

02° 2013

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all about ebm-papst

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EC OLÉ

After some lively discussions and level-headed calculations, a Spanish abattoir operator decided on EC rather than AC





”Japan awakes to new life“

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New ideas on familiar topics

Thomas Borst
Managing Director
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Dear Readers – certain topics are real evergreens: no matter how often they have come up before there is always room for discussion. For example, noise reduction and energy efficiency have become absolute best sellers around the world. Not least because the use of innovative technology makes air conditioning, ventilation and refrigeration systems quieter and also more efficient, thus helping to save money as well.

As our current leading article from Spain (page 24) shows, the new AxiTop diffuser is an excellent example of such technology. Its outstanding features ensure market success and play a central role in system planning. In the world of centrifugal fans, the new compact

RadiPac product range means that customers can design more compact new devices, thus saving space, materials and costs as well.

This product range is also one of the factors giving impetus to another evergreen topic: The modernisation of ventilation and air conditioning systems is an expanding market around the world. As already experienced with refrigeration systems, we are now also witnessing a similar development in these sectors – one reason being that users can now easily replace less efficient fans with convenient plug-and-play concepts. And such conversion can have a significant effect as shown by the example of a data centre (page 17). I hope you will feel similarly inspired by reading this edition of your mag°! ○

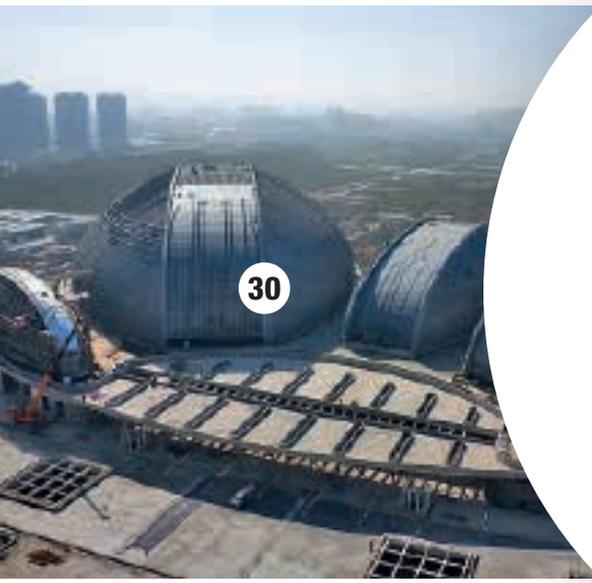


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Prize for presentation

Architecture award for new trade fair stand

The completely re-designed ebm-papst trade fair stand was on show for the first time in March at the ISH, the world's leading trade fair for Bathrooms, Building Services, Energy, Air Conditioning Systems and Renewable Energies in Frankfurt. And the stand did not just make a good impression on visitors; the jury of the Iconic Award 2013 found it so appealing that they awarded it a prize in the "Architecture at Trade Fairs and Events" category.

Comprehensible graphics and integrated touch pads provide a clear product guide. A green DNA double helix rising out of the centre of the trade fair stand is intended to symbolise that the GreenTech philosophy is part of the genetic make-up of ebm-papst. The design council awards this prize to honour outstanding architectural and interior design concepts.



Prize-winning presentation area: The new ebm-papst trade fair stand



Dirk Schallock at the ground-breaking ceremony for the new St. Georgen test centre

What's the spade for, Mr. Schallock?

Dirk Schallock, managing director of ebm-papst St. Georgen, talks about the new test centre

Mr. Schallock, what are you building here?

On 17 July we held the ground-breaking ceremony for our new test centre in St. Georgen, which is due to open in the second half of 2014. We are investing more than two million euro in this project.

And what will you be testing?

The centre will enable us to measure the acoustic and aerodynamic properties of our products in their application environment, for instance in vehicles or in telecommunications devices. The test centre is to be constructed on the so-called room within a room principle. In

other words, the measurement area is mechanically isolated from the building, thus permitting extremely accurate measurements to be taken without any interference from vibration for example.

Why go to such trouble?

In future, the test centre will allow us to perform psychoacoustic noise analysis for example. Understanding of positive acoustic sensations can give us a competitive edge. Equally important is the analysis of the aerodynamic properties of new products with a view to constantly improving their performance and energy efficiency. Our customers insist that our products and concepts should satisfy ever higher standards in terms of performance, reliability and quiet operation. As a leading technology supplier, we meet these challenges with our highly qualified development work, which in turn helps to secure jobs at the plant.

Swedish anniversary

40th birthday celebrations at ebm-papst AB

Our Swedish colleagues had cause for celebration in February. Employees from the head office in Järfälla and the Skinnskatteberg production plant gathered to mark 40 years of ebm-papst in their country. They celebrated this anniversary with a special lunch and a huge birthday cake. 42 Swedish colleagues also visited the Mulfingen head office at the end of August, where they took a look at various production lines and the development department. Founded as a joint venture in 1973, the Swedish branch has been a full member of the ebm-papst Group since 2006. Today, there is a total workforce of 60 at the seven locations in Sweden.



Managing director Bengt Knutsson cutting the cake

Amongst the elite

ebm-papst chosen as one of the top 100 German businesses

In July, compamedia GmbH awarded the "Top 100" prize in Berlin to Germany's most innovative businesses for the 20th time. And this year ebm-papst has joined this exclusive club, where the firm is in very good company: 51 domestic market leaders and 21 world market leaders are to be found in the list. In 2012 the total turnover of all the companies honoured was in the region of 13.5 billion euro,

around 10 per cent of which was invested directly in research and development.

The prize is awarded on the basis of a company analysis conducted by Professor Nikolaus Franke, holder of the chair of entrepreneurship and innovation at the Vienna University of Economics and Business. This year he and his team took a closer look at 245 companies from which the winners were chosen.

Dr. Bruno Lindl (right) receiving the certificate from Franz Untersteller, the regional minister of the environment



AxiTop comes out on top

ebm-papst nominated for environmental technology prize

The AxiTop diffuser made of epylen, a wood-plastic composite, was nominated for the Baden-Württemberg Environmental Technology Prize in the energy efficiency category. "We were particularly delighted to be honoured in this way, as the product was developed on the basis of our GreenTech philosophy, which aims to manufacture products designed for maximum energy efficiency whilst at the same time preserving resources," explained Dr. Bruno Lindl, research and development director, who was presented with the certificate by Franz Untersteller, the regional minister of the environment. The diffuser helps to significantly reduce noise and enhance efficiency in applications such as heat exchangers.

ebm-papst is one of Germany's most innovative businesses



Supplier of excellence

Wolf honours ebm-papst as “Supplier of the year”

For the first time, Wolf GmbH has chosen ebm-papst as “Supplier of the year” in recognition of outstanding quality, punctuality, reliability and service. On top of all these criteria, the heating, air conditioning, ventilation and solar systems provider emphasised ebm-papst’s contribution to the introduction of air conditioning units with energy-saving RadiPac fans. “Thanks to EC technology we have together achieved an outstanding position on the market. And so we are delighted to receive this award and look upon it as an incentive for the future,” says Alfred Müller, ebm-papst sales manager for Germany.



Presentation of the “Supplier of the year” certificate at Wolf GmbH in Mainburg, Bavaria



Young connoisseurs: The children from the Robert-Gerwig school prefer fruit and vegetables to chocolate

A healthy break

Free fruit and vegetables for school children

Twice a week the pupils of the Robert-Gerwig primary school in St. Georgen collect an assortment of fresh fruit and vegetables for their classmates. For two years now this has been made possible by the European Union’s School Fruit Scheme, financed equally by funds from the EU and sponsors including ebm-papst. The aim is to get children interested in healthy eating and show them that fruit and vegetables are not just nutritious but taste good too. Around 200 school children in St. Georgen enjoy the benefits of this scheme. An evaluation of the programme shows how successful it is: “The children are now familiar with nearly all types of fruit and vegetable, which wasn’t the case a year ago,” explains teacher Barbara Riege, “And more importantly still: They actually enjoy it. The children now prefer to eat fresh fruit in their breaks rather than sweets.”

