TNO innovation for life

Safety Military Vehicles
STANAG Protection Standards

Piet-Jan Leerdam


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Personal introduction

- Piet-Jan Leerdam
  - Aerospace Engineering (1987-1993)
  - Military duty: 42 BLJ, cdr YPR-765 PRI (1993-1994)
  - TNO employee since 1996
- Program manager Protection & Survivability of land based Vehicles
- Project manager for projects like:
  - Mine protection development Leopard 2A6
  - Mine qualification CV9035 and Boxer
  - Incident analysis and improvements YPR
- Expert in mine and IED protection evaluation
- Chairman NATO HFM-working group on Injury criteria for Vehicle Occupants

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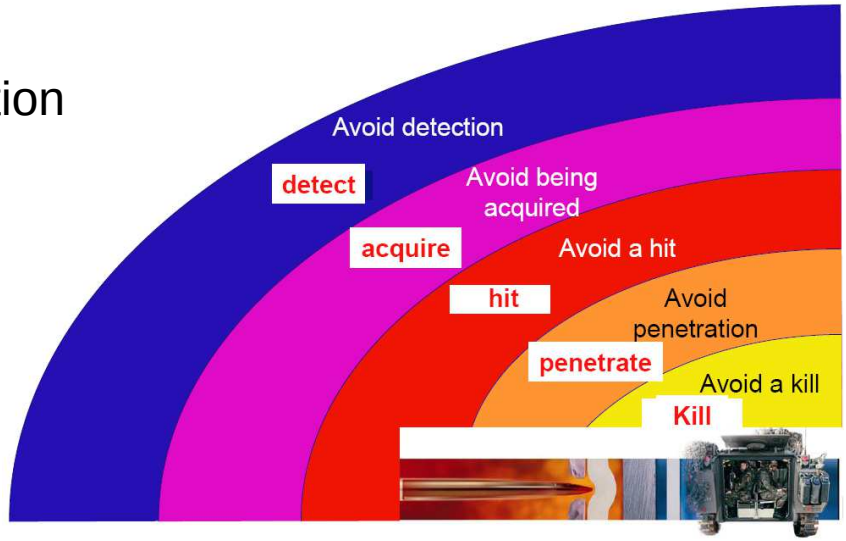
Outline

- R&D in the area of Vehicle Survivability by TNO
- Threat spectrum; lessons learned NLD in Afghanistan
- Vehicle Protection Standarization within NATO
- Final remarks about Standardization



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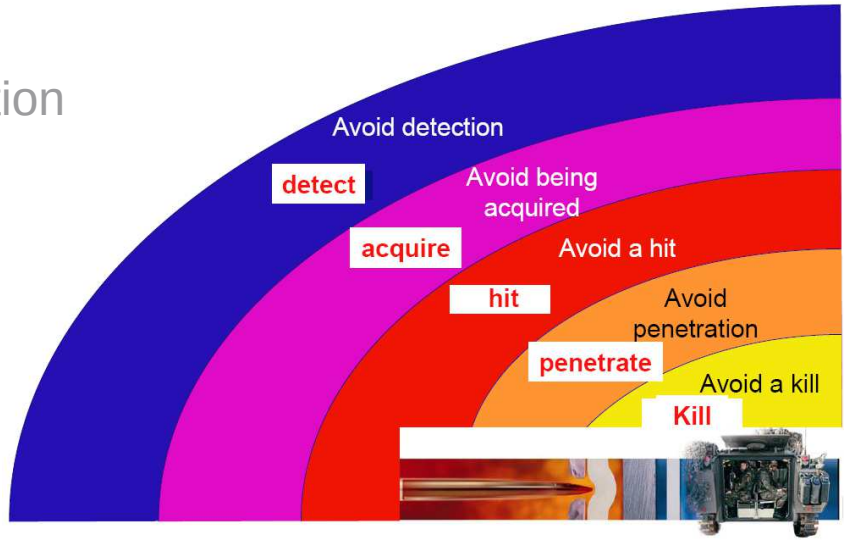


