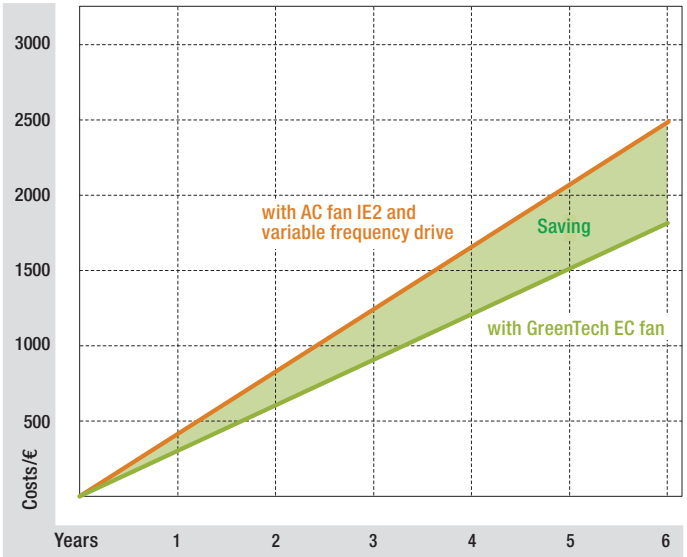


AC fans (AC standard motor with variable frequency drive)



For the given load profile, the GreenTech EC fans has an advantage of roughly 28% over a standard AC fan of the same power with variable frequency drive.





In use *all over the world.*

As the leading experts in fan technology, we have set standards everywhere in the world: with regard to the quality, efficiency and not least the reliability of our fan units. We have developed various product ranges for this purpose. Their strengths are highlighted again on the following pages, using RadiCal and RadiFit as examples.

Thanks to their flexible design, our products are used in widely diversified applications. They raise the potential energy savings and perform valuable tasks over the long term all around the globe in a diverse range buildings. On page 44, we have compiled a few examples for you. And we will tell you where you can find more.

Content

RadiCal: *compact and quiet.*

Whereas RadiPac is ideal for higher pressures, RadiCal is another ventilation and air conditioning highlight for low pressures. In addition to high efficiency levels, its "radical" advantage is minimizing noise. The fan impeller of the RadiCal is made of glass-fiber reinforced plastic. This permits an aerodynamically optimized shape that cuts noise generation by half and significantly reduces the power requirement.

But ebm-papst has further refined the GreenTech EC motors, or, perhaps more accurately, it has made them more compact. As a result, the fans are far more compact, so they can easily be substituted for existing AC fans. Together with optimized motor heat management and correspondingly greater efficiency, this yields energy savings of up to 50% as compared to AC solutions. And so the RadiCal has no problem conforming to the applicable ecodesign directives for fans and at the same time helps you to satisfy the ecodesign requirements for your applications.

RadiCal fans from ebm-papst are available in different sizes and various power ratings for a variety of applications – on request also as ready-to-install modules.

