

CASE STUDY

The Netherlands

Noise and Vibration Evaluation of Military Vehicles The Royal Netherlands Army

Automotive, Military

Portable PULSE, Customised Software

The Testing Division of the Material Directorate of The Royal Netherlands Army evaluates the noise and vibration characteristics of military vehicles and their components—from motorcycles to tanks. The data is used when compiling requirement specifications in purchase contracts, for durability testing and troubleshooting. To test vehicle noise and vibration under a wide range of operating conditions, the division uses a Brüel & Kjær 7-channel Portable PULSE™ multi-analyzer, customised software and transducers.



The Testing Division of the Material Directorate

The Testing Division of the Material Directorate of The Royal Netherlands Army is located at Huijbergen, near Breda. The group tests a wide variety of equipment used by a modern army, from items of clothing to complete vehicles and their components. Extensive test facilities are available. The dynamometers are particularly impressive – large and heavy vehicles can be run under controlled, stable conditions. Several test tracks are available which represent a range of driving conditions, from normal roads to rough and hostile terrain. Special facilities are available when firing live ammunition or testing the effect of mines exploding under a new version of a Leopard tank!

Fig. 1
*One of the
dynamometers at
Huijbergen*



The Testing Division cooperates with other NATO countries in the purchasing phase of new vehicles. For example, it is currently working with The German Army on the specification of a new reconnaissance vehicle.

Noise and Vibration Evaluation

Fig. 2
*A Portable PULSE
multi-analyzer
measures noise and
vibration inside a 6-
wheeled 25 tonne
armoured
personnel carrier*



The evaluation of vehicle noise and vibration is a vital factor.

C.J.A.M van Ginneken (known as “Koen”) is project leader of the team responsible for noise and vibration testing. He says, “We test both complete vehicles and individual components. The vehicles are tested using strain gauges and accelerometers. We use our PULSE system for testing components and specific areas of the vehicles, both externally and internally. We determine the natural frequencies of equipment and dampen these when necessary”.

Koen continues, “Vehicles and components must be tested for fatigue and durability under extremely adverse conditions.

The data are used to compile requirement specifications for the development and purchase of new vehicles and equipment, to ensure their durability during their operational lifetime.”

An FFT analyzer is generally used with time capture and data recorder for calculating the shock response spectra.

PULSE – The Cooperation with Brüel & Kjær

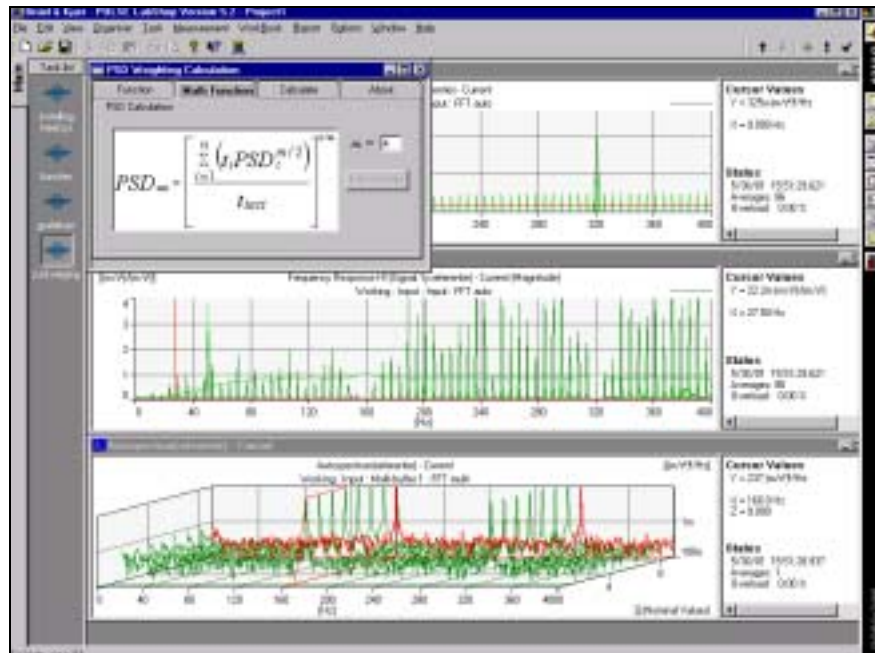
Koen explains, “We purchased our Portable PULSE system less than a year ago. We previously had more than 10 years good experience with our Brüel&Kjær Type 2032 analyzer but it was rather large and heavy and only had two channels. We needed something lightweight and portable with more channel capability. The normal method of averaging of power spectral density (PSD) was not suitable. The vehicles and equipment are subjected to severe vibration and therefore it was important for the software to take account of worst-case scenarios. Brüel&Kjær was the only company who could offer special averaging using our correction formula based on the PSD measurements.”

He continues, “I am pleased with our PULSE system. We got good on-site training and it is easy to set up and use. We can attach our PULSE to a laptop computer and we have a completely portable analyzer and data recording system”. The PULSE system bought by The Testing Division has a 7-channel front-end. Six channels are normally used and banks of three accelerometers are placed in two different locations. The single axis accelerometers, manufactured by Brüel&Kjær and ENDEVCO, are each mounted on special blocks which give greater flexibility.

Typical Vibration Tests

A typical series of tests might involve the fitting of a new radio installation in a vehicle. It is necessary to analyze the vibration levels and frequencies where it is intended to mount the equipment in the vehicle and also externally where the antenna will be placed.

Fig. 3
Customised PULSE LabShop software is used which incorporates special averaging using a correction formula based on PSD measurements



The vibration characteristics of the equipment are determined using PULSE and accelerometers. The vibration intensity and frequencies at the proposed mounting location inside the vehicle are also evaluated. Koen explains, “We might try measuring at several locations and then choose the mounting position for the equipment that is least affected by vibration.”

We run the vehicle several times to make sure that the results are always reproduced.”

Using PULSE and six accelerometers, the vibration is also analyzed in the area where the vehicle's antenna will be mounted. It's important that the vibration is at an acceptable level and that the frequencies present do not create excessive vibration in the antenna.

Data – Reporting and Security

The software runs under Windows NT[®] and the PULSE system is connected to a LAN. The data is exported into either MATLAB[®] or Excel. If printed reports are required, the data is exported directly into Microsoft[®] Word.

For security, the data is backed-up on either a ZIP drive or on MOD (magnetic optical disk).

The Material Testing Team

Fig. 4
Koen van Ginneken is the team project leader



Koen van Ginneken is project leader of the team responsible for the evaluation of noise and vibration PSD. He has worked with The Royal Netherlands Army for more than 10 years and specialises in vibration and fatigue testing. He previously worked at Philips.

Key Facts

- The Material Testing Group of The Royal Netherlands Army is based at Huijbergen, near Breda
- The Royal Netherlands Army cooperates with the armed forces of other NATO countries
- Noise and vibration evaluation data is used:
 - in the preparation of requirement specifications
 - for troubleshooting
 - for durability and fatigue testing
 - to analyse the noise and vibration characteristics of components and specific areas of military vehicles
- The Material Testing Group used a Brüel&Kjær Type 2032 Analyzer for more than 15 years
- A Portable PULSE multi-analyzer system with a 7-channel front-end has been purchased
- Brüel&Kjær was the only company that could offer the necessary special customised software
- PULSE on-site training was provided by Brüel&Kjær
- ENDEVCO and Brüel&Kjær accelerometers are used