

## Measuring for the Blue Helmets: Highly demanding Blast Tests



*Bild 1 <LTT\_WTD91\_1.jpg>:*  
On behalf of the Federal Armed Forces, the Technical Center WTD 91 at Meppen performs technical investigation on weapons, ammunition and vehicles.

**The WTD 91 at Meppen, Germany, is one of ten Technical Centers and Research Institutes subordinated to the Federal Office of Defense Technology and Procurement. Its history goes back more than 125 years, beginning with an artillery firing range built on this site by the Krupp company in the Imperial Germany of 1877. Today, the tasks of the Technical Center include technical research and testing of weapons, ammunition, armoured vehicles and all kinds of protection structures and buildings. Blast impact tests on tanks, mine-hunting and medical vehicles as well as on buildings are performed on a large site in the Emsland region. This puts challenging demands on the measurement technology.**

With the reorientation of the German Federal Armed Forces on peacekeeping "Blue Helmet" missions in conflict areas, the qualification and technical approval of mine protection vehicles used in these operations has become a task of particular importance for the WTD 91.



*Bild 2 <LTT\_WTD91\_2.jpg>:*  
Blast impact tests are used to verify the mine resistance of tanks and other vehicles.

The possible impacts on vehicle occupants are investigated with help of test manikins and seat structures equipped with sensors to determine the induced forces and accelerations. The test manikins used are similar to the crash test dummies known from traffic accident research, but considerably more sturdy with an even more complex design.



*Bild 3 <LTT\_WTD91\_3.jpg>:*  
Dummies are used to measure and validate the possible impact on the occupants in terms of forces and accelerations.

The measured data are used to calculate the so-called Dynamic Response Index that can be compared with ergonomic limits. On the measuring side, the challenge lies in the extremely fast transient processes and the multitude of measurement data to be captured simultaneously. The measurement duration is typically only 60 milliseconds, exceptionally up to 2 seconds. Within this short period, for example, 32 channels with sample rates up to 1 MHz (corresponding to one million

measured values per second) per channel are recorded. As the test objects usually are destroyed in the process, the measurements cannot be repeated, and thus must be performed with a maximum level of measurement redundancy and data consistency. The measurement equipment is kept in a container at a safe distance which necessitates extensive sensor cabling with lengths up to 100 meters.

With the transient recorder LTT-186 the WDT now has a measurement system at its disposal that lives up to the high demands. This front-end system, developed and produced by LTT, a Würzburg company specialised in ultra-fast measurement techniques, extends the scope of conventional PC measurement technology to dimensions never reached before. The single recorder offers 16 differential inputs while cascading several units allows hundreds of parallel channels to be captured synchronously. Separate AD converters and amplifiers for each input channel ensure simultaneous sampling of all channels and channel-specific amplification for input ranges from  $\pm 1$  Volt to  $\pm 50$  Volt. Depending on the required resolution, the available sample rate per channel is from 1 kHz to 2.5 MHz at 16 bit or up to 20 MHz at 12 bit. Each input is equipped with an adaptive anti-aliasing filter.



*Bild 4 <LTT\_WTD91\_4.jpg>:*

LTT-186 front-ends for data acquisition and processing with 16 input channels per unit are cascadeable.

PC connection is provided by a patented SCSI-II interface that configures itself upon installation. The LTT-186 does not require any driver to be installed on the PC and is ready for use as soon as it is turned on. The internal hard disk is automatically recognised by Windows as a system hard drive, allowing direct access to the recorded data from any application software. The included software will perform the complete hardware configuration of the LTT-186 and is also used to select recording mode (simple or ring), trigger options (digital or analogue) and time reference (internal or external clock). Up to 16 different configurations for stand-alone operation can be stored in the unit. When the PC is connected data can be displayed and processed online.

The measured data are saved to a high-speed RAM (128 MB) or to the integrated shock-proof hard disk (8 Gigabyte). Due to redundancy demands the WTD always uses two independent systems. For measurements with 32 channels, for example, two systems of two LTT-186 units will be operated simultaneously. The first system runs in transient recording mode and is automatically triggered by TTL pulses. The second system is triggered manually by keystroke or mouse click. First, the stored data are analyzed over the total theoretical bandwidth of the accelerometers involved (typically 40 kHz) to determine if overload has occurred.

Subsequently digital filters are used to restrict the bandwidth to the relevant range for post-processing.

For the test engineers from WTD 91 the implementation of the new systems means a significant improvement and streamlining of their work. Previously the tests were performed using magnetic tape recorders where handling the heavy tape decks and archiving the sensitive tapes was rather cumbersome. Prior to further processing, the analogue signals had to be digitised and then transferred to the post-processing computer. The sample rate was limited to 80 kHz per channel which is very close to the minimum bandwidth required. Alternative systems with PC plug-in cards had been tested, but were not flexible enough due to their limited sample rates and signal bandwidths. Finally, the LTT system brought the desired solution: Its online functionality ensures that the measured data are immediately available on PC and can be verified on site. This allows for a system check (e.g. for broken cables) prior to starting the test, thus ensuring a higher redundancy level. Now data can easily be stored to CDs which is both convenient and space-saving and allows flexible data retrieval on any PC system.

Andreas Evelt from the Measurement Group is very satisfied: "The compact and sturdy LTT equipment is lightweight and safe to transport and much more flexible to use. Furthermore, the new solution is more cost-effective than our old tape recorders, both in terms of purchase costs and maintenance – an important factor namely at times of small budgets!"

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