You can find further information at: **ebmpapst.com/radical**

RadiFit: *light and robust.*

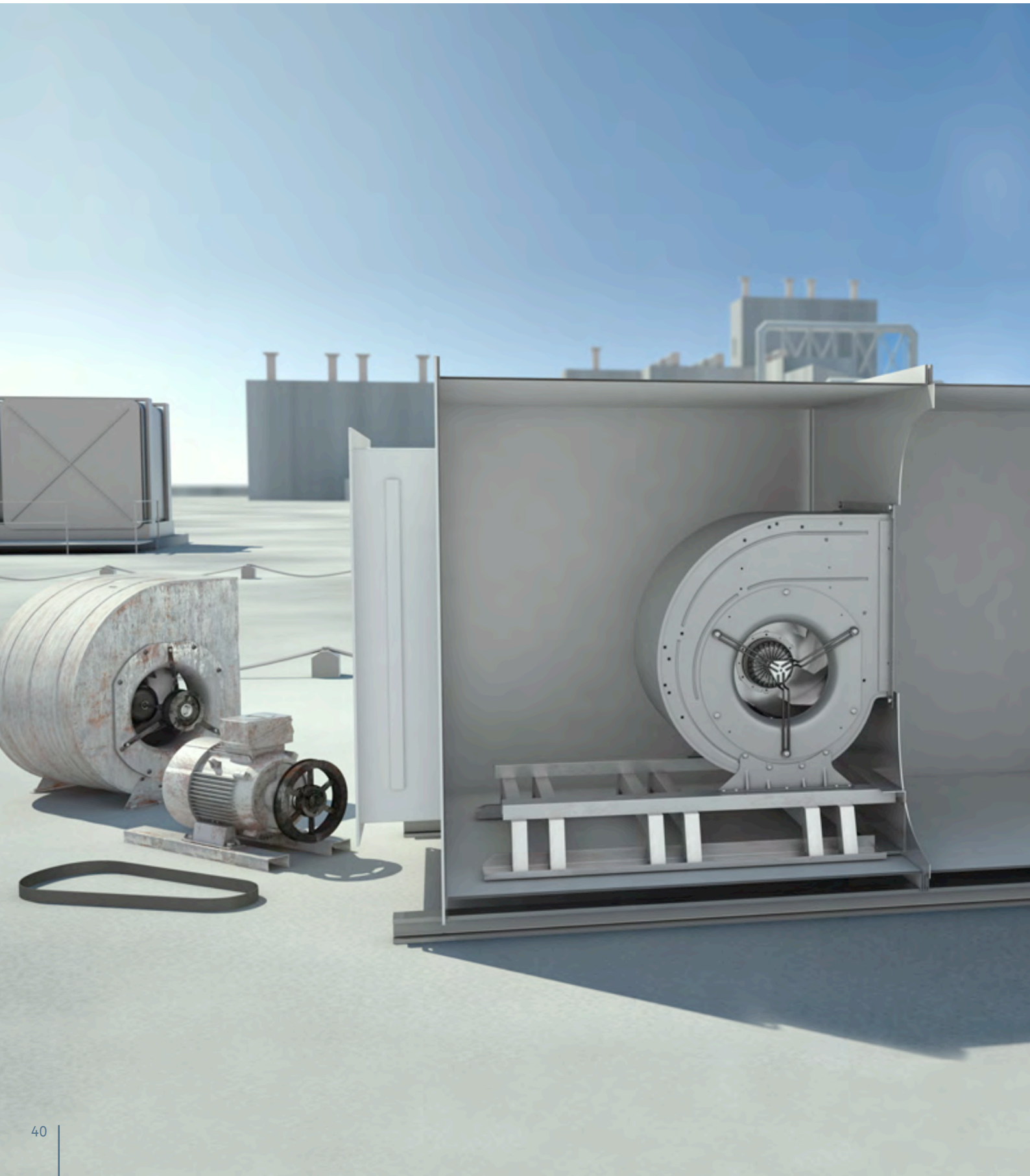
RadiFit EC centrifugal fans
The RadiFit centrifugal fan product range with scroll housing and backward-curved blades is the new system solution for a wide range of industrial and ventilation technology applications. With their highly efficient GreenTech EC motors in combination with efficient backward-curved impellers, they can offer excellent efficiency at high pressures. They are also extremely compact, light and robust. But the best thing is that the RadiFit fits the installation dimensions of common housed fans. So installation and replacement are child's play.