GreenTech worldwide

Making the world greener: Energy-saving seminar in the Urals

Environmental awareness is a matter of course for ebm-papst. So our branch in the Urals staged an energy-saving seminar for its customers on 5 June (UN World Environment Day) as part of the global “Every day is a GreenDay” campaign. Several presentations focused on ways in which efficiency potential can be fully exploited these days in a broad range of applications. And of course the spotlight was on the benefits of GreenTech EC technology. Not without success: Whilst the event was still in progress, ebm-papst entered into a strategic partnership for several pilot projects with Frigomax, a local supplier of supermarket refrigeration equipment.



The seminar was attended by representatives from numerous local businesses

WWW.GREENTECH.INFO



“This is a meeting place for any number of different branches of technology, from domestic ventilation systems to switch cabinet cooling and refrigeration engineering. And the exchange of information between the various sectors works to everyone’s advantage, as all can benefit from the shared knowledge.”

Eberhard Paul, founder of Paul Wärmerückgewinnung GmbH



“For development specialists such gatherings are crucial, as they permit direct contact with customers. In turn, customers gain an insight into the latest developments directly from their customers and rivals.”

Alfred Müller, sales manager for Germany at ebm-papst Mulfingen



“The event gives us the opportunity to analyse the market and take a look at what rivals and customers are doing, to

stablish where we stand from a technical point of view and to get an idea of what might be needed in the future.”

Stefan Bauer, head of project account/product management at emco Bau- und Klimatechnik GmbH & Co. KG



“This is an extremely important event for keeping in touch. Although the name ebm-papst is synonymous with EC fan technology, it has still not become established in all market sectors. So it is essential to promote the technology and new developments.”

Claus Händel, technical expert from the Building Ventilation and Air Conditioning Association.



“One of our main areas of interest is finding out about how new technologies come about. And this sort of forum provides an ideal basis for the communication essential to the generation of new ideas.”

Dr. Ralph Hintemann, senior researcher, Borderstep Institute for Innovation and Sustainability



Platform for progress

Experts discussed current and future developments at the fifth innovation forum

“Technological progress is only possible where technology and interests go hand-in-hand – right through from individual components to the end customer,” says Dr. Bruno Lindl, research and development director of the ebm-papst Group, in explaining the idea of the innovation forum. The Mulfingen company staged the event for the fifth time in June. Around 250 participants followed presentations by 28 experts from independent institutes, customers and ebm-papst on developments taking place in the fields of ventilation and air conditioning, computer centres and utility engineering. In keeping with the motto “Create efficiency – mould the future”, the event also provided a platform for an informal exchange of ideas, as the participants were keen to confirm:



▶ Watch ebm-papst°TV on mag.ebmpapst.com

“The forum provides a showcase for innovative ideas and progress from which everyone can learn. And so it is an ideal event for the people whose job it is to actually bring new products and developments onto the market.”

Mathias Lich, head of service and product management at GEA Heat Exchangers, GEA Küba GmbH



“We as manufacturers depend on the input we receive at such gatherings. For instance it is important to find out about the latest ebm-papst research projects and to see how fans are being optimised to make sure we are able to keep up with developments.”

Ralf Panknin, company manager and authorised signatory of Stulz GmbH





1972



ebm is already well established at the Hanover Trade Fair. The time has now come for the company to present itself on the international stage as well. Stands bearing the ebm logo can be seen at a total of nine trade fairs.

50 Years

The engineer's
choice



1963

The first product to come off the line at ebm is the "Behr fan". At the same time, bearing failure in the centrifugal fans for range hoods represented a threat to the company's livelihood. The answer to the problem was the "68" motor with ball bearing which already existed as an oil burner motor.

1977



Business boomed at ebm in the seventies. Consequently: Space was at a premium in the factory. To guarantee quick success in tough negotiations to acquire new building land, Gerhard Sturm has to resort to some strong arguments. Success justifies the means.



“We need determination to be successful”

Company founder Gerhard Sturm talking in an interview about future opportunities and challenges for ebm-papst

Mr. Sturm, you can look back on 50 years of prosperity. What is the secret of ebm-papst's success?

Our constant efforts to keep moving forward – both with regard to the company and our products. Ever since I founded ebm together with Heinz Ziehl, our company philosophy has always remained the same: Every new product must be ecologically and economically superior to its predecessor. And so we would never dream of resting on our laurels. On the contrary, we should be looking

ahead to the next 50 years. We will only be able to maintain our current rate of growth if we continue to develop new, highly innovative products.

What does that mean in concrete terms?

The whole area of system solutions has gained tremendously in significance for us. After acquiring the specialist gear company Zeitlauf, our plant in St. Georgen is now in a position to provide complete drive systems including gear units

and control electronics. This means we are able to compete with low-cost manufacturers in the Far East. In Landshut we are seeing clear signs of a similar development towards system solutions including gas valve technology and electronics. We must however also consider the possibility of offering system solutions for customers above and beyond our regular product portfolio. Not just from the point of view of the added value, but also to guarantee the use of our products. If we were to provide control techno-



1975



ebm develops the first EC motor – three decades before energy saving became a major issue at a political level. In view of the high production costs involved, the internal attitude towards the EC motor is still somewhat critical, however the computer industry is already starting to demand energy-saving compact fans – and an efficiency level of around 65 per cent speaks volumes. By way of comparison: At this point in time a comparable shaded-pole motor just about manages 15 per cent.



1980



In the early days, Gerhard Sturm used to drive his employees to work in his own Ford Taunus. Now a whole fleet of company buses does the job instead. Kind to the workers' pocket and to the environment too.



logy for other components as well – for example in the refrigeration compressor sector – we could considerably expand our electronics production. We should however also bear in mind large fans for industrial applications like those we are already manufacturing in Hollenbach. Or fans and motors required to satisfy highly specific demands – for instance in explosion-proof devices as used nowadays in the petrochemicals industry. The main thing is to broaden our horizons whilst at the same time maintaining close contact with our customers.

And how do you intend to manage that?

Allow me to use the following image to explain my idea: I see ebm-papst as a large tanker in the midst of a group of smaller, more manoeuvrable ships and boats. All are largely free to travel the seven seas and dock at all the world's harbours. But: All the ships and boats regularly come back to the ebm-papst mother ship to report on their journeys and plans and present the results of their work. Experts call this divisionalisation. This development has been coming for years. And since every ship needs a captain and a crew, there are plenty of opportunities for motivated employees to climb up the ladder.

On which international markets will ebm-papst be intensifying its activities in the future?

We are still working on getting ourselves established in the USA. The trend towards energy saving has been a help – as it enabled us to diversify into various sectors. One new outlet is the market for precision climate control technology in data centres. Products from St. Georgen have already achieved some initial, albeit modest success in the American automotive industry. The major obstacle to resounding success in the USA over the past 30 years has been the dollar exchange rate. Competition in China is fierce, but we are nevertheless aiming to achieve substantial growth by tailoring our business to the demands of the market. For example our new, ultra-modern development centre in Shanghai will help us react even better to the requirements of local companies in future. We are equally convinced of the potential offered by the Indian market and have in-

“A company needs a highly motivated team prepared to go through thick and thin.”



“We've won the Federal Order of Merit,” the entire workforce proudly chants as Gerhard Sturm receives the award on the company's 25th anniversary. He himself emphasises that he was only acting on behalf of his employees in accepting the distinction. Jovial celebrations all round.

1988



1999



1996

Expansion in Hungary is followed by major developments in Asia: The new building of the ebm-NADI joint venture is inaugurated in Madras in India. The first small sales office opens in Shanghai – and rapidly grows to a considerable size thanks to the untiring efforts of the employees.



