

S-Force

The new generation of high-performance compact fans from ebm-papst.
World champions in air performance and pressure build-up.

1 | 2008



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S-Force: In the pole position at 14,000 rpm

The new measure of things!

When it comes to providing fast, powerful and efficient cooling for electronic components of all kinds, the S-Force series of high-performance fans is in the front starting row in terms of air performance, pressure build-up and technology.



Ready to win – with perfect aerodynamics, high-performance drive engineering and sophisticated design details. And made by ebm-papst.

Air performance with world-championship power

14,000 revolutions per minute, advanced motor technology throughout, sophisticated aerodynamics. Though it may sound like something out of the Indy 500, Le Mans or the Nürburgring, it hails from St. Georgen, Germany: the new generation of fans of the S-Force line. Five sizes, from 80 x 80 mm to a diameter of 172 mm, and all kinds of power bring the S-Force to the pole position for compact fans.

Because ebm-papst is always close to the customer, the development of the S-Force line started with that proximity. Manufacturers of mainframes, servers, base stations for telecommunications, control cabinets, and customers from a wide variety of

other industries ask for increasingly high-performance cooling solutions which, despite their power, are still compact and work relatively quietly. Because the power densities are growing while the space is getting smaller, they constantly have to dissipate more heat.

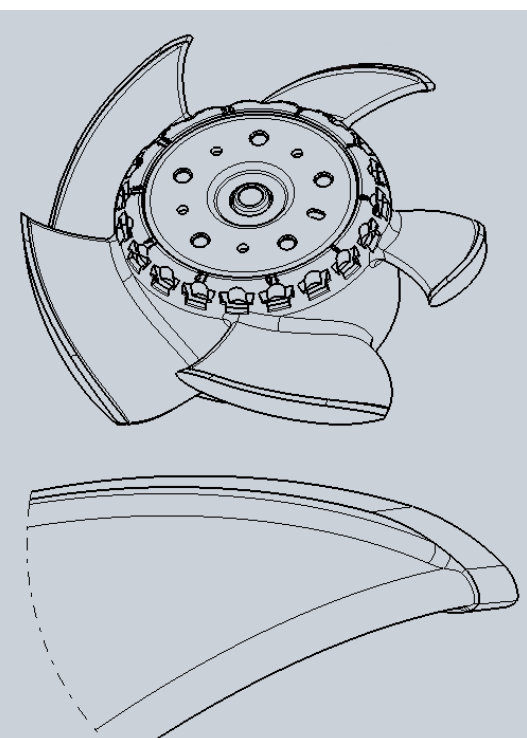
An analysis of the situation quickly led to a clear, unambiguous result- a paradigm shift in the strategy of cooling. Rather than using ever larger fans to move an ever-increasing amount of air with little focus, the future belongs to compact, fast-rotating fans with intelligent control that are networked to the overall cooling system. This provides highly focused and versatile heat evacuation. Among the other results of the analysis: future requirements cannot be met by merely continuing to develop the fans of the past. Only an entirely new development

would be able to provide the performance data customers expect. Overall Development Manager Mojtaba Moini fired a starting gun of sorts: "Gentlemen, start your engines..."

The S-Force fans set benchmarks in many areas. Completely newly developed 3-phase multipole motors with the latest magnet technology attain outputs of up to 320 watts and a very high efficiency of up to 89 %. The highly rigid housing with multiple fixed-link struts enables nominal speeds up to 14,000 rpm. Precision aerodynamic tuning of the impeller and venturi housing, combined with full motor output, ensure outstanding air performance and pressure build-up. High-strength ball bearings and the intelligent, speed-dependent self-ventilation of the motor unit guarantee running times of 70,000 hours or more without a pit stop.

Generation S-Force: Bigger, faster, more

In the world of IT and electronics, innovations keep progress moving at unimaginable speed. Fast processors and complex applications are setting the bar ever higher, and fan and cooling systems are no exception. We at ebm-papst are known around the world for our pioneering spirit as technological trend-setters. Precisely that is our inspiration to set the benchmark of the possible a new every day and precisely when, as is the case with the S-Force series, that means outdoing ourselves yet again.



impeller with sickle-shaped blades and winglets

It is obvious that nominal speeds of 14,000 rpm demand new and exceptionally ambitious solutions when it comes to optimizing the aerodynamics and fluid mechanics. Even in the smallest size of 80 mm, the tip of the impeller travels approximately 25 cm per revolution. At 14,000 rpm, this equals about 3.5 kilometers per minute, which yields a top speed of 200 km/h.