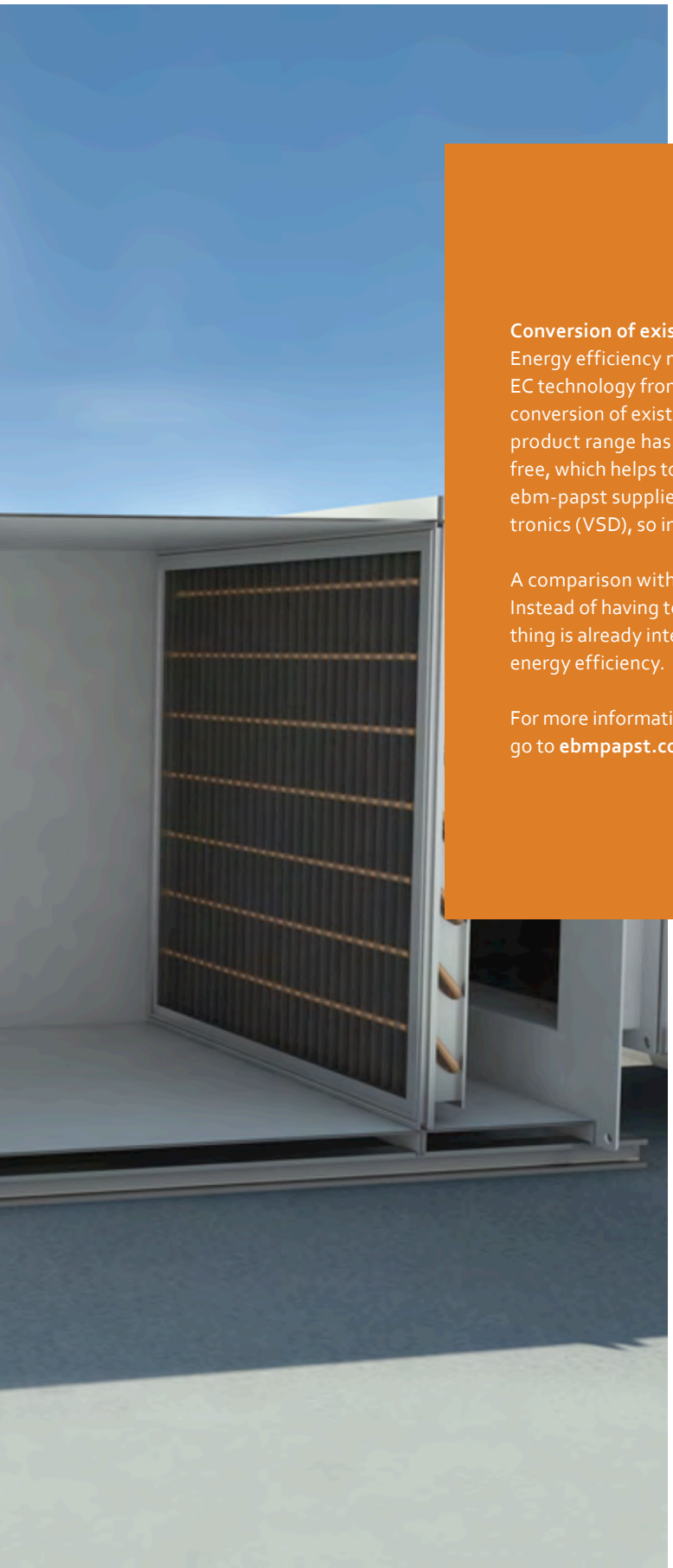
Low-profile air conditioner with RadiFit
In air conditioned buildings, the warm exhaust air is used to control the temperature of the inlet air. For this purpose, fans convey the air through the heat exchanger and then through the inlet and exhaust air ducts. Stringent energy conservation regulations require not just a compact design and flexible control of the fans, but also high efficiency. Just like the new RadiFit range.

Central air conditioner with RadiFit
In central air conditioning systems, various components are used, such as filters, heat exchangers, humidifiers and dehumidifiers. The job of the fans is to convey the air through all these components, as well as through a branching duct system, while at the same time providing compensation for the high pressure losses. The system should also occupy little space and permit simple, demand-based ventilation for a large number of rooms. The flexible, robust and easily implemented solution: EC centrifugal fans with scroll housing from ebm-papst.