2009

A new logo to symbolise the company philosophy: GreenTech. The underlying principle goes back to Gerhard Sturm's original way of thinking: "Every new product we develop must be economically and ecologically superior to its predecessor."



Looking back on 50 years of prosperity – and into the future: Company founder Gerhard Sturm

vested in a new, high-performance factory in Chennai to enable us to supply Asian countries even more efficiently. A decision which to this day has proven its worth. So I am expecting ebm-papst to carry on growing in India as well.

All-in-all that sounds as if there are plenty more challenges waiting for ebm-papst.

That is true, but I don't have any worries about ebm-papst! The challenges we are currently facing are nothing other than normal growth problems. We just need to do our homework.

Let's not forget that we are already in an excellent position throughout. In future success will not necessarily depend on having "better" products, it will be a matter of getting on the market first. And to do that, a company needs a highly motivated team prepared to go

through thick and thin. We need total commitment to success! Our outstanding workforce is our most valuable asset. ebm-papst remains a family business and that is how we intend to keep it. The positive spirit of the early days still lives on. When all said and done, there is no law which says that anonymity has to increase with the size of a company and that the human aspect has to suffer.

I am pleased to see the current management upholding the spirit of the ebm-papst family. After all it makes good sense: What is good for the company is good for its employees. ○

“Our secret for success: Our constant efforts to keep moving forward.”

Start of the ebm marathon. For the first time the company is the main sponsor of this event. There are 432 contestants. 13 years later the number is already up to 3,500 – including some top athletes. ebm also takes on responsibility for the “Young researchers” competition and organises the regional contest. Both events were primarily initiated by Thomas Philippiak.



2003

Management unveils a secret in October: In future all members of the ebm Group are to bear the company name “ebm-papst”. Papst, based in the Black Forest, had already been taken over in 1992 and was joined by the Alcatel SEL factory in Landshut in 1997.

**Miele is the world's first
manufacturer to fit
EC technology in range hoods**



Cooking the Eco way

The new generation of Miele range hoods has
energy-efficient technology at heart

*Rainer Ragert of Miele/imperial,
Gerald Ehrler and Wolf-Jürgen
Weber of ebm-papst with
the EC blower*



A kitchen is not only a place for cooking or having a chat, it is also a source of considerable power consumption: It offers tremendous potential for savings, from the fridge right through to the stove. A fact of which kitchen appliance manufacturers are also well aware. "Nowadays energy efficiency is at the forefront of people's minds," explains Rainer Ragert, head of development at the Arnsberg plant of the Miele subsidiary imperial, the Miele Group's centre of excellence for range hoods. "So we put some thought into how we could pick up on this development and make our products even more efficient."

The solution: Forever better Ragert is himself involved in the creation of a new EU-wide energy efficiency label designed to show consumers at a glance whether or not a range hood for example is fitted with power-saving technology. At a joint meeting in Mulfingen, engineers from

both companies therefore took the decision to develop a special blower with particularly low energy consumption. "We knew that the EC motor from ebm-papst already fulfilled the corresponding technological requirements," explains Rainer Ragert. "But certain modifications to the motor were still necessary to suit our purposes." In keeping with the Miele motto "Forever better", we wanted to work together to come up with a solution which would be a real bonus to consumers: Quiet operation, reliable extraction – for small fitted kitchens, combined dining / kitchen areas and kitchen islands – and also greatly reduced power consumption. Miele is thus the first manufacturer to offer range hoods featuring EC technology. A conscious decision in favour of top quality in a highly competitive market.

Success of the pilot model The first step involved ebm-papst engineers bringing the dimensions and electronics of the EC blower into line with



Top: Gerald Ehrler, Hans-Jürgen Weber and Rainer Ragert (from the left) inspecting the new range hood

Centre: The individual components of the unit with the EC blower at the top left

Bottom: Intense coordination meetings were needed before the blower with EC motor could be introduced



those of the AC blower previously used. Miele presented the world's first range hood with EC technology in 2011. This pilot model was just produced in one size to try it out on the market. The highly innovative unit went by the name of "Eco package". In view of the fact that the efficient hood met with a good reception from customers, Miele started equipping the next series with full EC technology. Miele then integrated a new control system specially matched to the ultra-modern EC blowers into their "Generation 6000".

Coordination at many levels On top of the purely technical aspects, there was another central challenge: "The crucial factors in this project were the limited time available and the need for coordination between lots of different people in different places," explains Gerald Ehrler, project manager at ebm-papst. Three groups were working on the project at the same time: imperial Arnsberg on the range hood, Miele Gütersloh on the control system and ebm-papst in Muldingen on the motor and control system coordination. At first the deadline set for the series launch looked almost impossible. But thanks to intensive cooperation, not least with managerial involvement and any number of coordination meetings, the engineers managed to overcome all the obstacles: In the end, the VDE approval required for the blower was obtained the day before the set deadline and the unit went into series production just in time.

Blower in coasting mode All these efforts bore fruit: With energy efficiency as the main winning feature. "In the lowest speed setting the EC blower uses next to no power as it runs in the part load range," explains Ehrler. "Like allowing a car to coast along at 120 kilometres per hour on a straight road." ebm-papst engineers are still working on pressure stability and noise generation to find the ideal answers here as well.

A combined approach to saving As a range hood is only used for around one hour a day on average, Miele combined the EC technology with other measures designed to reduce energy consumption even further. Stand-by consumption was reduced and new lighting elements were introduced for example. In the past, consumers only had the choice of good lighting with high power consumption or low power consumption but a poor view of the cooker. Miele now uses high-performance LED lights with a power consumption of only two watts each for illuminating the hob. Commercially available halogen lamps need around ten times the amount of energy. What's more, the LEDs are designed to last for the entire lifetime of the range hood – in other words they never have to be changed in 20 years.

The working relationship of the various companies is also a long-term affair. A range hood blower jointly developed by imperial and ebm-papst 20 years ago is now accepted as the standard for the global market. "There are many points of contact between the Miele Group and ebm-papst and that has been the case for many years now," says Rainer Ragert. "Because our aims are very similar: Development expertise, customer satisfaction, consistency and sustainability." ○

A FRESH BREEZE IN THE DATA BANK

A data centre in the United Kingdom switches to EC fans and reduces the energy consumption of cooling units by 50 percent

At the data centre of a major investment bank in the United Kingdom servers process astounding amounts of sensitive data every day. Reliability is everything, and failure is not an option. Therefore, good cooling is indispensable. Some 76 air-conditioning units ensure that this job is done well. As recently as 2006, facility management provider installed new air-conditioning units in the bank's data centre. When just five years later, Emerson Network Power – which provides services focussed on business-critical processes – suggested replacing belt-driven AC fans with efficient GreenTech EC fans from ebm-papst, the customer was interested straight away. "Our customers are generally very open-minded towards projects in data centres, as these rooms use a great deal of energy, and the savings potential is extremely large," explains Helen McHugh, Divisional Manager at ebm-papst United Kingdom. As a result, the customer decided in favour of the upgrade in this case. When switching from AC to efficient EC fans, Emerson Network Power had to meet a variety of criteria. The installation team was only allowed to

take one air-conditioning unit off-line at a time, and at no point during the upgrade was the data centre to be shut off. Thus the air-conditioning units were successively retrofitted during operation with adapted GreenTech EC centrifugal fans made of aluminium, which were installed in the ground.

