

> THE OPTIMAL BALANCE BETWEEN **PROTECTION, PERFORMANCE, USABILITY, COST, AND WEARER** COMFORT

CONTACT

Technical issues

Emiel den Hartog emiel.denhartog@tno.nl +31 88 866 13 93

Commercial issues

Rogier Kalkhoven

PERSONAL PROTEG-TION

TNO.NL

E rogier.kalkhoven@tno.nl T +31 88 866 11 97

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

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.

TNO innovation for life





BALANCED SYSTEM

The development or design of protective clothing and soldier systems has to be based on the optimal balance between various requirements: protection, performance, usability, cost, wearer comfort, etc. The objective trade-off analysis methods and tools developed by TNO will help users and manufacturers to quantify and optimise the often conflicting requirements for individual protective clothing systems that allow optimal human performance.

DURABILITY, USE & MAINTENANCE

Reliable and verifiable quality parameters for the acquisition of military and firstresponder clothing are essential, but difficult to determine. It is also crucial that the quality of clothing remains the same during the entire life cycle. Innovations in clothing materials help to achieve this, leading to significant life cycle cost savings, increased performance and better outward appearance (although the acquisition cost is slightly higher). TNO helps to develop and optimise new coatings and maintenance cycles to improve product quality during the entire life cycle. TNO also investigates new finishes, coatings and nano applications to enhance textile products, including innovative cooling methods.

ERGONOMICS & PHYSICAL LOAD

6. Cost of Ownership

OPERATIONAL PERFORMANCE A successful clothing and equipment system has to meet a large number of operational and human performance requirements, and avoid any 'unnecessary' load. TNO has the knowledge, models and tools to provide the appropriate and optimal mix of equipment for any conceivable mission profile.

ERGONOMICS

The effective use of individual equipment largely depends on freedom of movement, fit, comfort, and the interaction with other equipment. TNO developed a number of unique scientific models and tools for the in-house design and evaluation of thermal and wearer comfort and other ergonomic aspects.

PHYSICAL LOAD

Personal protective equipment always increases the physical load, limiting operational performance and endurance. TNO uses scientific models to evaluate and predict the thermal, physical and psychological load experienced by military personnel in different scenarios.

OUTWARD APPEARANCE & CAMOUFLAGE

The outward appearance of clothing is subject to a number of requirements. Depending on the situation, military personnel has to be either visible and recognisable, or remain invisible through camouflage. Current military operational environments vary widely, confronting soldiers with rapidly changing conditions, while rendering the 'standard' Woodland pattern obsolete. TNO uses its own unique conspicuousness evaluation methods and an extensive photo database of all relevant environments to define and select the optimal camouflage patterns and colours, ranging from highly specialised to multitheatre, and taking into account equipment colour.

HEALTH MONITORING & SUSTAINABILITY

Reliable real-time information on the health and readiness of military personnel is essential in small forces operations. This will allow commanders to make balanced operational decisions based on the knowledge of optimal preparation and recovery times. Our knowledge, tools and methods in this domain are tested in practice and used to advise the Ministry of Defence and the defence industry. TNO supports the industry in the application and integration of this knowledge to create innovative personal health monitoring systems.









CBRN PROTECTION

CBRN protective clothing and equipment are designed to perform in chemically or biologically contaminated environments, setting strict and sometimes very specific requirements to protective suits. However, the protective properties of CBRN systems often limit human performance, because the focus of these systems is first and foremost on protection. TNO has many years of experience in the use and performance of CBRN protective suits as well as in human performance, both in the lab and in operational environments. Based on this experience, TNO supports users and manufacturers in various ways:

- Matching the often conflicting requirements for protection against BC agents and human performance
- Advice on the design and development of new CBRN protective systems
- Advice on the use and limitations of CBRN protective systems in relevant operational environments
- Recommendations on safe operating times and performance guidelines

BALLISTIC PROTECTION

What is the best ballistic protection combination under any specific conditions? At the TNO Laboratory for Ballistics Research we ask ourselves this question every day, because developments in ballistic protection never stop. Thus far, the market has produced an extensive range of advanced combinations of ultra-strong fibres, flexible laminates and composites, metal or ceramic plates. In helmets, vests, visors, safety glass and armour plates. At the TNO Laboratory for Ballistics Research we develop, test and validate the performance of personal ballistic protection equipment for the industry, in compliance with the latest standards. This includes the development of practical engineering tools to predict the performance of protective systems.

CASE IN POINT : INTEGRATED HEAD PROTECTION

n close collaboration with the Royal Netherlands Armed Forces TNO is working on a new concept for Integrated Head Protection. Our approach is a humanpriented design based on our own human actors research. It focuses on the optimal palance between:

- Ergonomics: Improved stability, user comfort, optimised size system and lov overall weight
- Protection: Three levels of modular ballistic protection, enhanced V50 ballistic shell performance
- Compatibility: Compatible with other
- Situational Awareness: Improved vision and hearing combined with protection and communication
- Platform function: Balanced platform for modular display and sensor systems
- Usability: Adaptable to mission and threat, easy to operate and maintair

The Integrated Head Protection by TNO is designed to enhance the operational berformance and safety of dismounted soldiers in future military environments.