

CASE STUDY

United Kingdom

The Transport Research Laboratory (TRL) Measurement and Analysis of Tyre and Road Noise

Automotive

PULSE and Microphones

TRL, located at Crowthorne, Berkshire, is the UK's largest transport research institution. TRL is an independent, internationally recognised centre of excellence in surface transport issues. For more than 60 years, TRL has worked closely with customers in the public, private and independent sectors of the UK and world-wide and is currently involved in a number of important European projects. The organisation provides research-based technical help that enables customers to obtain improved value for money, and to generate competitive advantage and a better understanding of transport problems. TRLs research extends into many areas – from roads, tunnels, bridges and construction – to safety and environmental issues.



Tyre/Road Noise

With public concern about the environmental impact of transport increasing, environmental standards and constraints will become more demanding. To make informed judgments, decision makers in government and industry require accurate information and advice on environmental issues. More and more organisations recognise that TRL's unique research facilities and its role in developing international environmental standards and assessment techniques reflect leading-edge expertise in understanding and reducing the environmental impact of transport.

A major factor which contributes to the environmental impact of increased traffic is the noise created by vehicle tyres on road surfaces and TRL is now equipped to test, measure and analyse this.

TRITON

TRITON is the name of the Transport Research Laboratory's new, specially built, mobile research laboratory – a large, white, 7½ tonne truck. TRITON is used by TRL's scientists to better understand the relationship between noise and the characteristics of the road surface and tyre.

Fig. 1
*The test tyre and
frame carrying the
microphone array*



Today's standard noise measurement methods for road surfaces rely on statistical monitoring which measures the noise levels of a large number of vehicles travelling through a fixed test area. However, this method is quite site-specific and does not lend itself to assessing long lengths of road. In addition the method is, by its nature, unsuitable for examining the performance of individual tyres. Both of these problems were overcome by using a special test wheel running in the near-side wheel track with close positioning of the microphone, 200 – 400 mm from the tyre wall, and isolation from external noise sources such as the truck engine, other vehicles, etc. As the next step, real traffic speeds and placing the tyre in the wheel tracks were needed to achieve accurate and repeatable measurements.

Unique New System

TRITON uses a completely revolutionary approach employing a specially designed truck body that incorporates an anechoic chamber (a room where the walls absorb virtually all the sound) containing a test tyre and Brüel & Kjær microphones. This chamber can be lowered until it almost touches the road surface and the test tyre and microphones are effectively isolated from other sounds. In fact, the chamber is so effective that the tyre/road noise delivers about 100 dB but the background noise is limited to about 60 dB.

Benefit

The major benefit of TRITON is that measurements can be made at real traffic speeds, at any location and on any road surface. TRITON is equipped with on-board positioning equipment so that measurements can be made along both short and long trial lengths of road. The key tests can be accurately and reliably repeated using different tyres and the tyre angle can be changed to simulate different wheel alignments. Additionally, the road and tyre surface temperatures can be measured, as can the internal tyre pressure.

Fig. 2
The test tyre is pneumatically lowered to contact the road surface. The array of seven Brüel & Kjær microphones captures the noise



Inside the anechoic chamber, seven Brüel & Kjær microphones capture the noise emitted close to the tyre. These are connected to a Brüel & Kjær PULSE™ multi-analyzer. The eight-channel PULSE system measures and analyses the signals from each of the seven microphones, while the eighth channel is used for triggering purposes. The PULSE system is triggered at regular

20 metre intervals along the length of the road under test. Each trigger starts a new real-time measurement over fixed road segments to build up a noise profile of the road.

In-Vehicle Control Room

In the sophisticated on-truck control room, TRITON gathers huge amounts of data that will enable TRL to help improve the design of both tyres and road surfaces.

Fig. 3
TRITON's on-truck control room



Steve Phillips, head of tyre/road noise studies comments, "We are currently evaluating the initial data from TRITON to determine the best way to present data and improve our understanding of the relationship between noise and tyre and surface properties. Even with the power of Brüel & Kjær's PULSE system, it will take some time to investigate all the data and all the possibilities because we are well aware that, in the case of both tyres and road surface technology, changes made to reduce noise could adversely affect road holding performance and safety".

Steve continues, "With TRITON though, we can now measure a wider range of road surfaces under a wider range of conditions and over much longer distances. All this can be done in real conditions without requiring any special precautions and, especially, without causing unnecessary disruption to other road users".

Quieter Motoring

Fig. 4
The Brüel & Kjær logo is displayed on TRITON – the relationship between the two organisations is strong and reflects the "partnership"



"TRITON will be monitoring noise routinely around the trunk road network and we anticipate that it will help us to unravel the mysteries of the complex relationship between tyre noise and road surface texture so that we can, perhaps, all look forward to quieter motorways in the not too distant future", concludes Steve.

Key Facts

- The Transport Research Laboratory, founded in 1933, is the UK's largest transport research institution
- There is increasing focus on environmental noise, including traffic noise
- TRL has been a Brüel & Kjær customer for more than thirty years and uses a wide range of Brüel & Kjær products including analyzers, charge amplifiers, transducers and calibrators
- TRITON is a specially built mobile laboratory which is used to better understand the relationship between tyre noise and the texture of a road surface
- An anechoic chamber is used which effectively isolates the noise from the test tyre from other noise
- An eight-channel Brüel & Kjær PULSE multi-analyzer system is used to measure and analyse the data, and to prepare the reports
- An array of seven Brüel & Kjær microphones is used – the eighth channel is used for triggering
- Measurements can be made at real traffic speeds and are accurately repeatable
- The PULSE system in TRITON collects and processes huge amounts of data – TRL can measure a wide range of road surfaces under a wider range of conditions, and over much longer distances than previously possible