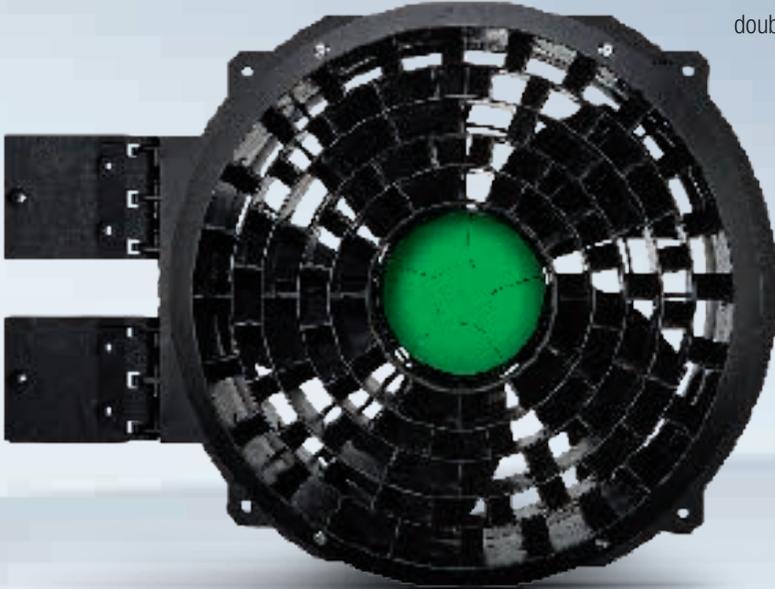


In the United Kingdom alone, data centres use approx. 6.4 gigawatts of energy annually – this corresponds to the consumption of six million private households. The savings potential in the cooling system, which is responsible for half the energy consumption of a data centre, is enormous.

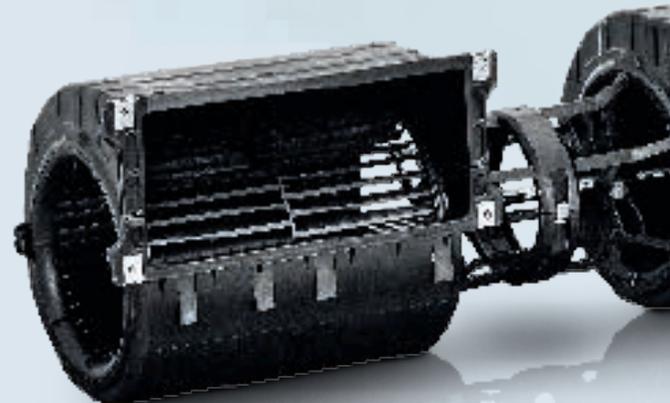
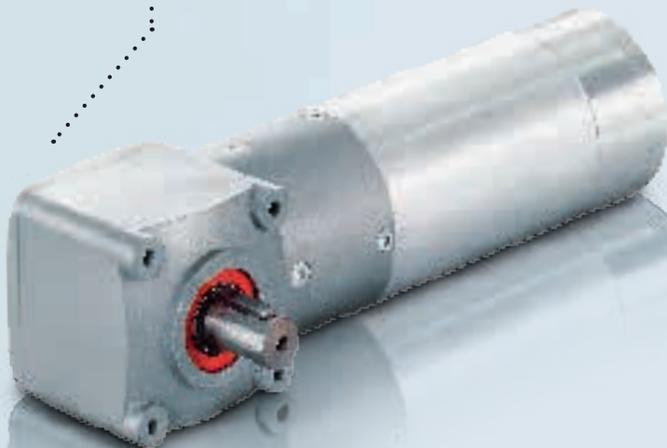
On average, customers attain savings of 50 percent by upgrading to EC fans.

The investment is paying off. Across all units, the end customer is now enjoying average energy savings of 50 percent and reducing annual CO₂ emissions by about 1,500 tonnes. The financial savings are approximately 336,000 EUR per year. The data centre now operates both more quietly and more reliably. As a result of not using the belt-driven fans, the noise and maintenance effort are reduced. Ian Shaw, Energy Manager at the facility management provider, states with satisfaction: "Not only were the energy savings exactly as predicted, there was actually no reason to carry out more detailed analyses, since monthly energy consumption is obviously so much lower." ○

COOL AIR THROW The new AxiCool fan range is tailor-made for all standard evaporator applications: These axial fans can withstand temperatures down to minus 40 degrees centigrade, are easy to de-ice and reduce power consumption, waste heat and noise levels. The air throw can also be doubled by using the optional Air Guiding System, and the additionally available hinges facilitate cleaning of the heat exchanger.



THE RIGHT ANGLE The latest EtaCrownPlus bevel gearhead generation has the crown and planetary gear combined in one unit, making it both enormously efficient and compact. This sets new standards in terms of efficiency, safety, ecological aspects and cost-effectiveness for medical technology and automatic door and security system applications.



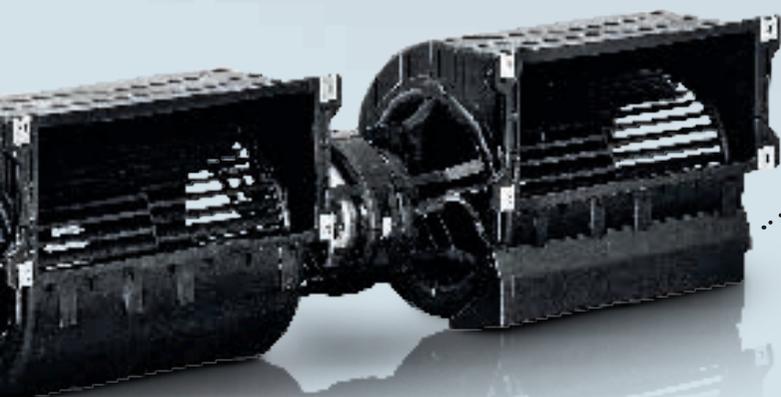
More information: www.ebmpapst.com/product-news



AIR GUIDE Once they have been installed, centrifugal and axial fans often act differently than under the ideal test bench conditions forming the basis for catalogue measurements. This is due to the uneven inflow of air and the resultant turbulence at the impeller inlet. The newly designed air inlet grille FlowGrid now keeps the air on the right track and thus distinctly reduces noise levels.



EFFICIENT HEATING The brand new iNR77 system for use in condensing gas boilers provides an extremely compact, highly efficient solution for the electronic gas and air modulation system. The fully integrated compact unit comprises a blower, a mixing unit and the new electronic gas valve F01 developed by ebm-papst – and is around 20 per cent smaller than its pneumatically controlled predecessor, the NRV77.



TRIPLETS! A new addition to the Fan Coil family: The range of highly efficient quiet-running fans for hotel air conditioning systems has been extended to include a triple blower. GreenTech EC fans only use up to 70 percent of the power consumed by conventional designs.



COOL LIGHT By conveying the waste heat in LED headlights to the lens, the 622 M compact fan extends the lifetime of the LEDs to last as long as the car. Thanks to special ball bearings, the fan can withstand considerable fluctuations in temperature and hard knocks on the road. Special insulating lacquer protects the electronics against moisture. Winglets on the blades make the fan particularly efficient and quiet-running.





AT THE HUB OF DEVELOPMENT

One fan for two different applications: For an Australian customer colleagues on the spot had to coordinate operations on two continents

The great new era of communication has long since entered the industrial world. Globally-linked project teams have taken the place of garage inventors. Channels of communication are becoming ever more sophisticated – but the challenges remain the same: Information has to flow smoothly even over distances of 15,000 kilometres and with an eight-hour time difference. An example of how well this can work is shown by CSR Edmonds in Australia and ebm-papst in Germany. And the most important aspect is to have a capable representative on the spot – which explains why ebm-papst has a network of branches in more than 50 countries, including Australia.