You can find more information on the RadiFit at:
ebmpapst.com/radifit

Retrofit: *out with the old, in with high efficiency.*





Conversion of existing installations makes sense
Energy efficiency means low operating costs. Centrifugal fans with GreenTech EC technology from ebm-papst are so superior to conventional fans, that even the conversion of existing installations is a good investment. What's more, the new product range has a particularly long service life and is absolutely maintenance-free, which helps to reduce life cycle costs even further. And, last but not least, ebm-papst supplies the fans complete with housing and fitted with control electronics (VSD), so installation costs are also kept to a minimum.

A comparison with standard belt-driven fans clearly illustrates the difference: Instead of having to bother connecting up several different components, everything is already integrated into the RadiFit in a highly compact unit with maximum energy efficiency.

For more information on the comparison "Out with the old, in with high efficiency", go to **ebmpapst.com/retrofit**

Trial run helpful? With our app you can have a go at installing the RadiFit or a FanGrid in your AHU.

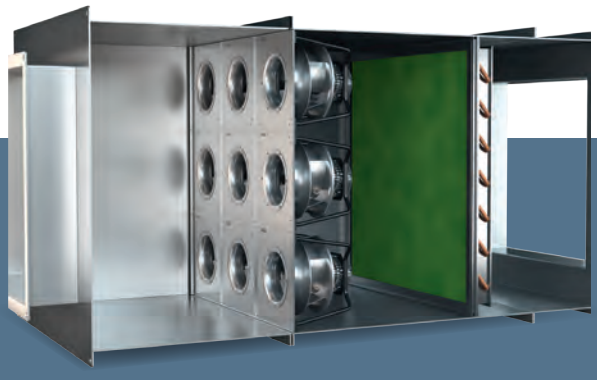
Optimal FanGrids
for AHUs.

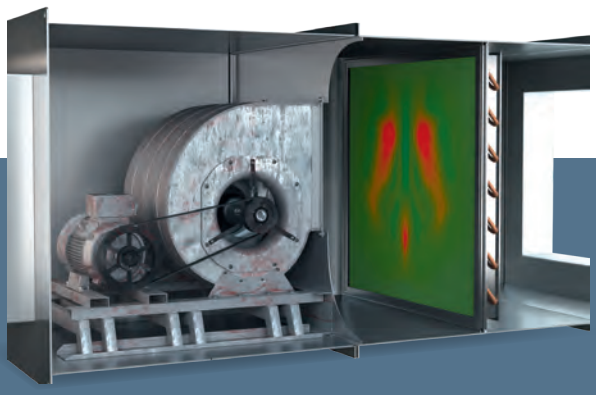
In the past, large fans were usually used to move large air volumes. Modern ventilation technology employs multiple small fans working in parallel in so-called FanGrids, which saves space, ensures dependable operation, and is efficient. GreenTech EC fans in parallel arrangement guarantee great reliability and significantly reduce operating costs. The ebm-papst FanScout selection software makes it possible to work out the most economical fan combination.

