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Diagonal compact module for filter fans

Smart electronics cooling for industrial applications

Electronics housings and control cabinets are often jam-packed; they need to accommodate more and more components. Their unavoidable waste heat results in hot spots that can easily reach temperatures of over 90 °C, causing heat stress that significantly reduces the performance and service life – and in extreme cases causes the destruction – of sensitive electronics. So-called filter fans, units that combine fans and dust filters, can help by conveying excess heat out of control cabinets and electronics housings while also preventing the ingress of dirt particles. Diagonal fans in compact modules are a breath of fresh air in many respects, with their flat design, high pressure stability, constant output and reduced noise levels.

To ensure that electronics function reliably, the waste heat resulting from their operation needs to be dissipated as efficiently as possible. This is usually done using a filter fan in the housing door to blow cold air into the interior. The air takes up the heat inside the housing, rises, and exits through an outlet grill or is extracted by an additional fan (Fig. 1). In practice, however, performance differences in the filter fans used are often observed. The axial fans that are often used frequently reach their limits, especially at high back pressures, which can be caused by high component density or increasingly fouled filter pads. The reason has to do with their operating principle.

When axial fans are no longer enough

Since the air flow in axial fans is parallel to the impeller’s axis of rotation (hence “axial”), they can convey large amounts of air but only at low static pressure. This means they are best suited to free-blowing applications. Outside the correct operating range, i.e. at increasing pressure beyond the saddle point, the noise level of axial fans increases considerably because the flow stalls on the impeller and turbulence arises. At the same, the fan’s efficiency decreases. A

frequent reason for such a pressure increase is a dirty filter pad. As a result, centrifugal fans are usually the right choice when applications call for greater pressure stability. In this case, flow through the impeller is radial, i.e. perpendicular to the rotation axis. Since the entire flow exits the impeller at the outer edge where the higher rotational velocity is used to impart energy, the centrifugal fan produces a greater pressure increase. However, the amount of air conveyed is lower.

Motor and fan specialist ebm-papst has combined the advantages of these two different fan concepts in a new diagonal compact module (Fig. 2). The module is currently available in size 200 with identical dimensions, with the choice of drives using AC motors or the especially efficient GreenTech EC motors. Both versions are specially designed for use in filter fans. Other sizes are in the planning phase and will be implemented as demanded by the market.

Axial plus centrifugal makes diagonal

With axial inflow, the fan blades in diagonal fans move the air both axially and radially. The advantage of such a configuration is air flow that is largely similar to that of an axial fan but with a greater pressure increase. The curve is steeper and the saddle point is at a higher back pressure, which results in more constant air performance over a broad range when the fan is installed under operating conditions (Fig. 3). With back pressure, the adjustable modules equipped with GreenTech EC motors deliver up to 50% higher air flow than classic axial designs (for the same size and operating point), have lower noise emissions and consume up to 49% less power at the same air flow. Over time, this results in significantly lower energy costs for cooling control cabinets and housings (Fig. 4) while reducing CO_2 emissions.

Longer maintenance intervals for filter pads and quieter operation

As filters become increasingly clogged, the diagonal compact module supplies the air performance needed for heat dissipation. This considerably reduces power loss in the control cabinet, which in turn significantly enhances the cooling action. The diagonal compact module’s pressure-insensitive curve lengthens both the service life of the filter pads and the maintenance intervals (Fig. 5). With the speed control for the EC motors via the 0-10 V interface, the air performance remains constant even with clogging; the cooling capacity adjusts to meet demand, and waste heat can always be dissipated in corresponding amounts so that the electronics are cooled reliably. The same applies when the intake temperature of the cooling air varies due to diurnal or seasonal effects.

The diagonal compact modules are also up to 7 dB quieter than conventional axial solutions – a clearly noticeable noise reduction, especially in situations where many control cabinets or electronics housings need cooling. At over 70%, the especially high efficiency of the EC motors also reduces the amount of waste heat generated by the fan itself; heat that is not generated does not have to be dissipated – a welcome effect for cooling applications in particular.

Simple conversion

But the diagonal compact modules have more to offer. They can be easily mounted on filter frames and are mechanically compatible with the industry standard, with external dimensions similar to those of the familiar axial design to facilitate easy replacement.

And they can be installed on either the intake or the outlet side, so those who install filter fans both ways need not stock multiple models. Plug connectors simplify electrical hookup, and the diagonal compact module can be installed in four different orientations 90° apart depending on the required plug position. Optional guard grills for outlet or intake side mounting round off the advantages offered by the diagonal compact module. The guard grills are aerodynamically optimized and can simply be snapped on without tools. Now an easily installed, practical and energy-efficient solution is available for filter fans to cool electronics housings and control cabinets.

