CASE STUDY

Goodyear Dunlop Europe
Colmar-Berg, Luxembourg
Analysis of Tire Noise and Vibration

Europe

Automotive

PULSE, Pass-by, Transducers

Goodyear, named after Charles Goodyear who invented rubber vulcanisation, is one of the world's largest tire companies. The company employs about 70 000 people and manufactures its products in more than 60 facilities in 26 countries around the world, representing net sales of more than US$20 billion. More than one hundred years of product development, racing sport experience and billions of tires sold, enable Goodyear to combine maximum level of safety, comfort and outstanding durability in its products.

Goodyear Dunlop Europe uses Brüel & Kjær's PULSE™ data acquisition and analysis solutions to record and analyse tire noise and vibration on test circuits and in anechoic test cells to ensure the development of quieter tires and to support the research for new materials for product improvements.

Fig. 1 *Test cell at Goodyear*

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Goodyear in Europe

In 1951, Goodyear founded its first European manufacturing unit in Colmar-Berg just 30 km north of Luxembourg's capital – a manufacturing unit that expanded to a European manufacturing and distribution centre for truck tires. In 1957, the Goodyear Technical Center Luxembourg (GTC*L) was inaugurated. Today, this unit is one of the group's two major RD&E centres.

Fig. 2
Goodyear production facilities at Colmar-Berg, Luxembourg

Goodyear is a world market leader and supplies tires to leading vehicle manufacturers. Besides the Tire Plant, Goodyear Luxembourg has a separate Mold and Wire Plants totalling about 3300 employees, 900 of whom are working at the Goodyear Technical Center. GTC*L supports 31 production units with test and technical advice in the production of tires for passenger vehicles, light and medium trucks and farming machinery. The Technical Center is responsible for the total test program.

Fig. 3
Goodyear's pass-by track equipped with Brüel & Kjær's PULSE system

GTC*L installed its first Brüel & Kjær PULSE system in 2002 and has subsequently purchased additional PULSE systems. Very recently, the pass-by system on the test circuit has been upgraded to a new GPS-equipped pass-by system. With the natural focus being on tire noise testing, the system was selected based on its overall performance and ease-of-use. Using a GPS-based system presents a number of benefits including less ground side equipment and no azimuth error in the speed measurement as would be seen by a radar placed at the side of the track and as such measuring at an angle to the line of vehicle travel.

In Search of Product Perfection

Fig. 4
Paul Leclerc started his career in Goodyear in 1988 and shortly after joined the acoustic group. Today Paul is Principal Engineer in the department of tire Vehicle Engineering Technology and the driving force in implementing NVH solutions at Goodyear. Paul holds a degree in Mechanical Engineering from Belgium

Within the automotive industry, among racing fans and ordinary consumers, Goodyear products stand for quality as well as reliability, a reputation Goodyear has earned over the years. Persistent quality-related work has led to advanced development test programs which have fulfilled the requirements of global legislations as well as the consumer's expectations for comfort and safety.

"Building a tire is a complex process", explains Paul Leclerc, Principal Engineer. "The more information we have, the more accurate we can predict the tire corresponding to the requirements of the vehicle manufacturers. In our search for product optimisation, safety will always be our first priority, but other parameters such as durability, adhesion noise, braking, handling and comfort are also of key importance to us. The Goodyear noise and vibration test programs are mainly used for developing new, quieter tires".

Prototypes and Smaller Volumes

"Prototypes are an important part of our industry due to individual requirements from vehicle manufacturers", says Paul. "With the laser cut technology the tire is only a few hours on its way and that's nothing compared to the times when it was hand cut."

It is obvious that Goodyear operates with a strong knowledge management system used in a very professional way when the vehicle manufacturers make new enquiries. "It saves time and it brings us faster to the desired product," says Paul.

"Tubeless tires are of course our main product, but a small number of tires with inner tubes are still produced", explains Paul. "A smaller volume of tires with inner tubes such as Rolls Royce, Bugatti, Aston Martin, Bentley and some Mercedes sports cars are supplied by Goodyear."

Test Facilities and Tests

Fig. 5
The Goodyear test circuit

The noise test facility at Goodyear incorporates semi-anechoic chambers equipped with dynos and a test rig running independently of each other. The electrical drive drums of the dynamometers are located remotely and are sound insulated to ensure that they have no effect on the accuracy of the test data.

The acoustics laboratory was built in 2000 and has a cut-off frequency of 100 Hz while the second laboratory, dating from the late 90s, focuses on vibration measured on steering wheels, pedals, seats, steering columns, etc. To pick up the vibration data Brüel & Kjær's Triaxial Accelerometers Type 4524 are installed.

Fig. 6
Truck noise test using a PULSE system

"The lab tests mainly investigate improvements in materials," says Paul and continues, "whether it is comfort-related, in-vehicle noise or legislation-driven external noise".

Next to the test facility and the large complex of garages containing more than 100 vehicles, is Goodyear's test circuit. The total length of the circuit is 4.6 km, with a separate ISO noise surface permanently equipped for pass-by measurements.

"The objectives of the circuit are to collect data to determine quality, durability, safety level, grip, tire noise, ride and handling performance," explains Paul and continues, "We only employ highly skilled drivers who know the specifications of the subjective tests allowing us to compare test results".

Types of testing at Goodyear's Technical Center include benchmarking, troubleshooting, core R&D and fundamental technical research into new materials and methods.

Product Evaluation

In addition to the tests carried out at the test circuit, an important part of the test program is done on public roads, not only using European fleets but also under controlled and typically Asian conditions in Thailand, where the combination of high temperature and humidity is tested. The winter performance part of the test program is done in Switzerland, Scandinavia or New Zealand. The tests are a combination of handling, acceleration, braking and traction in snow and icy conditions.

Data Management

Fig. 7
From left to right: Poul Leclerc, Principal Engineer, Albin Pochet, Engineer and Dr. Bodo Ahrens, Manager

"After a test is completed, the results are instantly available on the Goodyear network," explains Paul. "All data are stored in the PULSE Data Manager, which is an excellent solution forming the basis for the Technical Center's data storage, sharing, retrieval and comparison.

"When investing in the first PULSE system, PULSE Data Manager was one of the most important criteria and one of the reasons to choose Brüel & Kjær as our preferred NVH solutions supplier."

Cross references of data with colleagues at the Technical Center in Akron, Ohio is of course frequently used at conclusion level. Direct comparison is not possible due to differences in vehicles, weight, size of engines as well as speed.

The Future

The future vision of Goodyear is to put greater emphasis on prediction and modelling of the tire's construction and tread. Practical testing costs money and takes time. Modelling should reduce the need for practical testing as well as time to market for future generations of tires.

Key Facts

- Goodyear measures noise and vibration on tires and automotive components using Brüel & Kjær's PULSE platform
- On the test circuit, pass-by noise from tires is measured using a PULSE pass-by system
- Measurements of noise from running tires are made in NVH dynamometer using Brüel & Kjær's PULSE system
- Microphones, accelerometers, cables and other equipment are supplied by Brüel & Kjær

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