CB^{plus} Protective Uniform: Ready for the next leap in Canada

Defence Research and Development Canada, with the support of the Canadian Forces (CF) Directorate of CBRN Defence, has just completed the CB^{plus} demonstration of daily wear combat uniform concepts that provide just-in-time dermal protection against CBR hazards, to be worn in theatres where there is an increased risk of asymmetric use of agents. The protective uniform is positioned in between the more conventional Chemical Biological protective ensembles, and the non-protective uniform in the tradeoff between protection and human performance. The concepts developed, when worn in the open state, have the look and feel of the in-service Canadian daily combat dress, but, when closed up and worn with the in-service respirator and gloves, will provide protection at a targeted level against a variety of potential CBR hazards.

The CB^{plus} protective uniform has the look and feel of duty dress. © Department of National Defence

The project objectives were, for the asymmetric threat environment, to develop:

- an operational concept for a uniform incorporating just-in-time chemical and biological protection;
- appropriate criteria and evaluation methods for uniform performance;
- appropriate novel lightweight materials, closures and designs;
- uniform concepts for chemical/biological protection

The concept of use and requirements are based on:

- The mobile battlespace, in which the wearer will complete the mission and move on or withdraw from contaminated area, with decontamination as needed, within 2-4 h, and
- Maintaining permissible user dermal exposure levels to result in minimal effects per NATO.

The lower required duration of protection means lower physiological burden systems are possible.

The concepts have been developed to include various combinations of protective capabilities, including chemical warfare agents, Toxic Industrial Chemicals (also known as TICs), biological agents and aerosols; each type of additional protection requires some trade-off with complexity of the design, and physiological benefit in the closed state in particular, and therefore the desirability of each should be carefully weighed when setting requirements.

The operational benefits of this approach were demonstrated in a computer-based simulation scenario for an asymmetric threat environment in which there was a threat of CB agent exposure. The mission started with the participants wearing personal protective equipment (PPE) systems with varying physiological burden that covered the range from that of a combat uniform through the current hot-weather PPE worn by the Canadian Forces. The mission success directly correlated with reduction in physiological burden, because of the ability to achieve a better work to rest cycle and fewer total heat stress casualties. Therefore, a system that provides lower burden in the closed state is of clear benefit.

There is an additional component of improved performance that is often overlooked, however, which is that of wearing a protective uniform that provides just-in-time protection all the time. Consider how traditional protective concepts have to be employed in the field (having particular implications in a hot environment). At some point, the wearer has to make the decision when to transition from a low dress state (wearing their combat uniform) to a higher dress state (wearing but not necessarily closing up their CB protective clothing). They have several choices: they can don their CB protective clothing an overgarment over their regular uniform (hot and cumbersome); they can remove their uniform in the field and then don their CB protective clothing (the best approach for managing physiological stress but operationally impractical); or they can wear their CB protective clothing as a standalone concept from the outset, leaving behind their uniform (again hot and cumbersome as they are in a higher dress state unnecessarily for a long time). If, on the other hand, the wearer can choose to wear a protective combat uniform that is comparable to a normal uniform in physiological stress when it is worn in the open state and is closed only when needed, then any additional stress and operational reduction in capability is limited to only that period when protection is actually felt to be needed. This effect has been demonstrated in laboratory-based physiological trials – when wearing the protective combat uniform in the open state, the users showed no increase in physiological stress markers compared with the normal uniform, and therefore, when they closed up to a high dress state, they were able to perform significantly longer (at least twice as long in the closed state for the concepts evaluated, compared with the in-service hot-weather protective system worn standalone or as an overgarment).

Users were actively involved at all stages of the demonstration project. Canadian Forces-supported activities included leading the development of new concepts of use, including a review of dress states and how they apply to this new protective concept, as well as actively assisting in the screening of material and uniform concepts and features. In particular, the CF supported user trials of the final concepts for general utility and acceptability, as well as further rating of design and features. Final uniform concepts were put through user trials in which a battery of human factors tests was conducted while the participants compared the protective uniforms with the current in-service hot weather chemical protective coverall worn over combat dress, in both open and closed states (Figure 1).

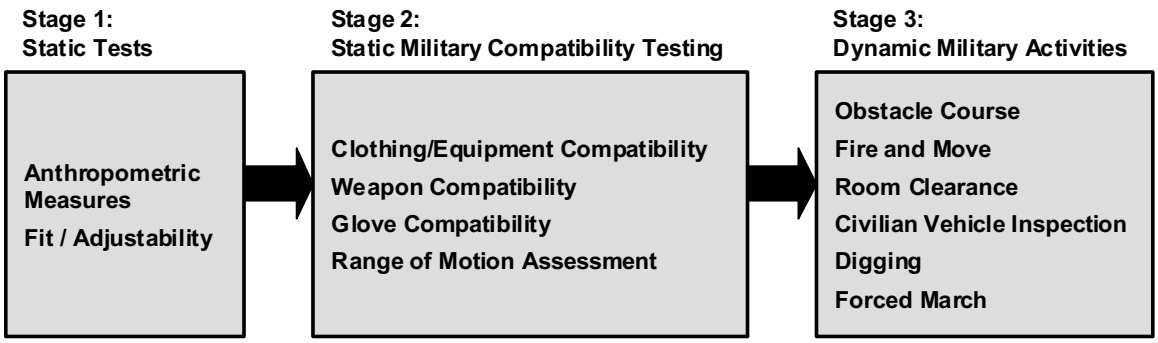

Figure 1: Army user trial design

Assessments included anthropometry and assessment of fit, range of motion, compatibility with clothing/equipment, performance of donning and doffing tasks, dynamic military tasks, thermal load, and physical comfort, with participants rating the uniforms based on fit, performance, compatibility, features, physical comfort, thermal comfort, range of motion, and material. A wide range of typical activities for ground forces, shipboard forces and boarding parties were performed. The trials indicated a high degree of satisfaction with the concepts, with the concept uniforms felt to be nearly comparable to duty dress in the open state, and preferred to the in-service hot weather coverall in the closed state. In particular, some of the features users preferred for the protective uniform over the coverall/duty dress combination included thermal comfort and operation in hot environments, material comfort, bulk, freedom and ease of movement, and transitioning between states. Compatibility of the protective uniform in the open state with other equipment items (for example, for the navy users, this included amongst others war-bag, emergency life jacket, gloves, and boarding and firefighting PPE and equipment) was equivalent to that of the in-service duty dress.

This project was a highly productive collaboration between numerous partners including various Department of National Defence organizations, an industry team that brought materials and uniform design experience, and international partners from FOI (Sweden) and TNO (the Netherlands) that contributed in the area of requirements development, test methods development, and performance evaluations, to meet an entirely new suite of requirements that included asymmetric threat agents.

In summary, several CB protective uniform concepts have been demonstrated that are designed for the asymmetric threat environment. Protection targets have been met when employing a variety of protective enhancement combinations. The concepts have demonstrated enhanced operational capability and human performance, permit rapid and seamless transition between dress states, and are acceptable to the user as daily wear concepts.

The next steps for the Canadian Forces involve transitioning the CB^{plus} concepts into a concept of employment with consideration of implementation of other protective enhancements such as flame and fire retardancy, and applying a wider range of laboratory and user evaluations to establish functional limitations.

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