

CASE STUDY

United Kingdom

London Taxis International Noise Vibration Harshness – The TXII

Automotive Manufacture

Portable PULSE, NVH Applications, Transducers



London Taxis International, based at Coventry, England is the major supplier of the world-famous “black cab”, a familiar sight not only in London, but in other UK cities and around the world. The latest model is the TXII which conforms to the new, strict, European emission regulations. But it’s environmentally friendly in other ways too. London Taxis International uses a Brüel & Kjær multi-analyzer system to refine the NVH characteristics of the TXII. Noise and vibration are greatly reduced – for the benefit of the driver, passengers, pedestrians and other road users.



A Demanding Environment

As the name would suggest, London Taxis International specialises in the manufacture of the taxi which is such a familiar sight in London. But you will also see them in other British cities - Liverpool, Birmingham, Manchester, etc. Additionally, left-hand drive taxis are built for use in other countries including France, the USA and the middle-east.

The company has a very significant share of the market, producing several thousands of taxis a year, and the conditions are demanding. There are about 500 employees.

A taxi is often in use for 12 to 24 hours a day with some vehicles operating around the clock using several drivers. A taxi is expected to have a working life of 10 to 15 years and to travel over half a million miles (800,000 km). Some 60% of production is fitted with automatic transmissions. The vehicle must be reliable and thoroughly engineered. Additionally, it must comply with tight regulations including such factors as a small turning circle, wheelchair access, etc. In London, a taxi must meet conditions of fitness, and converted MPV's can't comply.

Tim Bassett is Principal Engineer NVH at London Taxis International. Tim explains, "We have two types of customer. The first is the owner driver who generally wants all the options and takes a great pride in his vehicle, after all, it's his livelihood and he spends many hours a year in it. The second category is the fleet hire operator and they may run hundreds of taxis".

TXII – A Quantum Leap Forward

The European Union has introduced legislation which requires that all new taxis sold after 1st January 2002, must conform to stringent exhaust emission regulations. London Taxis International has developed a new model, and it's a revolution! Tim Bassett says, "Our TXII is a quantum leap from existing models. Not only does it conform to the new regulations, but we have improved the design in many other ways."

Fig. 1
Another development vehicle being prepared for test



Many sub-suppliers have cooperated with London Taxis International in the development. The TX11 is fitted with the quiet, clean and efficient 2.4 litre Ford Duratorq 90 PS diesel engine with turbo and intercooler. A special steel chassis is manufactured by Thompson Chassis while the manual transmission is from Ford. The automatic transmission is made by Jatco in Japan. LTI produces its own bodies.

PULSE – NVH Refinement

Tim Bassett explains, "When developing the TXII, we decided to refine its NVH (Noise Vibration Harshness) characteristics. In the past, we used consultants but the noise and vibration analysis is now done in-house".

NVH Expertise

Tim is an NVH expert. Following his university degree, Tim has worked exclusively with noise and vibration at such companies as Jaguar, Rover and LDV.

He joined London Taxis International two years ago and is responsible for all NVH testing and analysis.

Investment

LTI invested in new facilities which included the building of a sound-proofed testing room and the purchase of a Brüel&Kjær PULSE multi-analyzer and application programs.

Fig. 2
Two PULSE front-ends and a 16-channel TEAC DAT data recorder



“We decided to buy a Brüel&Kjær Portable PULSE multi-analyzer system for NVH work”, explains Tim. He continues, “I have had good previous experience with PULSE. It’s a cost-effective solution and it gave us the portability and flexibility that we needed.”

London Taxis International has two front-ends for use with Portable PULSE. One has five channels and the other seven channels.

Fig. 3
Tim Bassett is Principal Engineer NVH at London Taxis International

Tim comments, “Depending on the task, I can either use just one of the front-ends or I can connect them together to give me more channel capability. In the future, I can increase my processing power by simply buying a new, faster PC, so PULSE always stays up-to-date. It was another reason for our decision to buy it. I find the white and pink noise sound generator very useful.”

In addition, London Taxis International has invested in two 2238 Mediator sound level meters that are used for base line and internal sound level measurements. There is also a pass-by noise system which is used by the development department.



Tim comments, “We get very good service and support from Brüel&Kjær and I am pleased with the performance of the equipment”.

NVH Tasks

The PULSE system is used for NVH analysis in a number of areas including:

- Power train evaluation – both the automatic and manual transmissions must be as quiet as possible
- Engine bulkhead insulation – this has to be effective to insulate the driver and passengers from the engine noise
- Wind noise – to ensure that this is at a low level
- Interior sound insulation – foam and felt materials are extensively used to reduce noise and vibration experienced by the driver and passengers
- Benchmark testing – to evaluate the performance of the TXII against competitors products.

Fig. 4
Tim Bassett and his TXII, used for NVH evaluation



“The driver is the most important person”, says Tim, “After all, he spends many hours a day in the vehicle and the purchase is a significant investment for him, whereas, for the passenger, the average length of a journey is generally a few minutes.”

Tim has his own TXII model which he uses for NVH analysis and it’s used constantly. “We can make modifications and then immediately perform a test to measure the effect,” says Tim.

He uses standard PULSE software with order tracking and a high bandwidth analysis engine. “I use some of the standard PULSE templates but it doesn’t take long to set up a project”, Tim explains.