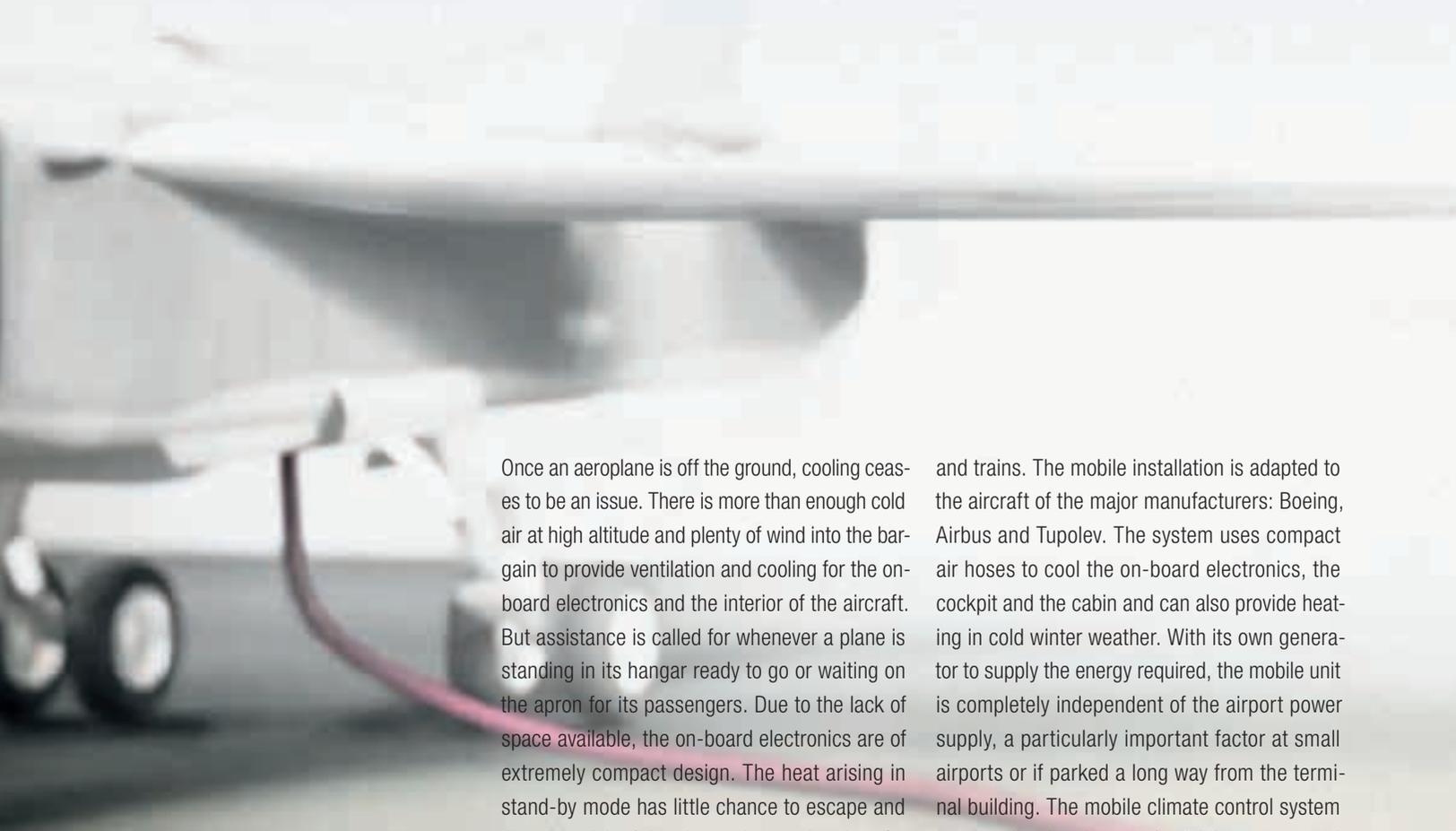
The first challenge awaited right at the start of the project, as Martina Heine, head of the technical department at ebm-papst New Zealand and Australia, recalls: “In the interests of cost efficiency, the customer was looking to install one of our axial fans in two different new products.” One of these was the AiroMatic roof ventilation system designed for air conditioning in houses. For this application CSR Edmonds wanted the main component, i.e. the fan to be as quiet-running and energy-saving as possible. The same criteria applied to the ecoFAN. This ventilation unit prevents mould developing in cellars by regulating the humidity of the air. Following detailed discussions with the CSR Edmonds development team, Heine and her Sales col-

league Garth Hurtz were of the opinion that from a technical point of view there was no reason why the same fan could not be employed for both applications: “Evaluation of the technical documentation and simulation revealed that the performance characteristics of the two products were sufficiently similar.”

Even so there were a few tough nuts for their colleagues in Mulfingen to crack. For instance, CSR Edmonds insisted on incorporating a drive motor with the lowest possible voltage rating so that the end users would be able to simply plug in the products at domestic sockets. But there was good news from Mulfingen: An appropriate motor was already being planned for market launch during the project period. However, deciding on the components was far from being the end of the matter. Certain other modifications were required to be able to integrate the fan into the applications concerned. In this phase Martina Heine’s main task in Australia was to make sure that the engineers in Mulfingen were precisely informed about what the customer wanted. Based on these specifications the decision was taken to adapt the wall ring holes to the situation in Australia. Thanks to perfect coordination between both parties she managed to improve the aerodynamic characteristics of the wall ring still further. That even came as a surprise to the CSR Edmonds development team, who were used to having to call in external experts for such “fine tuning”. ○

Ready for take-off

A mobile climate control system from the Russian company Leninetz cools the cabin and on-board electronics of parked aircraft – in the interests of increased safety and flight readiness



The key to optimising flight readiness and safety is an external supply system

Once an aeroplane is off the ground, cooling ceases to be an issue. There is more than enough cold air at high altitude and plenty of wind into the bargain to provide ventilation and cooling for the on-board electronics and the interior of the aircraft. But assistance is called for whenever a plane is standing in its hangar ready to go or waiting on the apron for its passengers. Due to the lack of space available, the on-board electronics are of extremely compact design. The heat arising in stand-by mode has little chance to escape and there is a risk of the electronics overheating. On the ground, cooling is often provided by the aircraft's own system with the engines running. This is however far from being ideal in view of both the fuel consumption and the lack of efficiency involved. The key to ensuring flight readiness and safety is an external supply system.

The ideal atmosphere – whatever the application The Leninetz company from Saint Petersburg has the answer to this problem in the form of a truck trailer packed with high-tech equipment. The company with its 120 employees specialises in climate control systems for aircraft

and trains. The mobile installation is adapted to the aircraft of the major manufacturers: Boeing, Airbus and Tupolev. The system uses compact air hoses to cool the on-board electronics, the cockpit and the cabin and can also provide heating in cold winter weather. With its own generator to supply the energy required, the mobile unit is completely independent of the airport power supply, a particularly important factor at small airports or if parked a long way from the terminal building. The mobile climate control system can handle air volumes of 1.6 kilos per second at a maximum pressure of 20 kilopascal. "Aviation is subject to extremely stringent regulations with regard to safety and reliability. But quick and easy handling was another factor which also had to be borne in mind. A single person can hook up the system to an aircraft in less than half an hour and control it via a simple interface", says Anatolij Emelyanov, Head of Development at Leninetz. The machine also has to be capable of functioning properly at airports anywhere in the world. "We have conducted tests to confirm that the design ensures reliable functioning in very cold, very hot and very humid conditions. What's

The mobile installation is completely independent of the airport power supply

more: Operation at altitudes of up to 3,000 metres above sea level is no problem”.