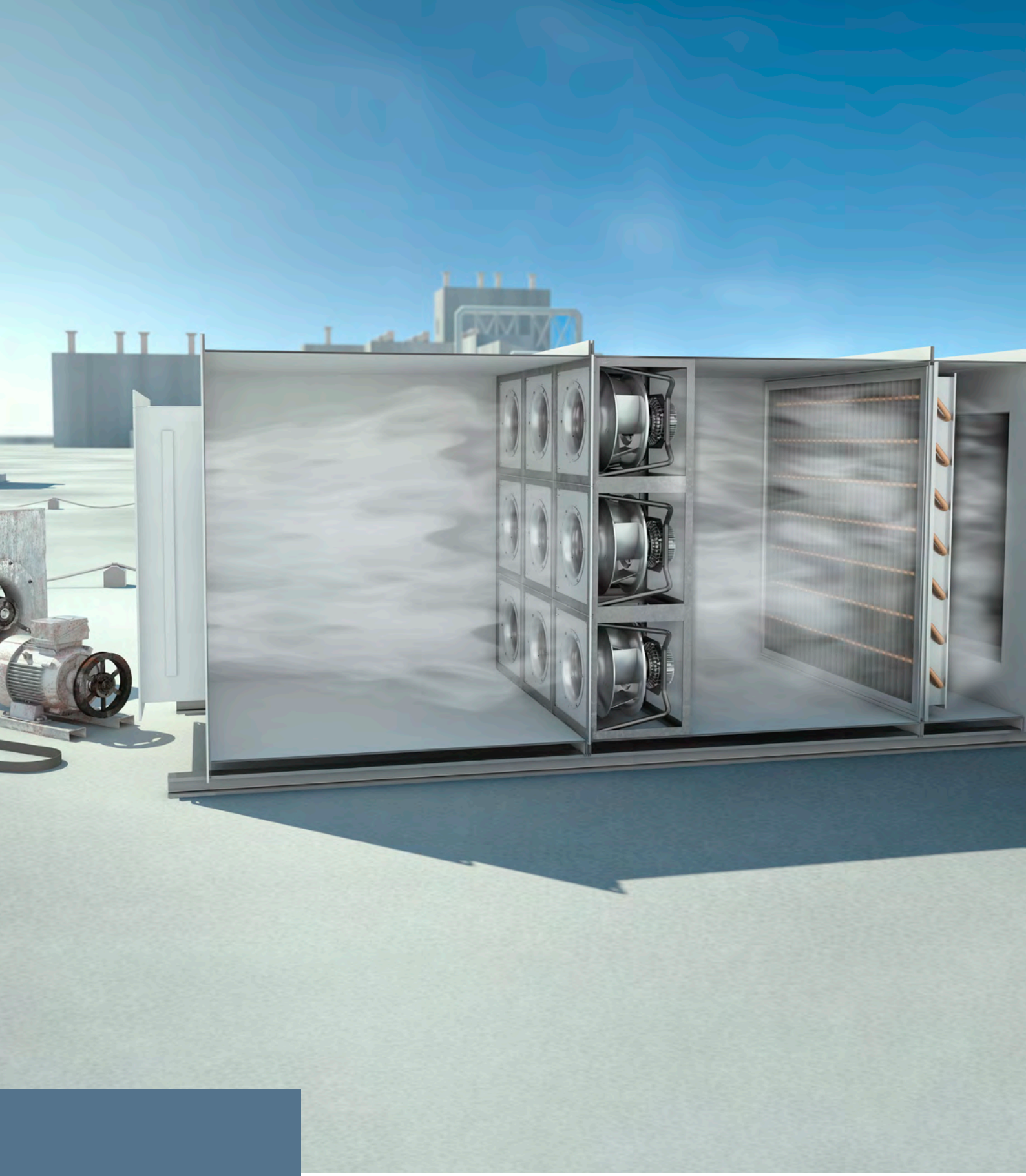
Efficient, space-saving air distribution
Centrifugal or axial fans configured as FanGrids are the best choice for achieving high air performance. This offers tremendous advantages over the use of large individual fans. Firstly, it makes the flow through upstream and, in particular downstream, heat exchangers or filters more even, resulting in better heat transfer and more efficient filtering of the air. Secondly, several small fans require much less space than one large fan, which reduces the costs of the system.

Redundancy for more reliable operation
To ensure a constant supply of the required volume of air in the building at all times, FanGrids are often of redundant design, ensuring that ventilation systems always have sufficient reserves even at times when individual fans are not in operation. This situation is also reliably simulated by the ebm-papst FanScout software, which thus helps to ensure an optimum ventilation system design.

For more information on the FanScout software, go to **ebmpapst.com/fanscout**





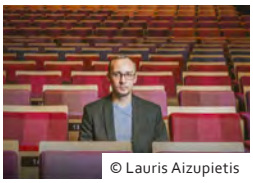


Outflow characteristics of RadiPacs in the FanGrid in comparison to two-side-intake housed fans.

