CASE STUDY

PAPST Fans
Testing and Development of Automotive Fans

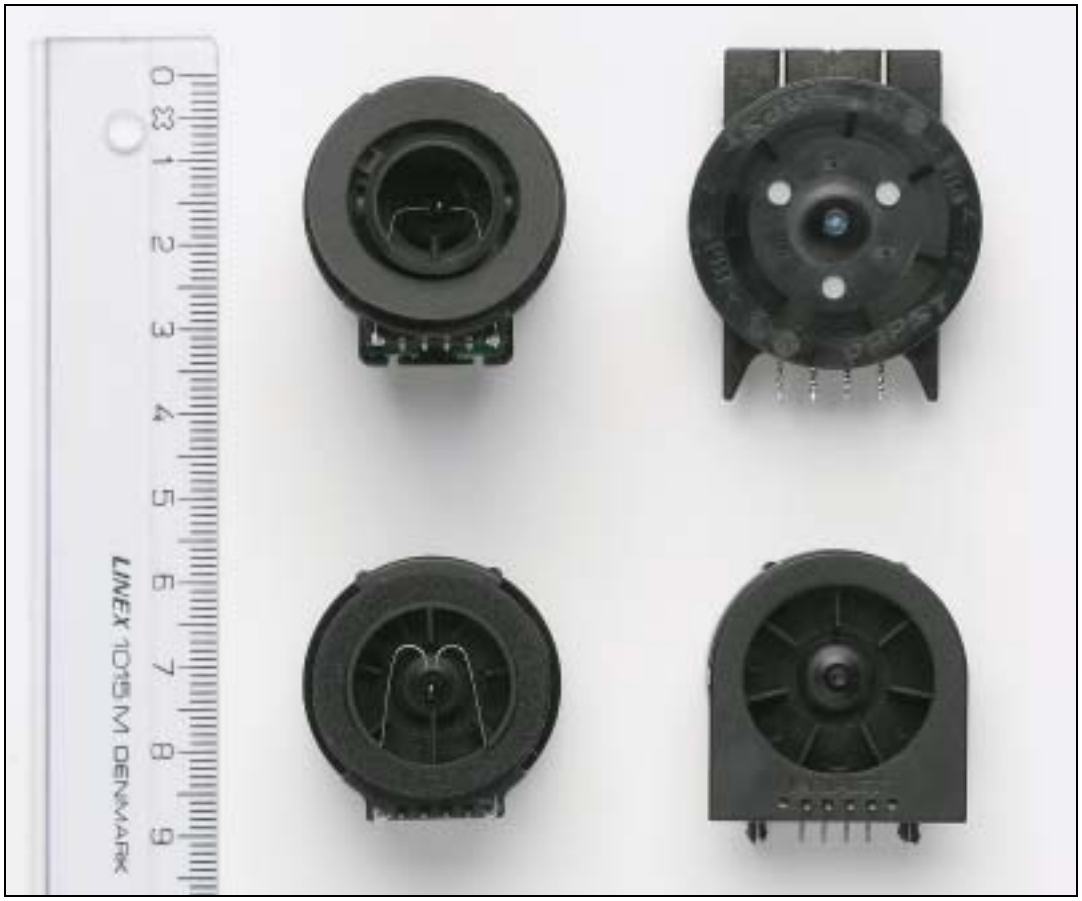
Germany

Automotive, Industrial, Consumer

PULSE, Transducers

Papst-Motoren GmbH & Co. KG, a wholly owned subsidiary of EBM Werke GmbH & Co. KG, has manufactured air conditioning sensor fans for the automotive industry since 1986. The company produces about 20 million fans each year.

Fan noise is an important factor and Papst uses three PULSE™ systems in the development of new products, and for batch-testing of fans from the productions lines to ensure compliance with the design specifications.



A World Leader in a Niche Market

Papst-Motoren GmbH & Co. KG, located at St.Georgen/Schwarzwald, 95 km southwest of Stuttgart, Germany is a wholly owned subsidiary of EBM Werke GmbH & Co. KG. EBM was founded in 1963 by Gerhard Sturm and Heinz Ziehl. The company has grown to be a world market leader with innovative, highly efficient and competitive external rotor motors and fans and has 8000 employees worldwide.

Papst, whose history goes back over 60 years, has about 2500 employees. Working in three shifts at five production plants, the company manufactures about 20 million fans each year. Of this vast production, Papst supplies about 4 million air conditioning sensor fans to many of the world's major automotive manufacturers including BMW, DaimlerChrysler, Peugeot/Citröen, VW, Audi, Fiat, Opel, etc., and is the world's leading producer of automotive fans.