Standards

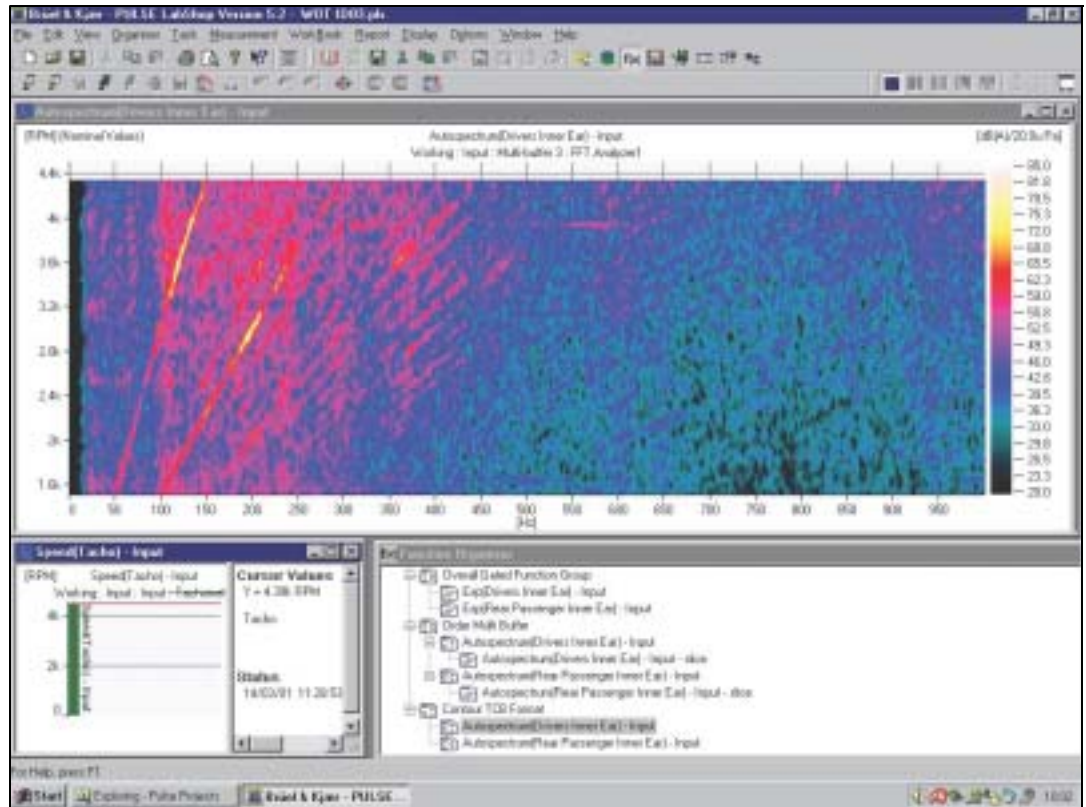
A main objective with noise and vibration testing for London Taxis International is to establish its own specifications and standards.

In addition, the taxi has to meet the strict pass-by noise levels set by the European Union for all public service vehicles.

Data Handling and Reporting

The PULSE system runs under Windows NT® and is connected to a local area network (LAN). The data is archived on CDs. When making reports, the data is exported to Excel where graphs and contour plots are created. These can be copied and pasted into a word document for presentation to the Board of Directors.

Fig. 5
PULSE LabShop software is used to analyze the NVH characteristics of vehicles. Here, an FFT analyzer with a tachometer input signal is used in a run-up test



Future Plans

London Taxi International is planning to extend the applications which can be run with PULSE. Tim explains, “Our next step is to use modal analysis which will be especially useful in the selection and development of exhaust systems. Then, at a later date, I would like to have the Noise Source Identification software – I think it’s great”.

Evolution

Fig. 6
They’re not all black - a TXII straight off the production line, ready for its proud new owner



We regard the development of the TXII as a major step forward but our work is a process of continuous improvement, and we have extensive future programs”, says Tim.

Taxis are becoming very sophisticated. Many are fitted with state-of-the-art technology including GPS (Global Positioning System), satellite tracking and digital communications systems.

London Taxis International has its own paint shop. Traditionally, most taxis are painted black but any customised colour can be supplied.

So, when you next visit London, or another large city in Britain, and need a taxi, you may be lucky and enjoy a journey in a new TXII.

It's environmentally friendly – not only are the exhaust emissions low, but it's quiet too – for the benefit of the driver, passengers, pedestrians and all other road users.



Key Facts

- London Taxis International specialises in the manufacture of taxis which are used in London, other major British cities, France, the Middle East, etc.
- The company is the leading producer of this type of vehicle with a very significant market share
- London Taxis International is introducing a new model, the TXII, which conforms to the latest European Union regulations on exhaust emissions
- The TXII is a major step forward in taxi engineering
- London Taxis International has invested major resources in the evaluation of the Noise Vibration Harshness (NVH) characteristics of the new model
- NVH analysis is made using a Brüel & Kjær PULSE multi-analyzer with both 5- and 7-channel front-ends, and application software
- The PULSE system was purchased due to previous good experience with Brüel & Kjær equipment and is a cost effective solution
- London Taxis International appreciates the flexibility and portability of Portable PULSE
- The company has purchased two Brüel & Kjær 2238 Mediator Sound Level Meters
- Future plans include the use of modal analysis and noise identification software packages with PULSE™