For the air, this means only one thing: speed, speed, and more speed. The 8200 series with a size of 80 x 80 mm, running at free air, moves up to 222 m³/h of air, while the 6300 series with the 172 mm diameter moves an impressive 950 m³/h. This air flow is more than twice what comparably-sized fans had been capable of. One thing is certain: normal speed was yesterday; in the S-Force, the air moves as if in fast-forward mode.

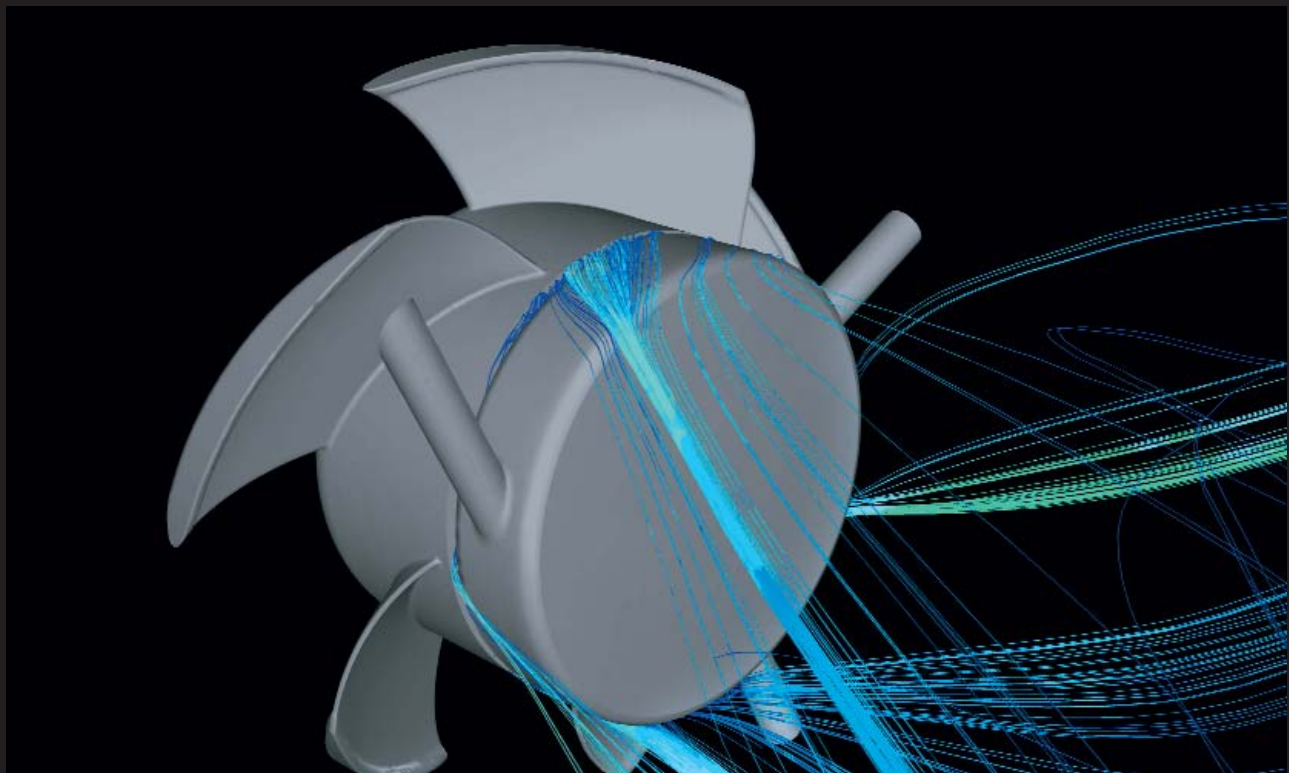
At the same time, the higher speed results in significantly higher pressure, as the pressure increases along with the square of the fan speed, while the air flow is proportional to the speed. Design measures have succeeded in guaranteeing an extremely practical pressure saddle curve that overcomes even massive obstacles such as high component density or large amounts of waste heat in the air flow. In the tip, the blower output—the product of the air flow and pressure increase—of the S-Force series increases by a factor of 16 compared to previous basic models.