Vehicle Survivability R&D by TNO

Military user with requirements

Threat

TNO

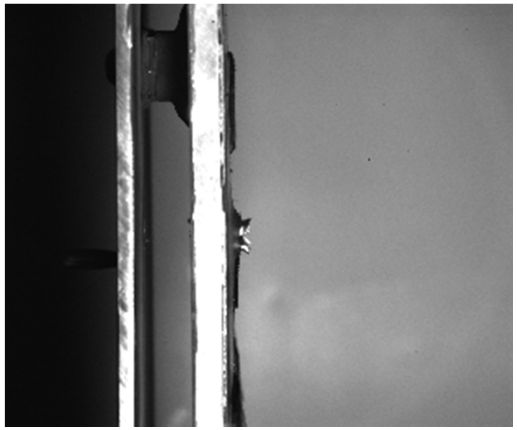
"Knowledge of the physics"

Vehicle and its protection design

Test and Qualification Procedure or Standards

R&D: Knowledge of the Physics

Ballistics: flying RPG & penetrating bullet



IED: Deep buried mine & Explosives in a ‘bomb car’

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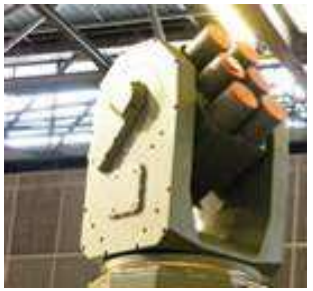
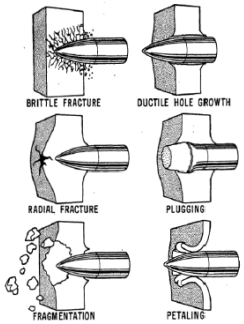
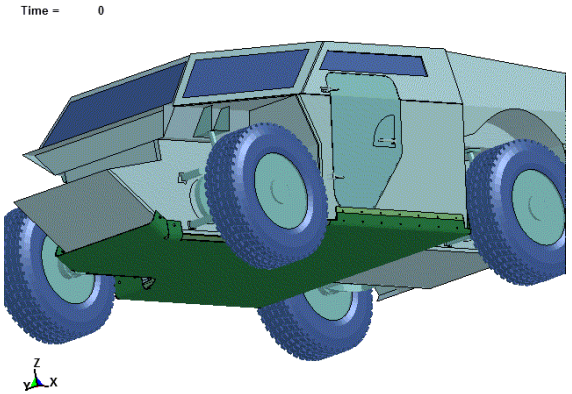
R&D: Investigation of new technologies

- Effective and light weight solutions
- Available and affordable materials
- Limited integration consequence
- Active Protection Systems







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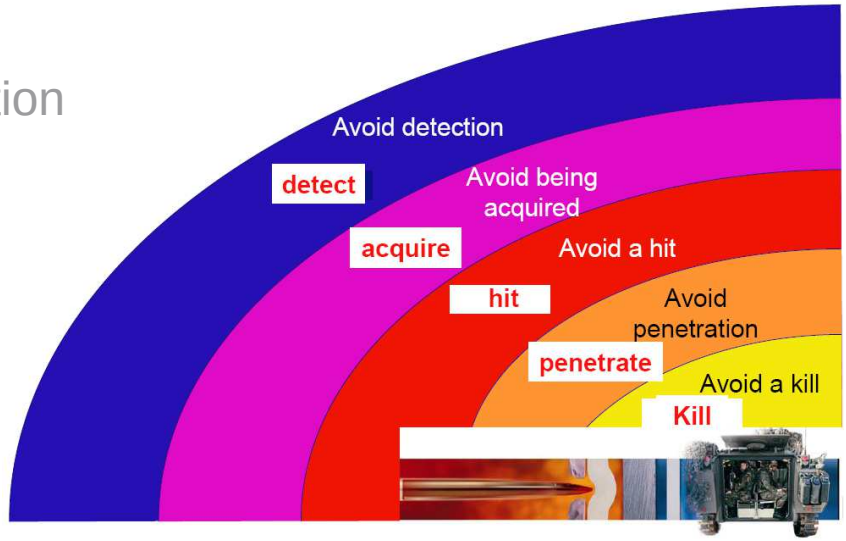