Fig. 1
Papst's headquarters at St.Georgen – a delightful town in beautiful surroundings

Papst focuses on the integration of independently functioning components and, in addition to air conditioning sensor fans, also manufactures a wide range of products for cooling electronics, small electric motors and actuators, etc. for the automotive industry. Papst ensures that delivery dates are strictly adhered to by holding large stocks at a number of strategically placed locations.

In addition, Papst and other companies within the EBM group, manufacture a vast range of state-of-the-art cooling fans, blowers, pumps, electric motors, power supplies and electronics for a wide variety of industries and markets.

Fig. 2
Just a small part of the extensive, highly automated production facilities at Papst's St.Georgen factory

Production is very highly automated using state-of-the-art technology. This results in high product quality and efficient volume production.

Long Relationship

Papst has used Brüel & Kjær products for many years. In addition to three PULSE systems, Papst uses a wide range of Brüel & Kjær transducers, conditioning amplifiers and preamplifiers, calibrators, input modules, and a variety of software applications.

Product Development

Fig. 3
Papst has a large anechoic room that is completely decoupled from the building and enables very low noise levels to be measured accurately

Papst continually develops new and improved products to meet the increasing demands from automotive manufacturers. It has extensive facilities. For R & D applications, a 16-channel PULSE system is extensively used with a variety of software including Sound Quality Type 7698.

Papst has a large semi-anechoic room (5.5 × 5.1 × 3.1 m) with a cut-off frequency of 90 Hz, and it's completely decoupled from the building. The background noise is very low (LpA < 5 dB). A noise reflecting floor simulates free-field conditions.

Noise levels of less than 0 dB can be measured using a unique Brüel & Kjær Microphone Type 4179 and Preamplifier Type 2660. Papst is using Visual Basic®-based software that controls the PULSE system. In addition, the software also very accurately controls the power supply that provides the voltage and current for the motor or fan being tested.

Production Line Testing

Fig. 4
One of Papst's test control stations at St.Georgen. Every fan is tested electrically and for vibration using a fully automated process

One Hundred Percent

Every manufactured fan is tested electrically and for vibration. Vibration testing is made using Brüel&Kjær Accelerometers Type 4393 connected to Brüel&Kjær NEXUS Conditioning Amplifiers. The testing procedure is completely automated and any fan that does not meet the required parameters is automatically rejected from the production line.

Production line testing is naturally carried out at other Papst factories. At one facility, a PULSE system is used together with software that Papst developed themselves. This provides the operator interface with the PULSE software running in the background.

Testing Expertise

Fig. 5
Michael Ebner is Test Equipment Manager at the St.Georgen factory

Michael Ebner is the Test Equipment Manager at Papst's St.Georgen factory. Michael has a Master's degree in mechanical and electrical engineering and has worked at Papst for five years.

Michael says, "We have used Brüel&Kjær products for many years. The relationship goes back far beyond the five years that I have worked for Papst. We always get excellent service and support from the local Brüel&Kjær office and their products have a reputation for reliability and accuracy. We consider Brüel&Kjær to be the leader in sound and vibration analysis. As we say, green is good!" He continues, "It's because of our good experience with PULSE that now have three systems".

Quiet Perception

Michael says, "Papst's focus is to deliver the products that our customers want, and demands are continually increasing. Today, it's most important that a car is perceived as being quiet and our aim is to increase added value to our automotive customers".

Fig. 6
Stefan Fleig is a Quality Assurance Manager

Stefan Fleig is a Quality Assurance Manager. He's worked at Papst for 10 years, has a technical degree and his specialities are electronics and computer software.

Stefan explains, "Manufacturers and their customers want cars to be more comfortable, and for the driving experience to be as stress-free as possible. It's for this reason that we carry out extensive R&D research on new designs and also test our products during manufacture to ensure that they fully conform to the design specifications. Quality control has a very high focus within our company and we are continually striving to improve on our already high standards".

Batch Testing

Although every fan is tested for vibration during the production process, approximately one percent of the total production is tested in a small anechoic chamber to ensure that fan noise is within the specification and thus fulfils customer demands on quality assurance concerning the acoustical noise of the products.