Extensive simulations and tests were required, which led ebm-papst's engineers to innovative answers to the aerodynamic and fluid mechanic requirements for the design. For example, the ends of the S-Force line's impellers have winglets, like those

used in aviation. Furthermore, a precisely sized gap is left between the impeller and housing. Both measures contribute to a substantial decrease in air turbulence. This lowers the noise level and helps to improve the fluid mechanics. This is important because the less air turbulence there is, the higher the possible blower output. The precision optimization of the fan impeller design also helps to improve the aerodynamics and fluid mechanics. The curvature, blade profile and design integration of the blades to the rotor were optimized and adapted to the requirements. This also includes optimizing the material strengths. On the one hand, the mass moved at the enormous speeds must be as low as possible, while on the other hand, deformations at full load, which would impair the air performance and pressure build-up, must be eliminated.

Motors: Real coolness comes from within

From nothing comes nothing-this old proverb is as true now as ever. Therefore, the strong cooling performance of the S-Force generation begins with an extra-strong drive. Of course, the energy-saving and intelligent motors with ebm-papst EC technology are the first choice here. For maximum cooling capacity in every fan class and size, with minimal noise and energy consumption.



The S-Force line sets new benchmarks in performance, and it was clear from the beginning that this would be possible only with a new motor design.

The 120 mm and larger fan sizes use a three-phase motor rather than a single-phase motor and a nine-slot stator pack instead of four-slot one. Despite this, the size of this pack increased by only a few millimeters. In the two small motors, the existing rubber-ferrite magnets proved to be a very good solution. The 120 mm 4100NH model uses a SmFeN magnet with high residual magnetism, and thus a high magnetic flow density. The two largest types are equipped with particularly elaborate ceramic magnets.

Due to the sheer amount of power-320 watts-the self-ventilation of the motors has far-reaching significance. In the S-Force motors, it is speed-dependent. Using the computer-intensive flow simulations, the flow of air through the motor could be calculated and optimized for various operating points. In addition, components with a low thermal resistance were used and critical components were arranged in a favorable position for cooling. After all, real coolness comes from within.

As on the racetrack, sheer power is useless on its own. It has to be brought to the place where the rubber meets the road-in this case, the device to be cooled. Therefore, the S-Force fan is equipped with

Vario-Pro, a highly flexible software configuration which, though a control center in the fan, enables the fan to be adapted to the specific requirements. Embedded intelligence, so to speak.

The control center of the Vario-Pro consists of a microcontroller and an EEPROM on which all characteristics are saved. Software assumes the motor activation and application intelligence and thus replaces analog components. This digitization provides countless advantages, including minimal operating tolerances and freedom from drift, but most importantly, versatility-new application options or modified configurations can be quickly implemented on the computer in production.

Interview

**Compact fans with five times the motor output and double the nominal speed-how is this possible?
Or the highest air flow and pressure of all products on the market available on the market in its size?
With exemplary service life and efficiency?
Find out the answers here.**



Dr.-Ing. Walter Angelis
Manager Research and Development
Aerodynamics and Simulation

Dr. Angelis, what were the primary goals when developing the new S-Force generation of fans?

Our customers clearly ask for more power with the fan requiring an equal amount of space-or lower if possible. For us, the goal was to develop a new generation of fans that can provide a great deal more pressure and a great deal more air flow than previous models. We also wanted these fans, with these ambitious blower output goals, to have the lowest possible noise level, even at high counter-pressure.

What technical challenges resulted from a significant increase in speed?

The substantial expansion of the speed level required particularly robust mechanical designs to be developed. The bearings, impeller, fan housing and fixed connecting link are subjected to significantly higher strain. The desired performance data could be attained only with excellent motor and electronics technology. Of course, entirely new questions arose in the area of aerodynamics.

What do the most important solutions look like?

The fan housing has been made extremely rigid by optimizing the material strengths and using fiber-glass-reinforced plastic and aluminum in the larger units. The multiple fixed-link design and its asymmetric arrangement give the fan housing additional stability and robustness. At the same time, an optimum fixed link profile allowed the aerodynamics to be improved and the level of the pressure saddle curve in the fan curve to be raised.

