

CASE STUDY

Germany

Continental AG NVH Measurement and Analysis

Automotive

PULSE, Applications, Transducers

Continental is Europe's second largest tyre manufacturer, and the world's fourth largest. However, in addition to tyres, Continental has broadened its product range and currently manufactures thirty-three other automotive components, including brakes, suspension units, engine mountings, seals and other rubber-based components.



The Need for Speed

Fig. 1
Dr. Ernst-Ulrich Saemann, Manager of Continental's NVH Evaluation Centre, works with PULSE



Each of Continental's products is produced in innumerable variations. Speed is a vital factor in today's fast-moving automotive industry – speed in bringing new products from initial conception to production. And speed is important while performing measurement and analysis tests during product development.

Brüel & Kjær's PULSE™ platform forms an important part of Continental's sound and vibration measurement and analysis. The main reason in the decision to choose PULSE was the mobility of the system and the possibility to make measurements on the road.

A further major influence was the system's ability to make different types of real-time multi-analysis measurements simultaneously and to immediately produce printed documentation of the results.

More Focus on Noise Pollution

Driving a car, van or lorry creates noise. Many different noises are generated by a variety of automotive components. Interior noise affects the driver and passengers – exterior vehicle noise disturbs us all, but especially people living in areas with heavy traffic.

These days, noise caused by vehicles is one of society's major concerns. As traffic increases, so more noise is generated. And there are demands for greater vehicle comfort, not only in cars, buses, trucks and vans, but also such products motorcycles, and even farm tractors.

Fig. 2
Many automotive manufacturers fit Continental tyres as original equipment



Of course, Continental's name has always been synonymous with tyres and they are one of the world leaders in this market with a reputation for quality. Many of the world's major vehicle manufacturers fit Continental tyres as original equipment.

Broad Product Range

Continental has a wide range of products and its markets include agriculture, bicycles, cars, motor cycles, scooters, rolling stock, trucks and lorries of all sizes, and industrial products ranging from aviation, protective clothing and footwear to the furniture industry. And, in addition to tyres, the company manufactures many other automotive components including brakes, shock absorbers, suspension units, engine mountings, interior trim, hoses, mouldings and other rubber-based items. Each is produced in innumerable variations.

A Practical Example – Pursuit of Quieter Vehicles

Marian Rostek is an acoustics engineer at Continental's Noise Vibration Harshness Evaluation Centre at Hannover. He carefully sprays atomised water over the side window of a MAN lorry. The water gathers in small, scattered drops, in much the same way as it does after driving in a shower of rain. Mr. Rostek enters a command on his PC, and walks round the test setup. On the inside of the lorry door he presses the button to wind the window down and a loud squeak is emitted. It reverberates through the cab as the wet window disappears down inside the door.

Simultaneously, sixteen Brüel & Kjær accelerometers that have been attached to the door register how the squeaking noise is distributed between the door, the window and the sealing strip. In this case, it's the sealing strip that starts to vibrate when the wet window is rolled down. Mr. Rostek goes back to his computer to see how the squeak is displayed graphically.

PULSE

Continental's NVH Evaluation Centre is a service department specialising in the analysis of noise transmission within a vehicle, and how the various components vibrate together. Mr. Rostek uses a Brüel & Kjær 16-channel PULSE Modal Test Consultant system to perform the measurements.

Dr. Ernst Ulrich Saemann, Manager of the team at the NVH Evaluation Centre, says, "PULSE gives us some very accurate information as to where in the sealing strip the vibrations occur, and how they are intensified by the window glass and by the metal plates in the door. The challenge is to use this information to suggest modifications to the sealing strip to make the squeak disappear. We have to deal with it quickly, or we'll lose customers. MAN won't want to purchase sealing strips from Continental if we can't get rid of that squeak."

Today's measurements are one step in the process of manufacturing a silent sealing strip. The NVH and Design Departments work closely together. When a new prototype is produced, it immediately goes to the NVH laboratory where it is installed in the lorry door, water is sprayed on the window and the noise is measured and analysed.

Customers Demand Documentation

All Continental's products are NVH tested as part of the development process – NVH measurements are not only performed when problems occur.

Today, NVH documentation is a prerequisite for Continental in marketing its products to the world's major vehicle manufacturers. A component's specification imposes NVH requirements and therefore sound and vibration measurements form a part of the marketing process.