Individual heavy-duty version Fans with closed-loop speed control are one of the reasons for the outstanding efficiency of the system. Emelyanov: “For years now, we have been a regular customer of ebm-papst for various products, including the mobile climate control system: Three axial fans provide cooling for the system compressors.” Leninetz originally opted for the standard version. However after six months, the company discovered that the mounting arms of the fan grille had broken – they had not been able to withstand the immense vibration during operation. ebm-papst engineers analysed the situation at the Mulfingen laboratory and decided to specially adapt the grille by adding a further two mounting arms to reinforce the original four. “We received the prototypes in a very short space of time. The reinforced design solved the problem”, according to Emelyanov. “Thanks to the prompt deliveries from ebm-papst we were able to complete the comprehensive testing required by the state in just one year.” ○

When a plane is standing on the apron, the mobile climate control system cools the on-board electronics and the interior of the aircraft



The combination of minimal CO₂ emissions, top quality and low operating costs is ideal



First step in the two-stage plan: The axial fans were fitted on the heat exchangers at Intersam and shipped



The power of persuasion

Four parties, any number of discussions, quick decisions: To start with, ebm-papst Ibérica had to put plenty of effort into finding enough convincing arguments for EC technology – but in the end our Spanish branch was positively overwhelmed by the customer’s enthusiastic response

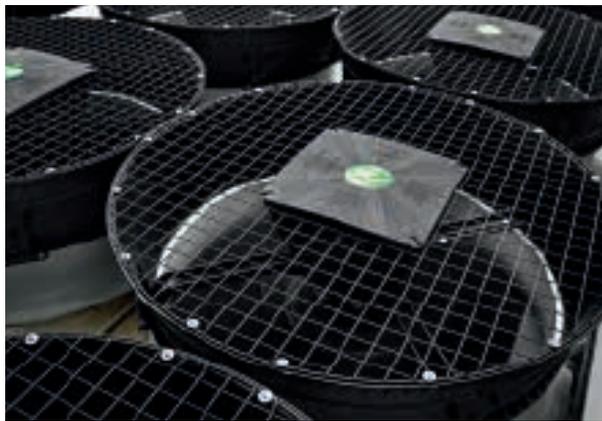
The whole business did not exactly get off to a promising start. In June 2012, Juan Corbalán, sales engineer at ebm-papst Iberica, received an enquiry from the air conditioning system manufacturer Intersam for large AC fans with a specific high operating point. 108 such fans were required to help cool the air at a new abattoir run by the Olot Meats company near Girona. The ebm-papst range does include this type of powerful fan, but it is only available with EC technology and not as an AC version. Although EC fans are more expensive to purchase, they use far less energy and are thus more economical to run as well as being quieter. However, Intersam were only responsible for supplying the evaporator units for the project and were bound by strict cost limits set by the installation company Fritecno and so decided to look for an alternative product from a different manufacturer. Which would normally have been the end of the story.

Bags of good arguments But the Spanish branch was not prepared to give in so easily. In view of ebm-papst’s long-standing close relationship with Intersam and a number of suc-

cessfully completed orders involving EC technology, Corbalán got in touch again and suggested a joint visit to Fritecno.

“We were aware that they had worked with AC fans and frequency converters in the past and not always found these satisfactory,” according to Germán Rojas, sales engineer at Intersam. “So we decided to give it a try.”

With plenty of good arguments up their sleeves, Corbalán and Rojas went to visit Fritecno. The engineering company had received an order from Olot Meats for the design and installation of an entire refrigeration system. Based on hard facts and figures the two set out the advantages for the end customer: A lower noise level and, most importantly, massive energy cost savings for the type of application typically encountered in refrigeration systems with continuous operation over the full speed range. “We have made use of EC technology for smaller projects in the past,” explains Jordi Tarres, Fritecno project engineer, “but never on such a grand scale! In the end we as engineers were convinced by the abundance of technical advantages, including a low fault rate, MODBUS connection, convenient control and monitoring.” That decided it: The engi-



The installed heat exchangers at Olot Meats. The second stage was to supply the AxiTop and mount them on the existing installation

A team from Intersam, Fritecno and ebm-papst inspecting the abattoir heat exchangers in operation



“We immediately realised that the diffuser would be an ideal addition to the project!”

Pere Solé, sales manager at Fritecno

Olot Meats are also committed to sustainability – so a combination of low CO₂ emissions, excellent quality and low operating costs was an ideal solution. The outcome was that ebm-papst Ibérica received the order for 108 size 910 GreenTech EC fans to be delivered in November 2012. But that still wasn't the end of the story.

Added bonus on top A pleasant surprise awaited at the Chillventa Refrigeration, Air Conditioning, Ventilation and Heat Pump trade fair in Nuremberg, where Intersam were exhibiting the brand new AxiTop diffuser from ebm-papst on one of their condensers. Representatives from Fritecno visiting the stand took an immediate interest in the product. The members of the Spanish engineering company responded enthusiastically to a spontaneous presentation with the participation of Fritecno, In-

neering company was determined to win over Olot Meats to the EC fan as well. Being a regular supplier, the customer places plenty of confidence in the expertise of Fritecno. And

tersam and ebm-papst. “We immediately realised that the diffuser would be an ideal addition to the Olot Meats project,” as Pere Solé, sales manager at Fritecno, is still keen to explain. “As the abattoir is not far from a residential area, the customer placed particular emphasis on a quiet-running installation. And the fact that higher air handling rates are anticipated for the future makes any possible energy savings even more of a priority.” Fritecno would have liked to order the AxiTop straight away. However there was a problem: “Only the size 800 diffuser was available at the time,” as Juan Corbalán recalls. “The 910 version was still at the development stage.” But the start of installation work at Olot Meats was already firmly scheduled for January – with no chance of postponement. “In October we thought this was an impossible task, after all there weren't even any tools ready for the 910 at that point.”

Up onto the roof in two stages The solution was a two-stage plan: As agreed, ebm-papst delivered the type 910 EC fans ordered to Intersam in November, where they were mounted on the heat exchangers and sent to Girona for installation. In January, the equipment was then gradually installed in the



The project team on site: Germán Rojas from Intersam, Pere Solé and Jordi Tarres from the installation company Fritecno and Juan Corbalán from ebm-papst (from left)

The AxiTop diffuser for axial fans

The diffuser helps to enhance efficiency and significantly reduce noise. Its pressure boosting effect minimises exit losses and facilitates adaptation of the fan to commercially available heat exchangers. Up to 27 per cent energy savings are thus possible and the sound power can be reduced by 7.2 dB(A).



building and on the roof by Fritecno. This gave ebm-papst the time they needed to work flat out to complete development of the size 910 diffusers, make the tools and start series production of the AxiTop. "We assembled the 108 AxiTops at our Madrid branch and sent these directly to Olot Meats," explains Corbalán. "There they were installed just in time." Is that now the end of the story?

"For us the Olot Meats abattoir is a reference plant in this region," as both Jordi Tarres and Pere Solé from Fritecno point out. And even today Germán Rojas from Intersam remains impressed by the smooth implementation of the project: "Despite four parties being involved, the negotiations always went very well and quick decisions were taken." ○

COOL THROUGHOUT THE NIGHT

Full LED headlights would not be possible without integrated active fan cooling systems. And the choice of material is crucial

Increasing use is being made of full LED headlights for both main and dipped beam operation in motor vehicles. These are compact, bright and efficient and with a colour temperature similar to daylight do not strain motorists' eyes. But there is one problem manufacturers have to tackle: How to dissipate the heat. The intense luminance in a very small area generates heat which in the long term would damage the semiconductor. If a certain limit temperature is exceeded, the efficiency of the LEDs drops dramatically. The strength of the light dwindles and the service life is drastically reduced. Without the cooling system developed by ebm-papst, it would not be possible to achieve the performance required from a full LED headlight.

It all comes down to the ball bearings The fans are integrated directly into the headlight. The air is blown onto the heat sinks of the LED array. This creates a turbulent but nonetheless controlled flow which ensures efficient heat transfer. At the same time the warm air is put to good use as it stops condensate misting up the inside of the headlight. "The ventilation must function just as well at winter starting temperatures of minus 40 degrees centigrade to prevent misting as at the maximum operating temperature of 120 degrees to cool the system. It was an enormous challenge to find a ball bearing grease capable of coping with this temperature span without solidifying or turning to liquid", says Johannes Hirt, the Automotive Fans project manager. In the course of numerous trials, the

engineers at ebm-papst came up with the ideal combination of ball bearing type and a highly specific grease.

Fit for motor vehicle use Even without very high or low temperatures, it's a hard life being an automotive component: Engine vibration, potholes and wet conditions all take their toll. To make their fans fit for motor vehicle use, the engineers at ebm-papst employ a special fan mounting system combining soft and hard suspension. This prevents the mutual intensification of natural vibration, engine vibration and impact – the so-called rebound effect. Optimum rotor and stator clearance is maintained. "The greatest asset is however the material. We make use of a special plastic which is crack-proof, temperature-resistant, stable and suitable for intricate geometry", explains Hirt. "And there is hardly any outgassing. That's an important aspect as it could cloud the lens".