The newly-developed 3-phase multipole motors with 6 to 12-pole magnetized rotor units in the 9-slot stator pack provide up to 320 watts of peak power. In addition, outstanding values were attained by improving the air flow through the inside of the motor. The optimized self-ventilation is indispensable for the long service life of the motors. The use of winglets at the tips of the impeller and the particularly steep aerodynamic curves of the impellers set new benchmarks. All of this is testimony to the amount of knowledge and innovative capacity possessed by ebm-papst.

Will the new generation of fast-rotating fans have an effect on the development of installations such as control cabinets?

We are at the beginning of a new era. Our customers want solutions that allow them to provide a highly focused air flow through their installations. The prerequisite is the intelligent networking of the individual fans and the ability to control them individually according to the specific situation. The S-Force line's modern electronics make highly individualized solutions possible. On the other hand, there is already pressure from the market-particularly from our customers' research departments-to provide space-saving, high-performance cooling solutions in response to the ever more compact equipment and associated heat build-up.

Three-phase multipole motors-doesn't that equal complicated motor technology with elaborate activation electronics and, above all, for technical knowledge on the part of the owner/operator?

Not necessarily. In S-Force fans, the operating electronics are fully integrated into the fan. The commutation and operating electronics are already onboard and require no particular attention from the user. By the way, the S-Force fans are equipped with a digital motor management system with microprocessor-controlled electronics. This means that the EC technology of the S-Force generation offers many additional features that are available as options and offer significant added value to the customer.

What features are implemented in the S-Force?

Of course, these fans are equipped with reverse polarity and overload protection. Optionally, we equip the motors with a wide variety of different control, interface and monitoring functions. Everything is possible, including speed monitoring, alarm signal, open loop speed control via PWM, control voltage or via integrated or external temperature sensor, and even special designs in IP54.

Which sizes are currently available?

Based on comprehensive market analyses, 5 sizes have been developed and implemented. The first step is axial fans in the standard dimensions from 80 to 172 mm. In the next step, centrifugal fans will be added to the S-Force generation. We will bring the first radial fan series to the market later this year; axial fans are already being sold ex stock.

S-Force overview

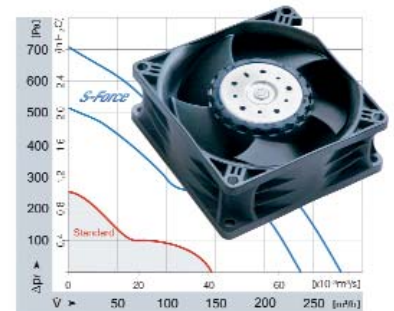
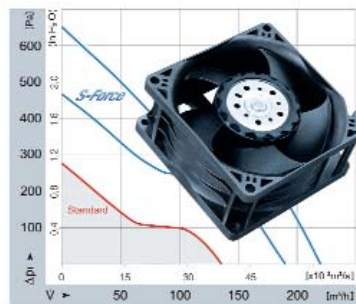
The strongest team in the league The entire package of the new generation of compact fans is divided into five series. Each series is the benchmark in its class in terms of air performance and pressure build-up. In a wide range of applications, the high-performance fans feature the highest cooling air flow at operating points with high counterpressure, high motor efficiency and a long service life. Wherever you need powerful cooling fast, they are the solution to which there is hardly an alternative.

Designation

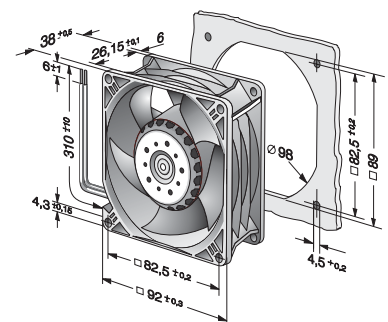
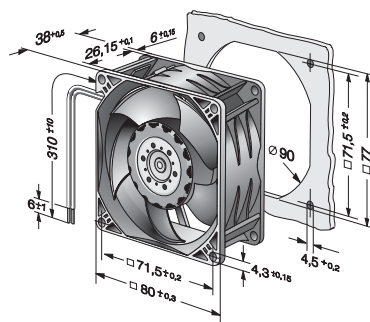
Series 8200 J