Discovering *great successes.*

With our products, we support AHU technology worldwide. In our online magazine, you will always find the latest success stories about how we have improved the efficiency of AHUs and have saved energy as a result. Read it right now here:

mag.ebmpapst.com/air



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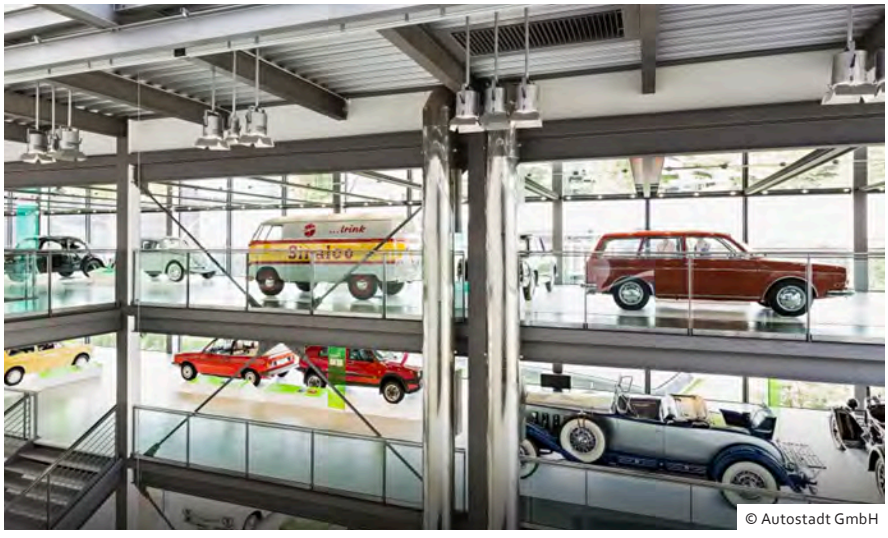

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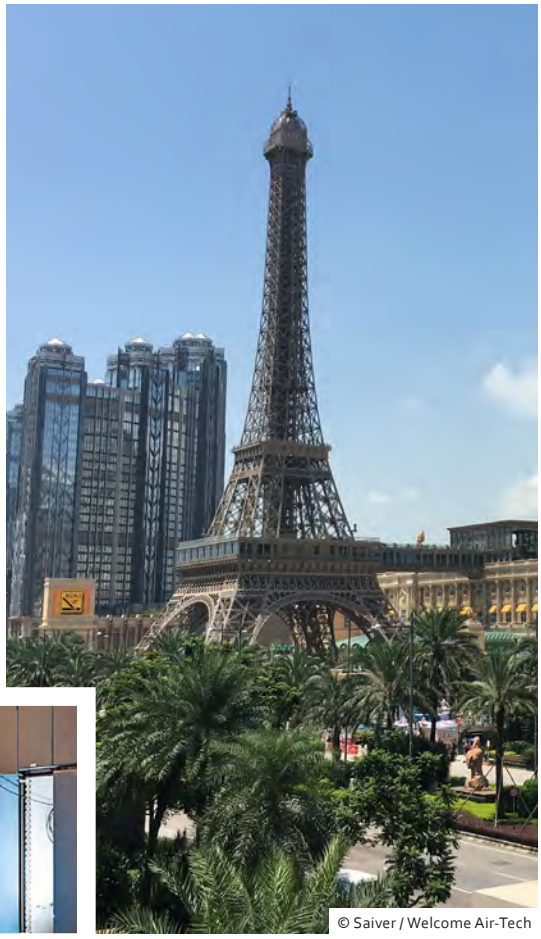

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Questions *and answers.*

In this brochure, you will have read a lot about ebm-papst and the company's product and measurement quality standards. Nevertheless, we would like to give some concise answers to the most important questions here.

What is so special about ebm-papst EC motors?
EC motors have not only proved to be ideal for the operation of fans or pumps in the building services sector, they are increasingly also being used in fans for cooling switch cabinets and variable frequency drives, as well as in modern agricultural applications. They offer outstanding efficiency, an unbeatably compact design and extremely smooth operation.