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A mixture of threats, but the IED is dominating

- Threat from machine guns and shoulder launched anti-tank weapons (RPG) in the beginning of the mission
- Change to the mine/IED threat during the mission
- Most vehicles were not prepared for this threat
- Several IED incidents resulted into casualties
- Urgent Operation Requirements to improve the protection

A mixture of Dutch Vehicles in Afghanistan












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A mixture of protection solutions and evolutions

Original YPR

Improved ballistic and RPGprotection

Underbelly IED protection

Next generation: CV9035NL

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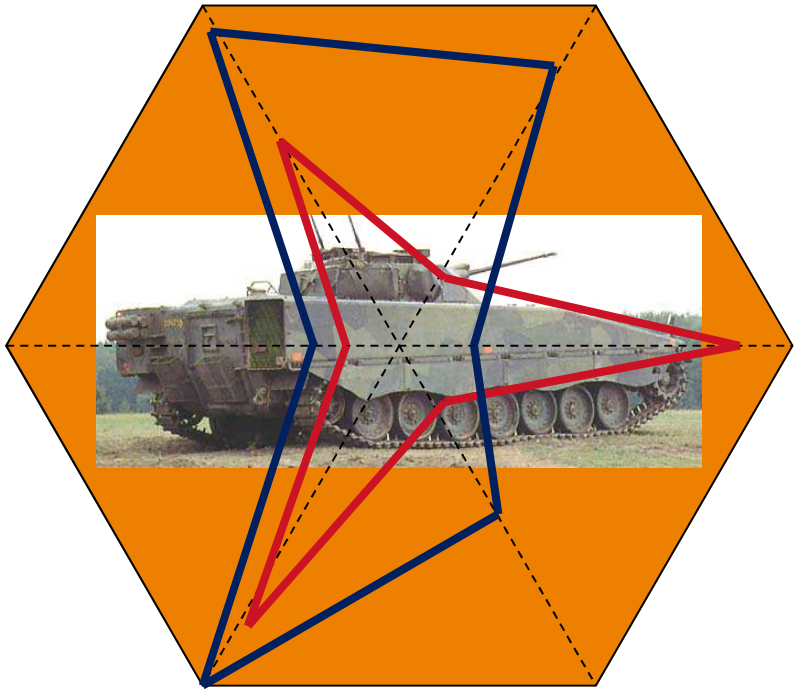
A mixture of threats asking for flexible protection

KE projectiles

Mines (under belly)