Full lifetime LED fans also need plenty of stamina. "The headlights are solid-state components. You can't just quickly change the bulb", as Johannes Hirt points out. Like the gearbox, they are designed to last for the full 15-year lifetime of the vehicle. "That's why motor vehicle engineers used to be so reluctant to fit a permanently integrated rotating and potentially problematic component like a fan. It took fans from ebm-papst to convince the automotive industry." ○

**A quick change
of bulb is not an option,
so the LEDs are designed
to last for the entire lifetime**

The hybrid locomotive combines the advantages of electric and diesel drive systems



Fast track to the future

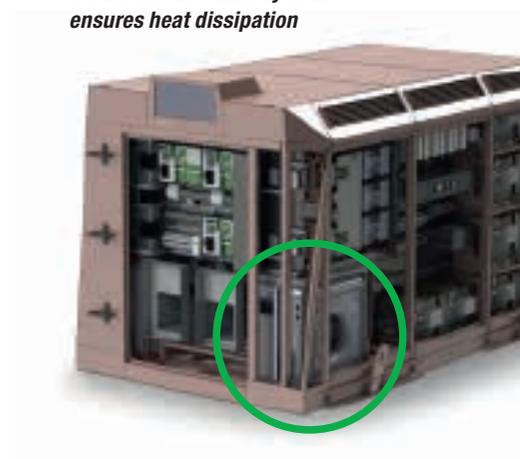
A hybrid locomotive points to a new era for the Russian railways

Modernisation of rail travel is right at the top of the Russian government's list of priorities: By 2030 a national campaign is aiming to make the railways safer, more reliable and more ecological in keeping with international standards. This will require a new approach on the part of Russian manufacturers who so far have always stuck to conventional designs: Namely diesel and electric engines. But both of these have certain disadvantages: Electric trains hardly produce any CO₂ emissions but the infrastructure costs are high on account of the overhead wires for example. Widespread electrification is therefore not a feasible option at the moment in a country the size of Russia. The use of diesel engines is attractive from a financial point of view but there are lots of ecological drawbacks to consider. To make the most of both technologies whilst minimising the negative aspects, a Russian locomotive manufacturer had the idea of simply combining the two systems in one engine.

The best of both worlds To be able to switch between drive systems as required in the course of a journey, the hybrid locomotive is designed for both electrical and diesel operation. The engine is therefore provided with an electronic module which, by way of a frequency converter, makes it possible for the drive units at the train wheels to make use of the electricity from the power line. Even at sub-zero temperatures, a considerable amount of heat is constantly generated in the module and has to be dissipated as quickly as possible. This was a real challenge for the development engineers, as the electronics have to be housed in a confined space and are also subjected to severe vibration and extreme temperature differences in the train – a difficult environment for any piece of equipment. The locomotive manufacturer approached the Russian branch of ebm-papst in Jekaterinburg with this problem. Thanks to a good working relationship over the previous eight years a solution was quickly found. Working on the basis of an exist-

ing GreenTech EC centrifugal fan, the Russians got together with experts from Mulfingen to develop four new fan models capable of ensuring the necessary heat dissipation in the electronic module even under the toughest conditions. The trial run in 2012 satisfied everyone's expectations. Delivery is timetabled for 2015. ○

An EC centrifugal fan (bottom centre) in the electronic module for the electric drive system ensures heat dissipation





This is what the modern architectural complex will look like, with the droplet-shaped Grand Theatre in the foreground

(Image courtesy Paul Andreu Architecte)

A fresh approach

The ultra-modern Grand Theatre in Jinan in China is an excellent advertisement for the region – not least in terms of energy efficiency. The new complex reflects the increasing significance of sustainability in China

Jinan, the capital of Shandong province in eastern China, is known for its freshwater springs. There are more than ninety of these in the metropolis with six million inhabitants. So it came as no surprise that the leading French architect Paul Andreu was inspired by this characteristic feature of the city for the design of the Jinan Grand Theatre. The complex is being built at the heart of the Cultural and Art Centre of Shandong, covering an area of 500,000 square metres where the city meets the countryside. Its

hollowed-out round shape is intended to symbolise the source of a freshwater spring. The central theatre building is surrounded by a further eight buildings of different heights which, with their soft lines and silver colour, are reminiscent of water emerging from a spring.

Sustainability is gaining in importance The Grand Theatre is a model project of the city of Jinan. In an area of 75,000 square metres it accommodates an opera house to seat 1,800, a

“Ecological technology is becoming an increasingly important issue in China”

James Sun, regional sales manager at ebm-papst China



concert hall with room for 1,500 music-lovers and a multi-functional hall for 500 visitors as well as hotels and offices. And to ensure that the spectacular architecture is complement-

ed by a new standard of technology, the air conditioning system in the theatre is equipped with

499 GreenTech EC-RadiPacs from ebm-papst. With a power of 1,180 kilowatts, these efficiently circulate 1,125,910 cubic centimetres of air per hour throughout the theatre.

“Ecological technology is becoming an increasingly important issue in China,” explains James Sun, regional sales manager at ebm-papst China.

“People are starting to think differently now that they are experiencing the effects of climate change themselves and hearing more about it in the new media. What’s more, the government is implementing laws and directives to actively promote the use of efficient technologies. This is illustrated for example by subsidies for energy-saving air conditioning systems, flat screen televisions and refrigerators.”

The air conditioning system for the theatre was installed by the air handling equipment manufacturer Tsinghua Tongfang Co. ebm-papst is the ideal partner for this company dedicated to sustainability. “The Jinan city council was determined to make the theatre as perfect as possible. Which meant having to demand top quality and efficiency from the ventilation system as well. This is the domain of ebm-papst, who produce fans entirely in keeping with the current Chinese

desire to build more efficiently and with the environment

in mind,” explains Hou Dongming, managing director of Guangzhou Tongfang Refine Air Conditioning Co.Ltd. With the electronics and motor combined in a single unit, RadiPac fans are both space-saving and easy to install. It means that there is no need for expensive, time-consuming coordination, earthing and screening work when commissioning the air conditioning system. In other words: The plug and play principle.

Quiet-running and powerful Economical operation and a good energy balance are not the only requirements for the fans in the Grand Theatre. They have to be powerful enough to convey the air at high pressure through the extensive air conditioning duct system whilst at the same time being easy enough to regulate to ensure the audience is never disturbed. The oblique trailing edge of the RadiPac high-performance impeller additionally guarantees an ideal air flow which, in conjunction with an integrated rotating diffuser, results in

a particularly low level of noise emission. To make sure the air in the theatre is not only a pleasant temperature but also clean, Tsinghua Tofang further incorporated a virus filter into the system to eliminate any pollutants from the air drawn in from outside.

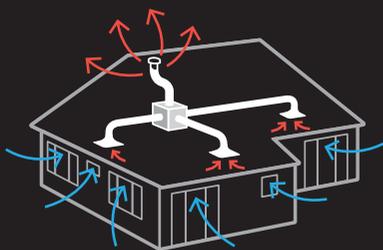
Ceremonious opening So visitors can relax and concentrate on what’s going on the stage. After a construction period of thirty months, they will have the first opportunity to do so in October 2013 when the Jinan Grand Theatre is to be ceremoniously opened as part of the tenth China Art Festival. The festival offers an insight into the full spectrum of Chinese culture and will be presenting eleven international productions alongside fifteen Chinese performances. The attention of the region will be focused on Jinan and its new theatre. An ideal opportunity to show visitors that energy efficiency and protection of the environment already play a major role in the city of the freshwater springs. ○



Jean-Pierre Martin

Technical director
at ebm-papst France

THE PRINCIPLE



An enclosed fan, usually installed on the top floor, is connected by way of a duct system to extractor vents fitted in the rooms affected, i.e. with damp conditions, such as the bathroom, toilet and kitchen. The pressure in these rooms is then a few Pa lower than outside. The fresh air flowing in from outside is conveyed via air inlets into the "unaffected" rooms, such as bedrooms, living room and dining room.