Fig. 7
A small anechoic chamber is used to test the noise performance. An external microphone is used to check that the background noise is sufficiently low for the test to be made accurately

The sound power of the products is very low and therefore a microphone, outside the acoustic chamber, is used to check that the background noise is sufficiently low. Inside the chamber a Brüel & Kjær Microphone Type 4179 and Preamplifier Type 2660 are used to collect the data. The testing is made by semi-skilled operators, in three shifts around the clock. The 4-channel PULSE system runs in the background and customised software, including a special operator interface, has been developed by the German company Akustec. The influence of background noise is automatically calculated by the software programme.

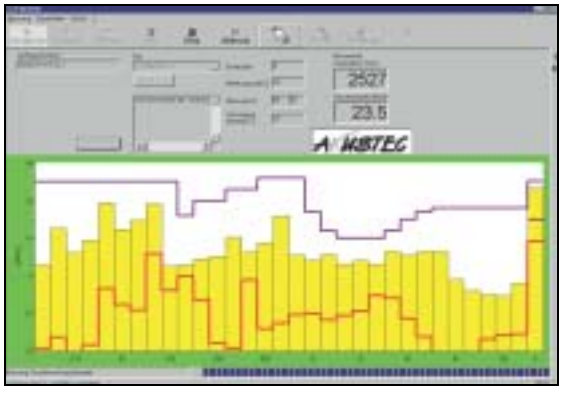


Fig. 8
A typical display from the operator interface developed by Akustec. Measurements are made using only three push-buttons

Each fan design has its own “template”, a set of 1/3-octave limit levels that are also stored in the database and shown in the display while the measurement takes place. It’s therefore very quick and simple to change the test parameters from one design of fan to another. The influence of the ambient noise is also displayed during the measurements. The system controls the fan's power supply and monitors whether the fan speed remains within specified limits. A database is used to document the results and to analyse statistics.

Michael says, “The operator interface developed by Akustec is so easy to use that semi-skilled operators are able to perform the noise test and record whether a fan passes or fails. In fact, the measurements are made using only three push-buttons”.

Stefan continues, “The Akustec software also controls the power supply for the fan being tested. Each fan is run for about 20 seconds. Using linear averaging we make a CPB (constant percentage bandwidth) measurement over a frequency range of 20 Hz to 20 kHz. The most critical frequency range is about 125 Hz”.

Akustec

Akustec, based near Munster, Germany, is a consultancy company that was founded by Mr. Wolfgang Metzen in 1990. Akustec works with many companies in the area of sound and vibration and, among others, specialises in the automotive industry. Akustec has recommended the PULSE multi-analyzer platform since it was first introduced in 1996 and has implemented a number of special test solutions.

Mr. Metzen states, “My goal is to provide effective and efficient NVH test solutions for our customers. Although Akustec provides consultancy in a number of areas, we work only with Brüel & Kjær in acoustics and vibration”. He continues, “I want to be a partner with the world-market leader and I like to have confidence in recommending their solutions to our customers”.

Calibration

Stefan says, “The PULSE-based test system is used every day. We calibrate the microphones using a Brüel & Kjær Calibrator Type 4231 and this is done every 24 hours, or if the test system is stopped for any reason. Knowing that the microphones are accurately calibrated gives us confidence that our test measurements are completely accurate”.

Data Handling and Reporting

Stefan Freig explains, “The data from the production line test system is saved on a network database. The batch-test system runs under Windows NT® and the test results are saved on an Access® database in the PC, and this is backed-up regularly. It’s easy to view the stored data. Tests reports are really easy to make and one of things that I especially like about PULSE is the data export facility to Microsoft® Word and Excel. It’s easy, quick and effective”.

Key Facts

- Papst-Motoren is a wholly owned subsidiary of EBM Werke GmbH & Co. KG
- The company produces about 20 million fans each year of which some 4 million air conditioning sensor fans are supplied to many of the world’s major automotive manufacturers
- Papst is the worlds largest producer of air conditioning sensor fans for the automotive industry
- Papst’s focus is to deliver the products that its customers want, and demands are continually increasing
- Papst uses three PULSE systems for product testing, and in the development of new products
- For R & D applications, a 16-channel PULSE system is extensively used with a variety of software including Sound Quality Type 7698
- Noise levels of less than 0 dB can be measured using a Brüel & Kjær Type Microphone 4179 and Preamplifier Type 2660
- A 4-channel PULSE system is used for sample batch testing
- A special operator interface has been developed by the German company Akustec
- “The operator interface developed by Akustec is easy to use”
- “We always get excellent service and support from the local Brüel & Kjær office and their products have a reputation for reliability and accuracy”
- Papst considers Brüel & Kjær to be the leader in sound and vibration analysis

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