KE- fragments



IED, under belly and road side

CE anti-tank

Others

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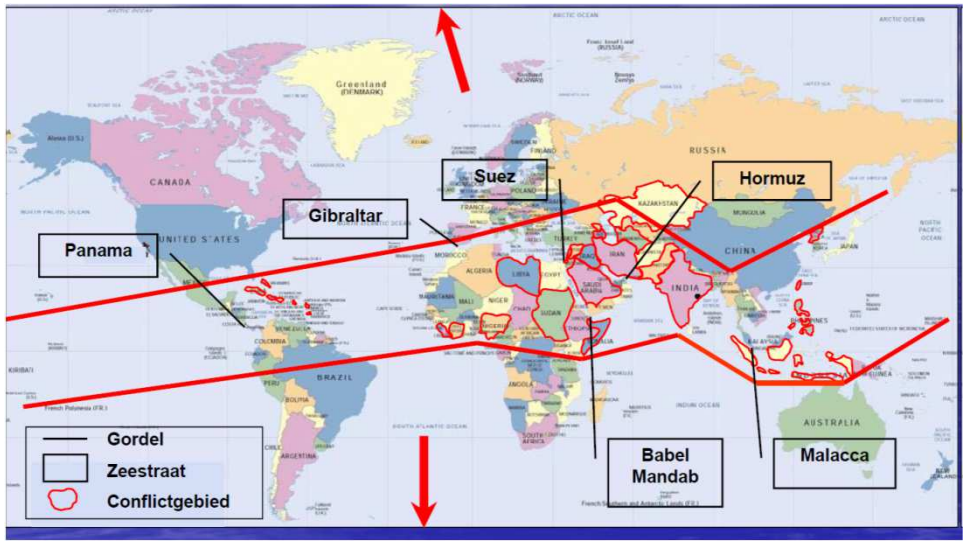
A mixture of threats also in the future

The ‘Belt of Instability’



- Where is the next mission?
- Which threats do we see?
- Asymmetric, but with symmetric type of threats?
- Urban areas?

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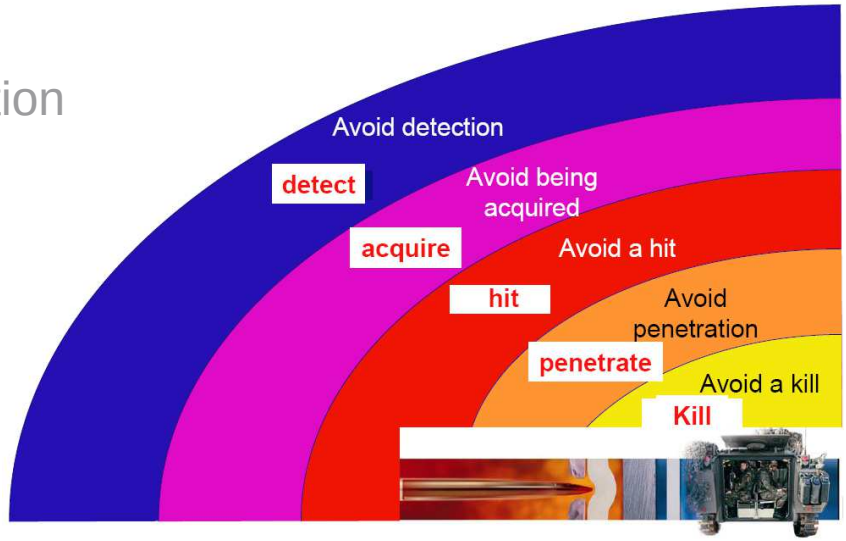

Standardization within NATO

NATO Standardization Agency (NSA)

NATO OTAN — NATO Standardization Agency — NSA

"The Agency's mission is to foster NATO standardization with the goal of enhancing the *combined operational effectiveness* of Alliance military forces"

- Support role to NATO Committees dealing with standardization
- Primary Product: **Standardization Agreements** (**STANAGs**)

Armaments Directorate

"The Armaments Directorate supports the work and activities for enhancing and encouraging *interoperability and co-operation*……."

- NATO Land Capability Group / Land Engagement (LCG/LE)
  - Working groups or Team of Experts

STANAGs for Vehicle Protection

STANAG 4569
Protection levels of military vehicles

STANAG 4686
Performance levels of Active Protection Systems

STANAG 4569: Levels of Vehicle Protection

- Aim is to *standardize protection levels* for vehicles:
  1. For selection of vehicles in the field;
  2. As national planning guide for deployment of vehicles;
  3. For national development and procurement.
- First edition from May 2004, second edition from December 2012
- Since introduction it has become the ‘protection design guide’ for the industry

STANAG 4569
(Edition 1)

NORTH ATLANTIC TREATY ORGANIZATION
(NATO)