Which technology is used in EC motors?
EC motors are very similar to PM motors, for example. Both types of motor have magnets attached to the rotor and have field winding on the stator. Their operating principle means that EC and PM motors are always superior to the widely-used asynchronous motors (AC motors) in terms of efficiency. The advantage is particularly significant when the motor power is low and in low-speed applications.

How efficient are EC motors?
The efficiency level currently attained by this type of energy-optimized motor - a line-operated, permanently excited synchronous motor (also known as BLDC or PM) - far exceeds the specifications for efficiency class IE5 (IEC TS 60034-30-2:2016).

What is meant by variable frequency drive operation?
In principle, EC motors require control electronics that are very similar to a variable frequency drive. This has certain advantages with regard to EMC problems, and the unit only has to be wired to one transfer point.

What are the typical applications?
EC motors have become established as fan drive units in many areas, not just in the building services sector. The external rotor design lends itself to air handling applications, as the axial or centrifugal fan impeller can be mounted directly on the external rotor.

What are the basic points to note?
The term EC motor is often used to refer to different concepts. As however BLDC, EC and PM all describe a motor with extremely similar properties, the name is not so important. One thing should be remembered though: The genuine GreenTech EC motor from ebm-papst is designed so that it does not need any problematic rare-earth magnets.

What makes ebm-papst's comprehensive approach so efficient?
In the power range below 10 kW, power savings well in excess of 10% can be achieved through the use of our efficient EC motors. The modern fan impellers contribute further savings of 10 to 30%.

And savings of 50% and more can easily be attained by adjustment of the air performance to changing requirements, in other words by controlling the speed. EC motors in particular are far more efficient in the partial load range than AC motors with variable frequency drive control. There is yet more potential for saving if the air routing is optimized upstream and downstream of the fan.

What are the strengths of the new RadiPac impellers?
It is often not possible to exploit additional energy saving potential on account of a lack of space. Not so with the new RadiPac impellers: The air outflow from the impeller is directed in such a way that almost no losses occur when it is deflected into the main flow direction in an AHU. That was ebm-papst's comprehensive approach when developing the new impeller generation.

Do you have any more questions or specific requirements?
We will always be pleased to help. Just get in touch with us!

