

# Vehicle Mine Protection

Designers, producers, and users of vehicles in operations where mines pose a threat, increasingly realise that apart from integrity of the vehicle after detonation of the mine, personnel safety is crucial.

We offer you the whole range of capabilities, from experiments to tools and methodologies, to analyse vehicle occupant safety and vehicle integrity after detonation of a mine.



## Balanced approach

To solve your problems related to the safety of the occupants of the vehicle after detonation of a mine, a balanced mix of trials and modelling may be used.

## Tools

Several tools are at your disposal for analysis of mine effects on personnel.

One powerful code is MADYMO, originally developed by TNO for the analysis of occupant safety during car crashes.

Instrumented Hybrid III 50%-tile male crash

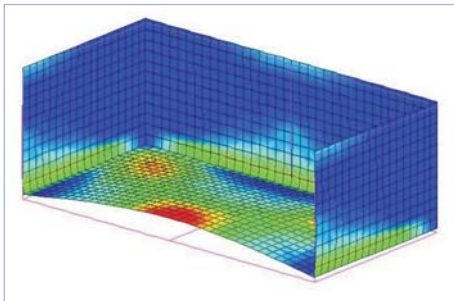
dummies are available to accurately measure the loads in the human body in full-scale experiments. The results of these dummy measurements can be checked with injury criteria in order to obtain a prediction of the probability of injury and to establish the confirmation with qualification requirements. Furthermore, the measurements serve as a validation for the simulations.

## Reference projects

- Evaluation and enhancement of the Leopard 2 mine protection capabilities;
- Analysis of a mine protected M113 personnel carrier;
- Occupant safety analysis of the DAF YA-5442 logistic truck;
- Crash dummy measurements in mine tests with the CV9035 Infantry Fighting Vehicle;
- Definition of requirements on the mine protection capabilities in several vehicle programs.



DAF logistic vehicle trials and simulation



'Finite Element Model in LS Dyna for response analysis of vehicle structures

### Advantage

A continuous effort is put into research on low-level injury criteria, model improvements, the use of the human body model in MADYMO and on the improvement of crash dummy measurements. Doing business with TNO allows you to get the full answer to any question related to vehicle mine protection in relation to occupant safety and vehicle integrity. Test with two crash dummies in armoured vehicle

### Standards

Within the NATO, standards on protection levels of military vehicles are under development. TNO takes part in working groups to define standards for the test procedures and the pass/fail criteria and leads the working group for the definition of the injury criteria and the tolerance levels for the test procedures.



MADYMO Human Body Model



Moving HYBRID III model

### TNO Defence, Security and Safety

TNO Defence, Security and Safety provides innovative contributions to the advance of comprehensive security and is a strategic partner of the Dutch Ministry of Defence to build up the defence knowledge-base. We employ our acquired knowledge for and together with contractors.

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