Series 3200 J

Series



Dimensioned drawing

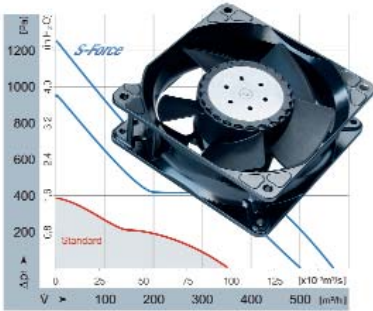


Dimensions	mm	80 x 80 x 38	92 x 92 x 38
Air flow	m ³ /h	190 ... 222	237 ... 280
Nominal voltage	V DC	12, 24, 48	12, 24, 48
Sound pressure	dB(A)	66 ... 71	69 ... 73
Power input	W	25 ... 39	30 ... 50
Nominal speed, max.	rpm/hours	14.000	13.000
Service life, max.	Std	55.000	65.000
Temperature range	°C	-20 ... +70	-20 ... +70
Bearing system		Ball bearings	Ball bearings
Housing material		Plastics PBT	Plastics PBT
Impeller material		Plastics PA	Plastics PA

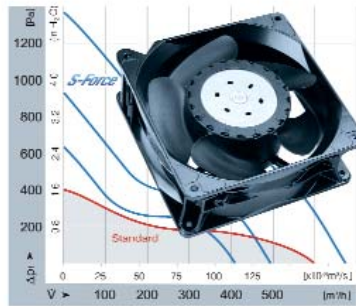
The typical application fields of the S-Force fans:

- ATCA systems
- IT and telecommunications
- Frequency inverter
- Control cabinets
- Printing machinery
- Industrial applications

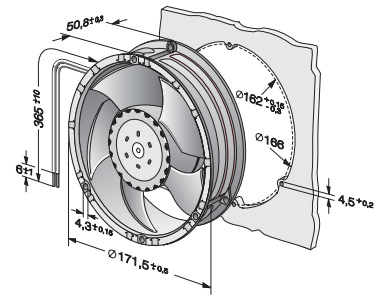
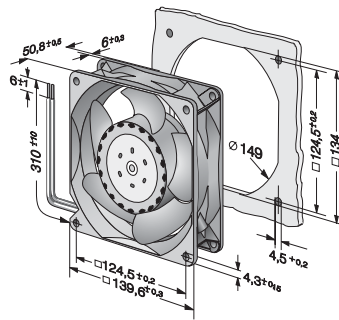
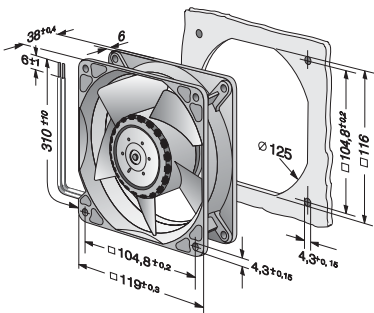
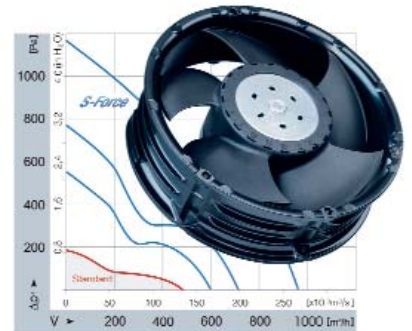
Series 4100 NH



Series 5300



Series 6300



119 x 119 x 38
 500 ... 570
 24, 48
 76 ... 78
 90 ... 120
 11.000
 57.500
 -20 ... +75
 Ball bearings
 Aluminium
 Plastics PA

140 x 140 x 51
 410 ... 670
 12, 24, 48
 70 ... 79
 41 ... 144
 9.200
 70.000
 -20 ... +70
 Ball bearings
 Aluminium
 Plastics PA

∅ 172 x 51
 600 ... 950
 12, 24, 48
 64 ... 75
 41 ... 150
 9.200
 70.000
 -20 ... +70
 Ball bearings
 Aluminium
 Plastics PA

Development, production and delivery from a single source

At ebm-papst, the development and production of motors, fans and electronics come from a single source. This ensures that all component parts are exactly matched to each other and yield optimum performance. Of course, we hardly need to mention that the delivery and logistics are just-in-time and from a single source. Whether in Germany or at our international locations, we provide first-class service and logistics offerings from onsite technical support to inventory management.

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