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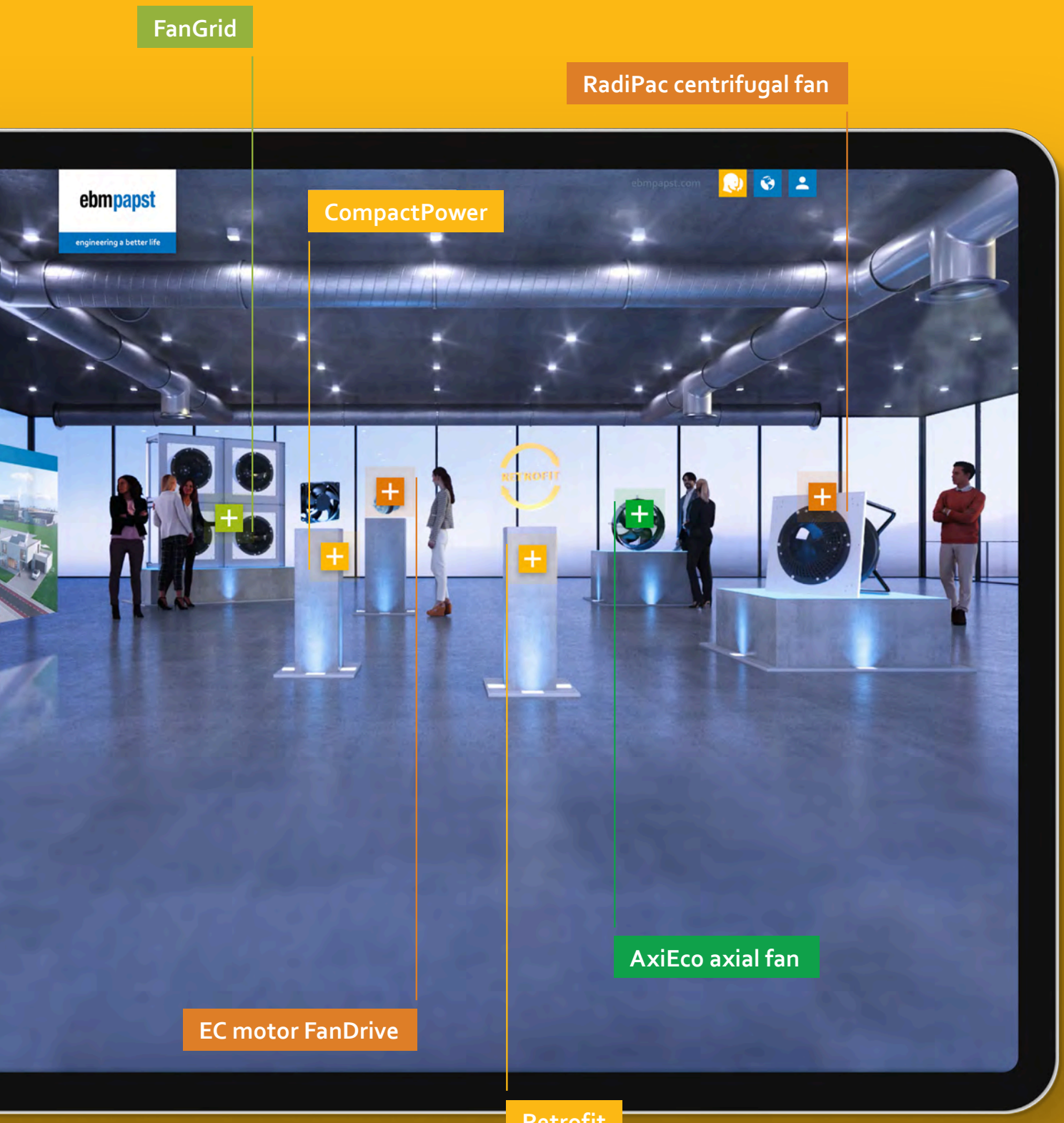
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CompactPower
AxiEco axial fan
EC motor FanDrive
Retrofit

What *Engineering a better life* **means to us.**

ebmpapst

engineering a better life

Who we are.

We lead air technology into the next generation: with innovative hardware and software solutions that are always more powerful, compact, efficient and sustainable than their predecessors. Over the years, this has made us the world's leading manufacturer for fans and drives and helps reduce the carbon footprint in our customers' applications.

Digitalization and the associated networking of intelligent components and systems play a central role for us. In this way, we create a holistic link between sustainability and digitalization and enable the responsible use of resources through intelligent solutions of the highest efficiency.

What drives us.

But our consistent pursuit of efficiency and progress has even deeper roots. After all, there is something that excites us even more than our market position. It is the deep awareness that, with our solutions we are making the lives of many people around the globe more pleasant, safer and thus better. Therefore, the central driving force in all our thoughts and actions is Engineering a better life. It is the reason why it is worthwhile for us to get up every day and do our best.

More about this at **ebmpapst.com/aboutus**

What you get out of it.

1. **Technological edge.**
With our EC technology, we combine the highest energy efficiency with the advantages of IoT and digital networking.

2. **Our sustainable approach.**
We take our responsibility seriously with energy-saving products, environmentally-friendly processes and through social engagement.

3. **System expertise.**
As experts in advanced motor technology, electronics and aerodynamics, we provide perfect system solutions from a single source.

4. **The ebm-papst spirit of invention.**
Over 800 engineers and technicians will develop a solution that precisely fits your needs.

5. **Personal proximity to you.**
With numerous sales locations worldwide, we create a glocal presence that ensures fast response times. We always consider the complete process and put the customer at the center.

6. **Our standard of quality.**
Our quality management is uncompromising, at every step and in every process.

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