Dr. Saemann explains, "When we talk about NVH measurement, customers are always very keen to know what equipment we use. It is crucial that they should have confidence in the results. When we tell them we use Brüel & Kjær's products, they are always quite satisfied, and we don't have any more problems in that area. Brüel & Kjær is synonymous with reliable results. That image has not been built up overnight, but is based on the fact that you can still use 30 year-old measuring instruments from Brüel & Kjær and get completely reliable results. In fact, we do that now and again, if we're stuck for modern equipment."

One Efficient, Flexible Solution

High reliability is not the only reason that Continental chooses Brüel & Kjær products. According to Dr. Saemann there are several reasons. He continues, "Brüel & Kjær's PULSE system is so flexible that it can easily be assembled in various combinations according to requirements. Continental therefore uses the same equipment for the many different types of NVH measurement that are needed."

"At Continental, we optimise the products in a large number of different quality areas. Noise and vibration are only two factors, and we don't have much time to carry out our NVH measurements before the prototype has to go on to the next test. So it is also extremely important that we can depend on the equipment, otherwise we might upset the overall plan," says Dr. Saemann. He continues, "And during my five years as manager of the NVH Evaluation Centre, I have found that Brüel & Kjær products are very reliable."

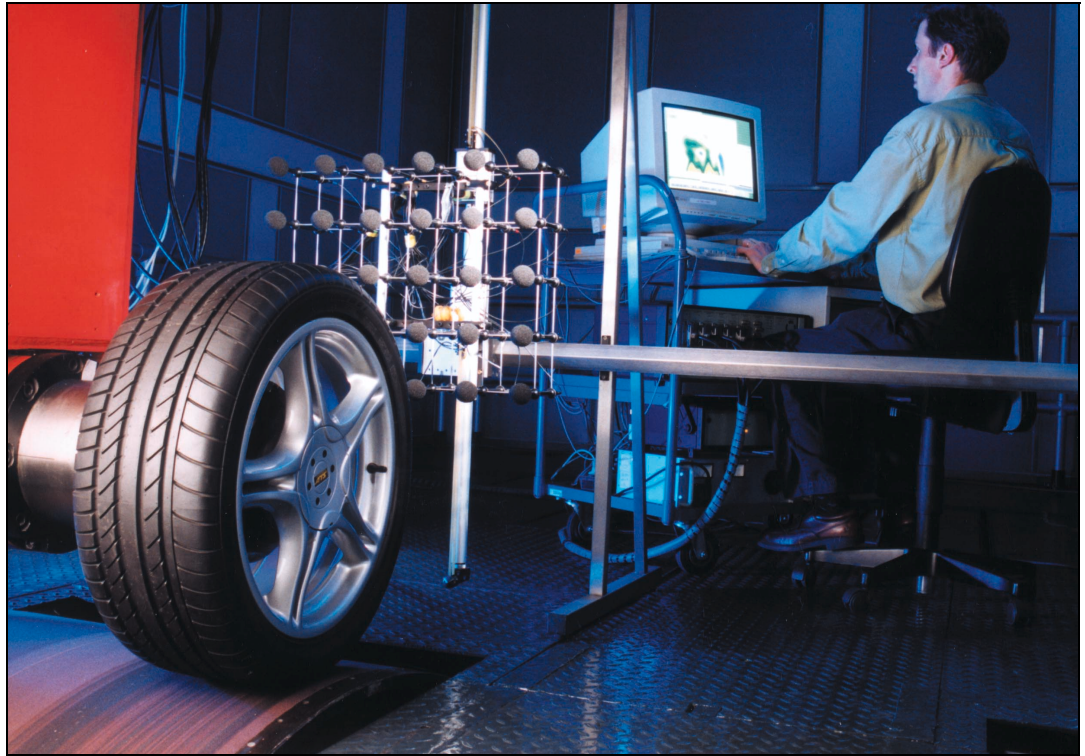
Competition and Lighter Weight

Customers are continually demanding increased NVH comfort and all automotive manufacturers are competing to make quieter vehicles. As noise is generally reduced, new sources of noise are becoming more prominent. In the old days it was only the engine you could hear when driving – today it's more likely to be the whistling of the wind that is noticed and the door seals need to be tight!

The demand for more fuel-efficient vehicles can have NVH consequences. The trend is towards using lighter-weight and thinner materials. Thin materials vibrate more easily than thicker ones and it's necessary to constantly check the NVH qualities of the individual vehicle components. The goal is for the separate parts to reduce noise created by driving the vehicle, rather than intensify it.

