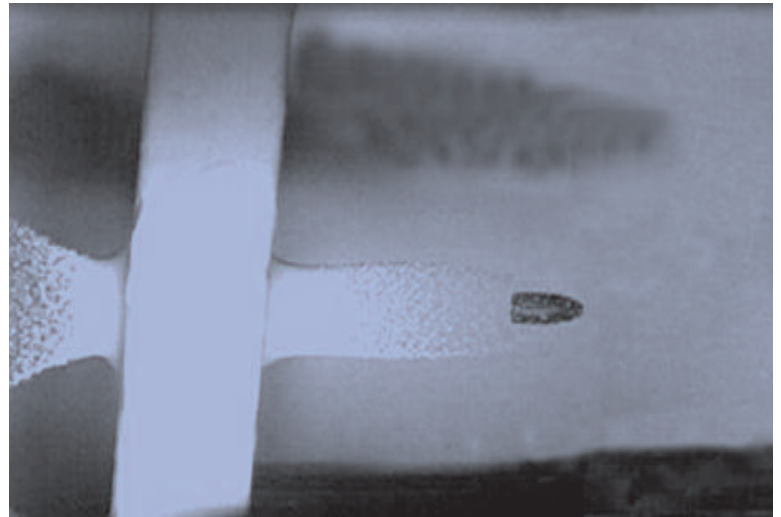


## Products & Services

# Armour Protection

TNO has built up an extended experience in ballistic protection for both personnel and platforms. Our main customer is the Netherlands Ministry of Defence. Over the years, we have supported the development and procurement for both new materiel and upgrades of existing materiel. Our expertise of ballistic protection is also available for other (foreign) government agencies and industry.



### Context

The current inventory of military vehicles of most countries largely originates from the period of the Cold War, especially with respect to their development. For low intensity conflicts however the threat for passengers and crew has changed dramatically. Vehicles with a well-protected frontal arc or vehicles, which used to operate behind the frontlines, are now exposed to threats from around (including from behind), from above and from beneath. Moreover, both politics and the public accept own victims during peace operations even less than in case of direct national interests being at stake. For this reason the protection of passengers and crew of vehicles, especially for the lighter vehicles, often needs to be changed drastically. Stopping bullets or knives with vests is often not enough. Injury resulting from behind armour blunt trauma should be considered as well. We offer protective armour designers and users a range of research and engineering capabilities in order to come to the best possible protection for a range of threats.

### Firing Ranges

At our ballistic laboratory we can perform standardised ballistic testing experiments e.g. or provide stab resistance assessments. Two small calibre testing ranges are available, each 15 meters long, which can also be combined into a one 30 meter long range. These ranges are capable of handling kinetic energy rounds of calibre 20 mm maximum. In the target bunker and large calibre firing range, kinetic energy projectiles up to and including 40 mm calibre can be fired at targets (targets may contain explosives). The target bunker can be used for threats up

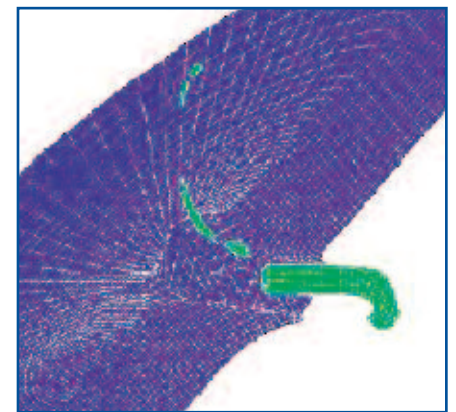


Small calibre testing range.

to an equivalent of 25 kg of TNT explosive. A range of advanced diagnostic equipment is available to assist in such studies, amongst others IMACON ultrahigh-speed camera's and X-ray pulsers.

### Simulation tools

Numerical codes dedicated to understanding the working mechanisms and physics of armours are ready to be used in contract research or consultancy projects.

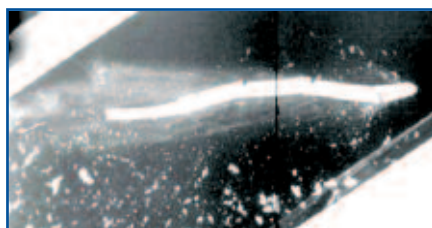


AUTODYN hydrocode simulation of long rod penetration.

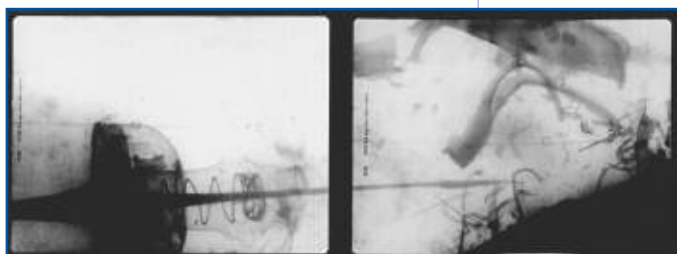
### Armour Research

We have performed background research on the following armours:

- Steel, aluminium and titanium (topics: penetration, perforation, material properties, experimental characterisation of behind armour debris)
- Lightweight vehicle protection (various armours against the common 14.5 mm threat)
- Spaced armours for medium calibre threats



*Damaged penetrator after interaction with frontplate of armour.*



*ERA versus shaped charge attack.*

### Advantage

Doing business with TNO allows you to get the full answer to any question related to armour protection.

- Ceramic-faced armour (with composite and metal backing)
- Sandwich armours (ERA, non-energetic ERA)
- Composites
- Spall liners
- Personal ballistic armour and devices (behind-armour blunt trauma, V50 measurement)



*Vehicle hull with add-on armour prior to ballistic testing.*

### TNO Defence, Security and Safety

'TNO Defence, Security and Safety' is the title under which TNO operates as a strategic partner for the Dutch Ministry of Defence and makes innovative contributions to enhance the safety and security of the Netherlands both at home and abroad. We also use our accumulated knowledge for businesses, industries and foreign governments.

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