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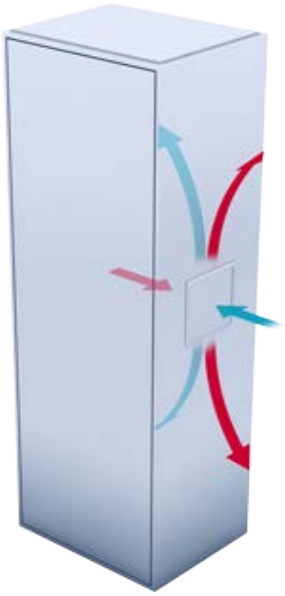

Fig. 1: Electronics cooling with filter fans: The air blown into the housing takes up the heat inside, rises and exits through an outlet grill or is extracted by an additional fan.

Fig. 2: The impeller in the diagonal compact module combines the positive features of an axial and a centrifugal fan.

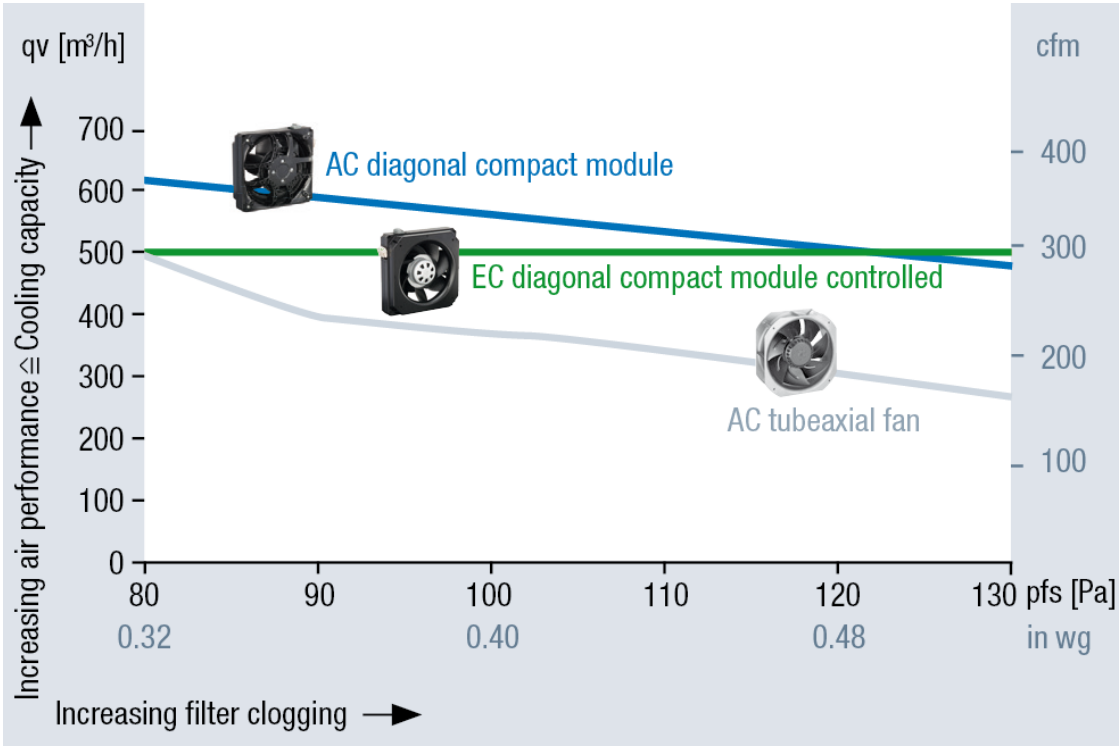

Fig. 3: Constant cooling capacity even as filter becomes clogged

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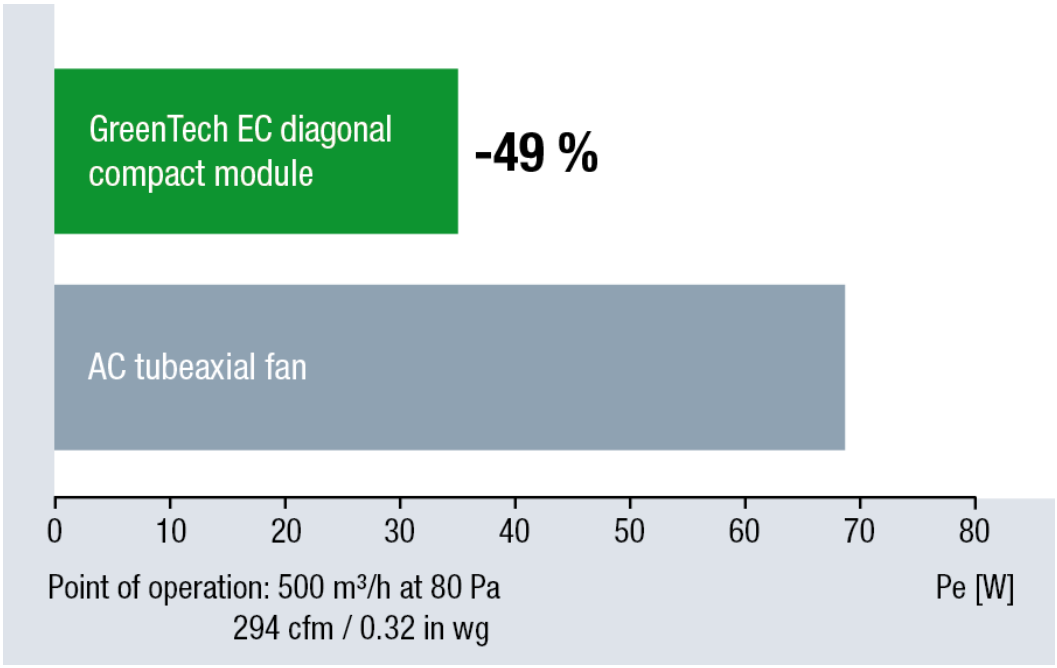

Fig. 4: Significantly lower energy consumption than an AC axial fan

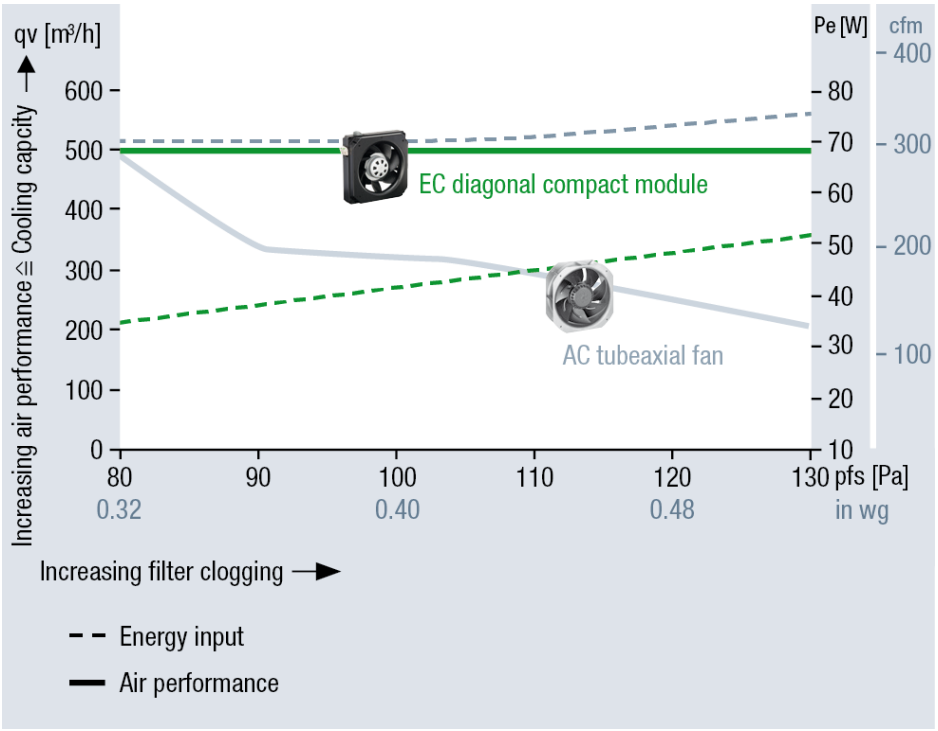

Fig. 5: The pressure-insensitive curve lengthens both the service life of the filter pads and the maintenance intervals.

About ebm-papst

The ebm-papst Group is the world's leading manufacturer of fans and motors. Since it was founded, the technology company has continuously set global market standards. Developments have ranged from electronically controlled EC fans, through aerodynamic improvements of fan blades, on to the resource-conserving selection of materials, with sustainable materials being just one option.

In fiscal year 2015/16, the company achieved sales of almost €1.7 billion. ebm-papst employs approximately 13,000 people at 25 production sites (in Germany, China, the United States and elsewhere) and in 49 sales offices worldwide. Fans and motors from the global market leader can be found in many industries, including ventilation, air conditioning and refrigeration, household appliances, heating, automobiles and drive engineering.