

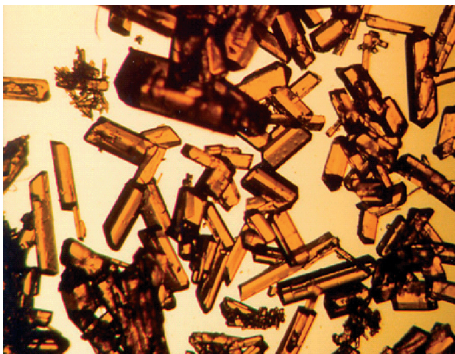
TNO research in explosives and Insensitive Munitions

TNO your partner for your future in:

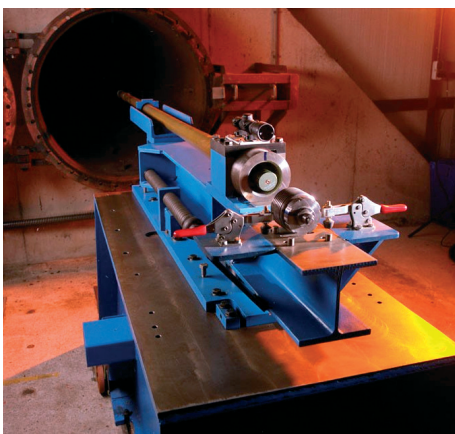
- IM Development
- Munitions Functioning and Safety
- Systems Design
- Understanding Explosive Behavior

Insensitive Munition (IM) reduces considerably the severity of an accident with munitions in operational use, transport or storage. Contrarily, from a defensive point of view, IM reduces the effectiveness of a weapon system against e.g. incoming mortars or missiles because a hit will not automatically induce a hard kill.

Understanding the explosive material's functioning or behavior of a munition item submitted to threats like cook-off, bullet or fragment impact etc., is therefore of importance. In the last several decades TNO has built the expertise on this field, built testing and analysis tools, and computer codes for the development and validation purposes. TNO is the expert institute and your partner in future (IM) developments and related safety requirements.



Properly shaped HNF crystals for insensitive compositions.



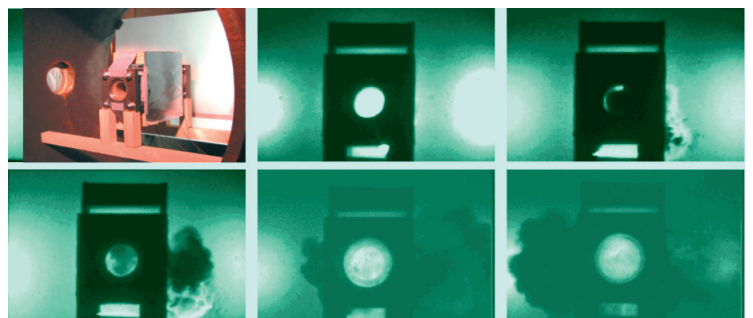
Bullet/Fragment test set-up for impact research and induced damage research of explosives.

Introduction

To understand the munition's behavior to bullet impact, a fragment impact from an adjacent exploding item or a fire etc., knowledge of the mechanism leading to the certain response is important. This also means, knowledge of the crystal and their sensitivity, knowledge of the binder-explosive composite properties but also of induced damage and the influence of this on the composite's behavior and sensitivity change in a confined environment.

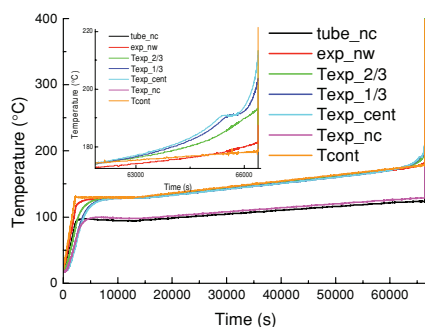
A broad expertise is available at TNO not only for IM development but also for effectiveness of a weapon against a certain incoming threat, so on areas such as:

- Re-crystallisation for insensitive explosives (RDX, HMX, CL20, HNS IV);
- Pressed, cast cured and extruded insensitive compositions;
- MEMs EFI characteristics;
- Functioning and safety of explosives and munitions;
- Damage of explosives in relation to sensitivity;
- Response of munition due to an "IM-related" stimulus (bullet or fragment impact or cook-off scenario, shaped charge etc.).

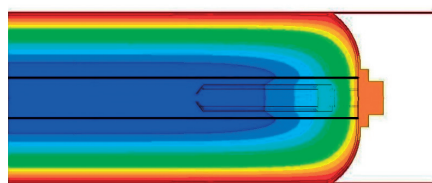


The response of a rocket (motor) model after the impact of a fragment. (Upper left photo displays the test set-up).

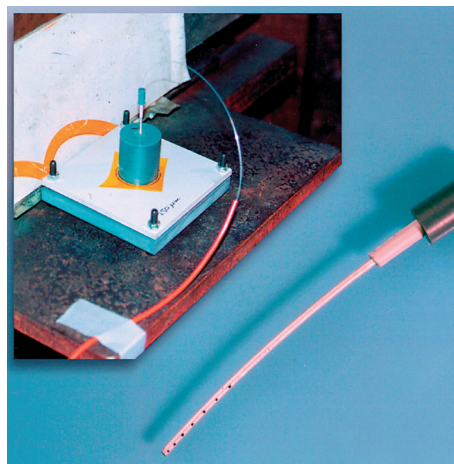
Furthermore, a variety of test equipment is available with a large variety of instrumentation; from Fibre Optic Probes (FOP) to measure the shock behaviour of small explosive samples, Sagnac, Mach-Zehnder and Fabry Perot interferometers for velocity measurements, up to high speed digital cameras to observe the response. In combination with computer codes and the expertise it forms the basis for future munition development. In all these fields TNO has built the knowledge and experience to be your partner in your future in explosive research, Insensitive Munitions development and related safety requirements.



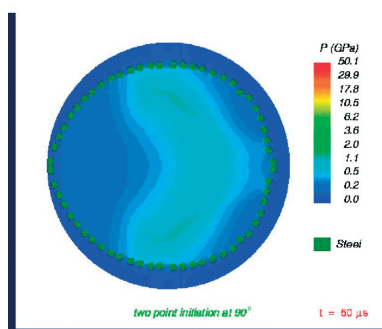
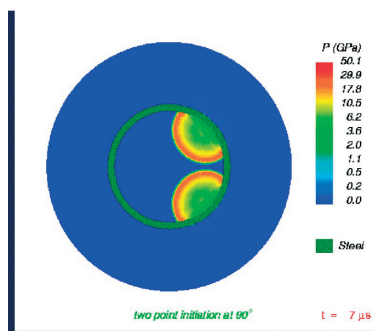
Internal temperature recording of a heating test (cook-off) of confined (2500 bars) explosives.



Fast Cook-off simulation of (part) of a rocket motor around igniter.



Fiber Optic Probe for shock characterization measurement of small explosive (down to 10x10 mm).



Aimable warhead simulation: an increase of the fragment velocity of 30% due to multipoint initiation.

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 enhancing the security of the Netherlands both at home and abroad. We also use our accumulated knowledge for foreign governments and for defence-related industries.

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