

FUNCTIONING AND SAFETY OF MUNITION



TNO innovation
for life

The demands that military operations put on ammunition are becoming more challenging over time. New ammunition types require identical or improved performance in comparison with existing ammunition, meet the IM requirements and remain at a comparable cost level. In addition, in some cases ammunition should have a multi purpose mode or scalable functionality for Military Operations in Urban Terrain. Technological innovations are required to fulfill to these demands.

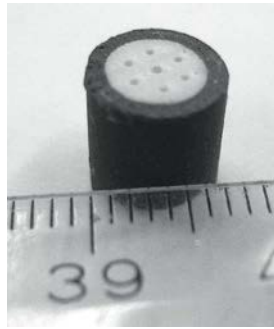
FUNCTIONING AND SAFETY OF MUNITION

For more than 5 decades TNO is responsible for the surveillance of the ammunition of the Dutch Armed Forces and has carried out a multitude of guided missile surveillance programmes.

In more than 25 years of IM research, TNO has gained knowledge on the mechanistic understanding of the functioning and munitions' response to external threats, covering the full lifetime from cradle to grave. Instrumented tests and computer models have been developed and dedicated methods and hardware has been designed in support of the research and development activities. So, a team of well-known specialists is capable of covering the complete area of ammunition safety and functioning aspects to realize the innovation that is needed to ensure safe handling and proper functioning of munitions, achieving today's challenging requirements.

WARHEAD, FUZE AND MUNITIONS DEVELOPMENT

TNO is experienced in the development and testing of insensitive explosive formulations, LOVA or temperature-independent gun propellants and green (pyrotechnic) compositions. TNO can assist in the application of state of the art fuzes for your newly developed ammunition with knowledge based on in-house developed, computer-controlled fuzes for modern adaptive or multi-role effect munition types. A mini EFI (Exploding Foil Initiator) could be part of such a highly sophisticated fuze-system. In addition, for a whole range of other munition aspects, ranging from internal ballistics up to performance and lethality, TNO has a broad experience and employs simulation tools and testing facilities for these purposes.



Experimentally produced co-layered gun propellant, developed by TNO

MITIGATION TECHNIQUES

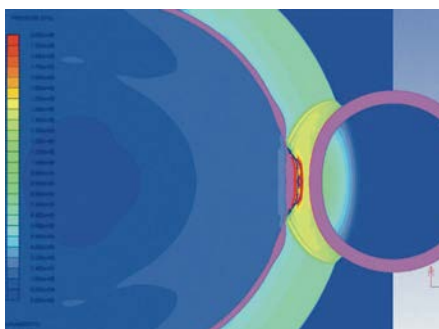
For packaging and protection of ammunition, TNO is focusing on mitigating concepts using novel materials to prevent sympathetic reactions and protect the ammunition from external stimuli, such as fragments from neighboring ammunition and debris. Concepts have been developed with modern material types in optimized structural solutions for blast mitigation and fragment diverters.

INTERNAL BALLISTIC MODELING

For internal ballistic modeling, TNO applies its in-house developed code TIBALCO (TNO Internal BALListic COde). This code is based on STANAG 4367 and is set up to be used in a flexible and user friendly way. Various modules are available for evaluation of closed vessel tests, prediction of pressures in vented vessels and simulation of guns. Small gun propellant samples are produced by TNO using ram extrusion. Many propellant shapes (cylindrical, hexagonal and rosette, 1, 7 and 19 perforations) and sizes (5 to 20 mm) have been extruded successfully. Co-layered gun propellants with improved performance are developed by TNO and also produced in-house. TNO produces granular and stick propellant for R&D purposes on a scale up to several hundreds of kg.

CLOSED AND VENTED VESSEL TESTS

Developing gun propellants requires good characterization of the burning behaviour of



FE modelling of detonation effects

gun propellants. TNO uses several closed vessels in a range of volumes with maximum pressures in the range of 20 MPa to 350 MPa. Both conventional and plasma ignition can be applied. A number of these vessels can be applied as vented vessel for erosivity testing or as burning interruption test. The extent of erosion has been studied using various gun propellant types and test orifice materials.

IGNITABILITY AND FLAME SPREADING

In order to study the ignitability of and flame spreading in a propellant charge, several full scale transparent burning chamber test setups have been developed. Both simulant, inert propellants as well as real propellants can be tested using these facilities. By igniting a full-scale propellant charge it is possible to capture the flame spreading on high-speed video in order to investigate the initial ignition behaviour.

PRODUCTS AND SERVICES

We offer you:

Research and development of Insensitive Munitions concepts:

- Mechanistic understanding of the functioning of munition
- Mitigation techniques
- Tailoring of energetic compositions

Modeling and simulation of the behaviour of energetic materials:

- Internal ballistics
- Natural and artificial ageing
- External threats

Development of modern fuze concepts and characterization of ignition trains

Munition and Explosive safety studies

Courses and Training

In summary, TNO can be your partner in your future munitions' development projects.



TNO.NL

TNO

TNO is an independent innovation organisation that connects people and knowledge in order to create the innovations that sustainably boost the competitiveness of industry and wellbeing of society.

TNO focuses its efforts on seven themes including Defence, Safety and Security: TNO works on a safe and secure society by creating innovations for people working in defence organisations, the police, emergency services and industry.

CONTACT

TNO
Lange Kleiweg 137
2280 GJ Rijswijk

P.O. Box 45
2280 AA Rijswijk
T +31 88 86 61355

E wim.deklerk@tno.nl
www.tno.nl/ammunitionsafety