Quieter Tyres

Fig. 3
*STSF analysis of a
tyre in
Continental's NVH
laboratory*



Tyre manufacture is a core part of Continental's business. Reduction of tyre noise first requires measurement of an existing tyre on Continental's own test track, "The Contidrome". Measurements are taken 7.5 metres from the middle of the track, at a height of 1.2 metres, using a PULSE Pass-by system. The tyre is also tested in the laboratory using STSF (Spatial Transformation of Sound Fields) which provides a complete image of the sound field near the tyre, and also PULSE Modal Test Consultant, which reveals the tyre's own vibration frequencies.

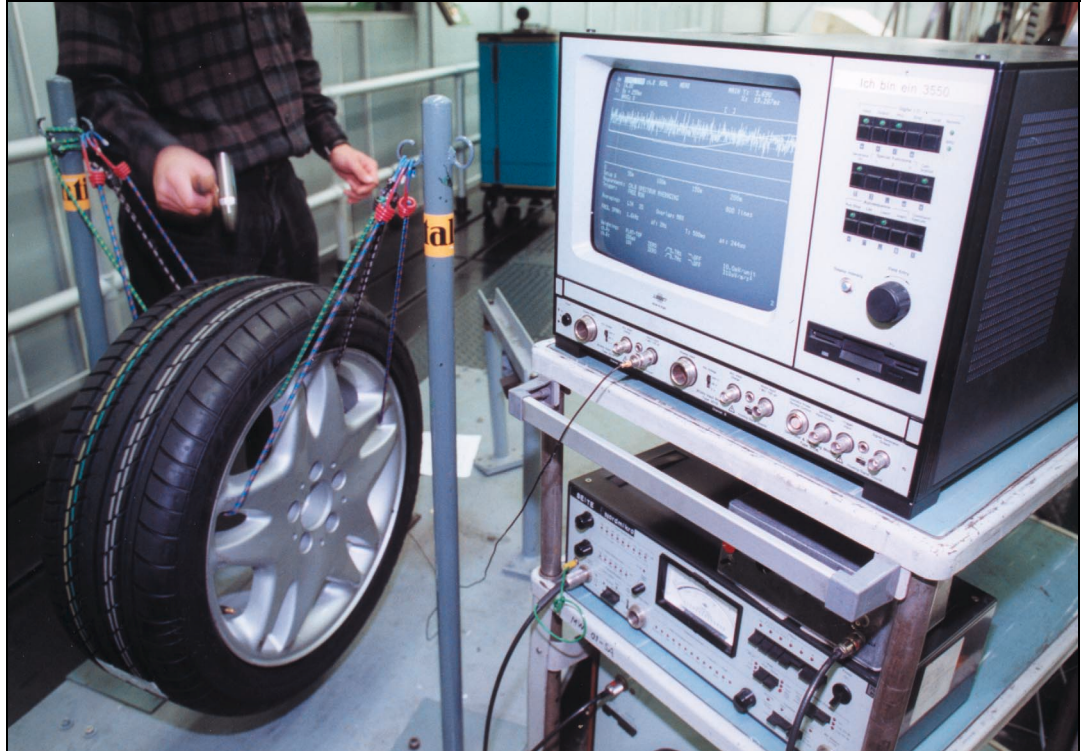
A prototype of the new quieter tyre is then developed. The prototype is tested in the same way, using STSF and Modal Test Consultant. The results are compared with those of the existing tyre, and further work is done with new prototypes until the desired result is achieved.

Partnership

The relationship between Brüel&Kjær and Continental is far more than that between supplier and customer – it's a highly successful partnership and the two companies are currently working together on an EU project using Inverse Boundary Element Methods (IBEM) to determine noise source models for tyres, engines and exhaust systems.

As a result, we will all enjoy quieter motoring and a reduction in traffic noise pollution.

Fig. 4
 Modal analysis of a
 tyre using a
 Brüel & Kjær Type
 3550 analyzer



Key Facts

- Continental measures noise and vibration in tyres and automotive components using Brüel & Kjær's PULSE™ platform
- On the Contidrome test track, pass-by noise from tyres is measured using a PULSE pass-by system
- Using a portable PULSE pass-by system, noise from tyres is measured on various types of road surfaces in different locations
- Measurements of noise from tyres running on a dynamometer are made in the NVH Evaluation Centre laboratory using Brüel & Kjær's STFS (Spatial Transformation of Sound Fields) system
- In the NVH laboratory, measurements of the natural vibration frequencies of tyres and other automotive components are performed using PULSE Modal Test Consultant™
- Measurements of cab comfort are made in the NVH Centre using PULSE Sound Quality
- Microphones, accelerometers, cables and other equipment are supplied by Brüel & Kjær