Fresh air, less power

Optimised ventilation systems in houses can save up to 75 per cent energy

Cooking, washing and even just living are constant sources of moisture and CO₂ in the home. The atmosphere and well-being of the residents can be improved by the use of a controlled mechanical ventilation system to ensure fresh air circulation around the clock. Such an installation extracts odours and moisture which could otherwise promote the formation of mould, and damage the structure of the building.

Since 1969, hundreds of thousands of type R2E190 and R2E140 fans have been fitted in this sort of system in France. For a 4-room house, these systems have a power consumption of around 35 WTh-C (WTh-C = Average consumption for one hour at high speed and 23 hours at low speed). The total throughput is between 200 and 250 m³/h. This type of system is extremely efficient, but the power consumption cannot be disregarded in view of rising electricity prices.

There are two possible ways of cutting the power consumption

Reducing the power consumption of the actual fan and regulating the fan throughput on the basis of how the room is used.

By employing EC fans and in particular motors of the ESM (R1G160) type, a considerably lower power consumption can

be achieved. Energy consumption can also be reduced by the use of throughput control based on room utilisation.

Whenever rooms are not in use and the impact level is low, there is little need to extract air. With conventional systems, users can regulate the air throughput

as required by means of a switch. In modern systems, the air throughput is adapted as a function of the moisture content of the air withdrawn by gradually opening the extractor vents (reduction of pressure loss by integrated sensor).

The use of EC fans and throughput control based on room utilisation makes it possible to achieve a power consumption of roughly eight WTh-C. In other words, consumption can be reduced by nearly 75 per cent as compared to a standard system. This also has a beneficial effect on heating costs, as the system helps to improve the energy performance of a building. Heating costs can be cut by 10 to 15 per cent in this way.

Even more advanced systems have the capacity to recover the heat contained in the extracted air to warm up the air on the supply side. The use of a heat exchanger does however result in greater pressure losses. A fan of type R3G140 is therefore employed. This principle fully satisfies Directive 2009/125/EC of the European parliament, which aims to both increase energy efficiency and reduce greenhouse effects by 20 per cent. ○



Exhaust air box by Aldes. The centrifugal fan used in this product is driven by an energy-saving motor

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Trade fairs

Busworld, Kortrijk, 18 – 23 October 2013
Interclima, Paris, 4 – 8 November 2013
Compamed, Düsseldorf, 20 – 22 November 2013
SPS / IPC / Drives, Nuremberg, 26 – 28 November 2013
AHR, New York, 21 – 23 January 2014
VSK, Utrecht, 3 – 7 February 2014
Euroshop, Düsseldorf, 16 – 20 February 2014
Progetto Fuoco, Verona, 19 – 23 February 2014
expoEnergy, Wels, 26. February – 2 March 2014
Acrex, New Delhi, 27 February – 1 March 2014
Mostra Convegno, Milano, 18 – 21 March 2014
For more trade fairs dates visit: www.ebmpapst.com

Events

European Heat Pump Summit, Nuremberg, 15 – 16 October 2013
Cooling Day, Würzburg, 22 – 24 October 2013
12. ebm-papst Hallenmasters, Mulfingen, 4 – 5 January 2014

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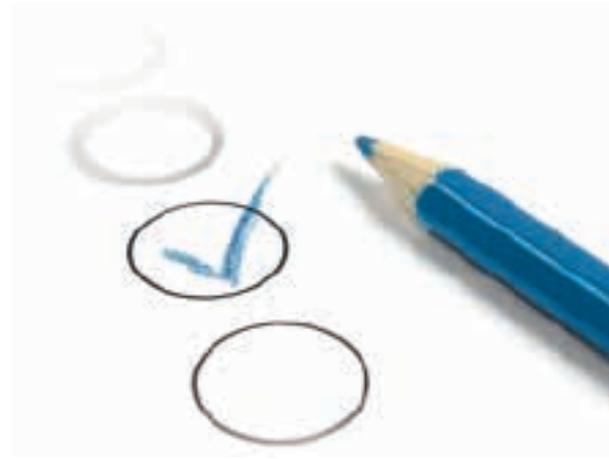
**Noise emissions with regard to the operation of fans and
air conveying systems: Concepts for quiet-running axial fans**

**Applications for EC fans in the data centre:
Making use of optimisation potential for cooling**

**Household appliances: Development of a highly efficient
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Qualified for the future

ebm-papst have found their own way of dealing with the shortage of skilled workers: By training their lesser qualified employees

More than five million workers in Germany have never had any vocational training. A skilled workforce is however becoming ever more of a necessity, particularly in the increasingly complex world of mechanical and electrical engineering. Kai Gebhardt, personnel manager at ebm-papst in Landshut, is in no doubt: "We really do need to invest in the potential of our lesser qualified employees." Wolfgang Beyer, his counterpart in St. Georgen, fully agrees. "If we do not react quickly enough, we could end up having to replace some of our workforce. And that would be the wrong course of action – both morally and from a business point of view." Bernd Ludwig, responsible for training in Mulfingen, puts it in a nutshell: "We are determined to ensure the continued prosperity of both the company and the region."

Motivation in Mulfingen The Mulfingen plant started offering internal re-training schemes for lesser qualified personnel back in the year 2000. To date, a total of 60 employees have taken advantage of this to obtain recognised qualifications. The theoretical side is taught by college instructors in technical courses organised by ebm-papst together with other companies and the local organisation "Innovation in the Kocher & Jagst region". In parallel to this, practical instruction takes place in the training workshop and quality assurance departments. "These days, the employees themselves ask us about new courses. With so much motivation, interest, commitment and initiative there is no limit to what we can achieve," as Ludwig is delighted to point out.

Landshut on the right road The Landshut plant is actively involved in a project organised by the state employment agency and known as WeGebAU. This stands for "Further training for lesser qualified and older company employees" and is aimed at all age groups. Concrete qualifications are the reward for taking part. "We have around 500 employees without any or with inappropriate qualifications," as Gebhardt explains. In addition to the WeGebAU project, the Landshut plant therefore puts a lot of effort into internal training and intensive familiarisation courses.

Keen to learn at St. Georgen In response to a works council proposal, ebm-papst St. Georgen initiated the EU-financed project GRIW, which stands for "Creation of structural and personnel-related conditions for the implementation of innovative work training concepts". This is aimed at lesser qualified shift workers who receive direct workplace training on various topics over a period of six to eight months. They are assisted by a total of twelve training counsellors, who in turn are supported by four so-called multipliers who coordinate the project and are responsible for embedding the training concept in the company. "The employees are motivated by having the opportunity to look beyond their own noses," says François Dehlas, one of the multipliers. "This group of people is keen to learn more and make a bigger contribution to the overall picture. And we are pleased to be able to offer this scheme to promote such motivation. It is a win-win situation for both sides," Beyer adds. ○



Left: Multipliers discussing with a trainee in St. Georgen. Right: A participant on the WeGebAU project with her instructor

“ Our country is in the process of awakening to a new ‘green’ way of life: Since the catastrophe in March 2011 only two nuclear power plants out of a total of more than 50 have been on line. This had led to an increase in electricity prices. So the market for alternative energy is booming. For example, the state has decided to introduce the world’s highest feed-in tariff for solar power. And everybody is looking for possible ways of saving energy. Local councils and industry have already reduced their energy consumption by ten per cent. Against this background our GreenTech EC technology is a welcome alternative, particularly for air conditioning systems and computer centres. Though we still see plenty of potential in the plant engineering and refrigerated transport sectors as well. ”



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