NATO STANDARDIZATION AGENCY
(NSA)

STANDARDIZATION AGREEMENT
(STANAG)

SUBJECT: PROTECTION LEVELS FOR OCCUPANTS OF LOGISTIC AND LIGHT ARMOURED VEHICLES

Promulgated on 24 May 2004

J. MAJ
Brigadier General, POLAR
Director, NSA

STANAG 4569: Testing of Vehicle Protection

- A Team of Experts, chaired by Germany, develops the threat levels and test procedures. Most active countries: GE, NL, FR, CA, …

- Test and Qualification procedures described in the Allied Engineering Publications (AEP-55):
  - Volume 1: Ballistic threat (published)
  - Volume 2: Mine threat (published)
  - *Volume 3: IED threat (under construction)*
  - *Volume 4: Anti-tank rocket/missile threat (under construction)*

- Since the introduction of the STANAG 4569 a huge improvement seen in the protection of military vehicles

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STANAG 4569: Mine threat protection qualification

- Mine threat levels 1 to 4: AP-mines up to 10 kg AT-mines

- Full qualification based on:
  - Testing the vehicle structure
  - Testing the interior behaviour
  - Testing the occupant loads

- Occupant response requirements defined by the NATO/STO HFM working group on “Injury Criteria for Vehicle Occupants”

Standardization within NATO

NATO Science & Technology Organisation (NATO S&T)

"The STO is to help position both national and NATO science and technology investments as a strategic enabler of the *knowledge and technology advantage* for the defence and security posture of NATO Allies and partners."

- Panels & Groups
  - Human Factors and Medicine Panel (HFM)

HFM working groups on "Injury Criteria for Vehicle Occupants":

- HFM-090/TG-25 (2001-2005)
- HFM-148/RTG (2006-2009)
- HFM-198/RTG (2010-2013)


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HFM Task Group on “Injury Criteria for Vehicle Occupants”

- A Task Group, chaired by the Netherlands, develops the human body related pass/fail criteria for the evaluation/qualification of both the mine and IED protection of vehicles.
- Most active countries: NL, GE, CA, FR, NO, RSA, USA, SW, …
- Results published in the NATO/STO Technical Reports
- The injury test and assessment procedures are part of the STANAG 4569 AEP-55 Volume 2 (mine) and Volume 3 (IED) procedures.

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HFM Task Group: Scientific Approach, Clear Goal

Investigation of **loading process**

Investigation of **vulnerable body parts**

Investigation of **expected injuries**

Investigation of **available injury criteria**

Choice for the (most) appropriate injury criteria

Investigation **of available risk curves**

Definition of the **tolerance level**

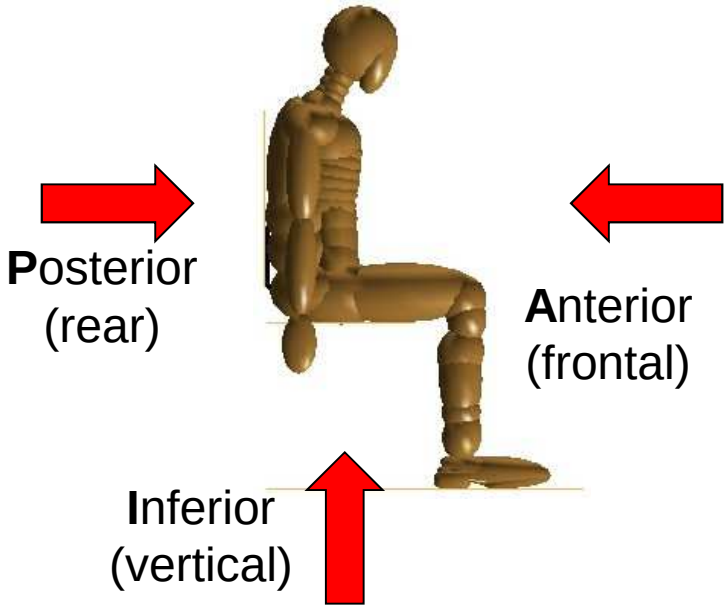
Investigation of **measurement methods**

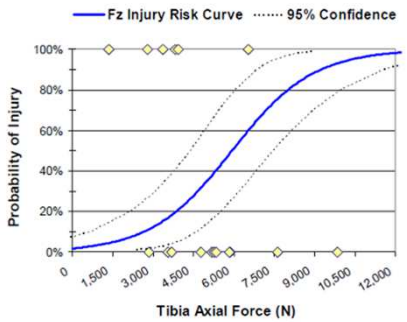
Definition of the **appropriate measurement method**

Description of the **test procedure**

HFM Task Group: Scientific Approach, Clear Goal

- Set of injury criteria
- Set of pass/fail
- Set of test methods





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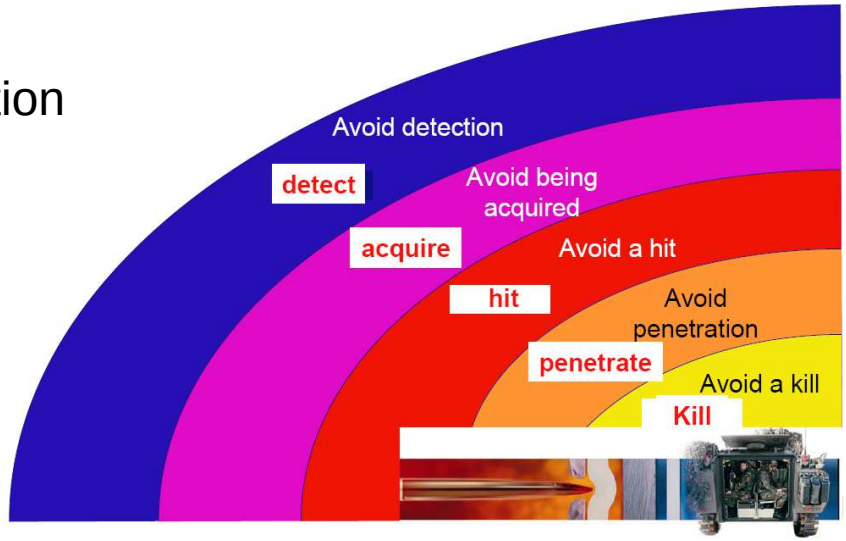

Final remarks about Vehicle Protection Standardization

Benefits of standardization:

- It boosts the protection of vehicles against a wide range of (changing) threats;
- It helps both the military user (he knows what he is asking and getting), and the industry (they know what is being asked and need to be developed);

Process of standardization:

- Within NATO it is a long and slow process (slower than threat developments), influenced by national agendas;
- Progress strongly depends on national R&D budgets;

Final remarks about Vehicle Protection Standardization

My personal concerns:

- Big steps made within 10 year, next (small) steps requires more time, but under pressure due to R&D budget cuts
- KE/Mine standard was easy, CE/IED standard is complex and results in wide set of test procedures. Risk of using it as a ‘shopping list’.

- Next to the NATO standard, still a lot of national activities on-going to define own threat/protection/test requirements. Why?
- Some countries put a lot of effort in test procedures, but sharing their knowledge and experience is limited.

- Chairing a NATO working group is a huge effort, but it is funded by the chairing nation only. Again under pressure due to budget cuts.

Final remarks about Vehicle Protection Standardization

Military user with requirements

Shared requirements
Shared procurement

Shared R&D

Shared solutions
Sharing vehicles

Shared testing
Sharing test sites

Vehicle and its protection design

Test and Qualification Procedure or Standards

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Vehicle Protection Standards Do Save Soldier Lives!

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TNO Defence, Safety and Security

Explosions, Ballistics and Protection

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