

PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

Development Of Improved Liquid Cooled Garment

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Impermeable suits protect wearers from Chemical, Biological, Radiological, and Nuclear (CBRN) hazards, but they retain body heat, which has been a concern of the Department of Defense (DoD) for some time. While the concept of a cooling vest in this context is not new, existing personal cooling apparels are incompatible and/or inefficient when used with CBRN protective suits. Excessive exposure to high thermal loading can lead to a multitude of adverse effects, beginning with cognitive problems and progressing through heat exhaustion, cramps, heat stroke, and eventually cardiac arrest. To avoid thermal injury, Warfighters limit their time wearing impermeable protective suits when managing a CBRN event, but this approach can reduce mission length and affect achieving operational objectives.

To address this challenge, Oceanit under the Small Business Innovation Research program funded by DEVCOM SC, Joint Science and Technology Office for Chemical Biological Defense (JSTO-CBD) and Air Warrior has developed one of the most effective FR Liquid Cooled Garments (LCG) in the market today. Oceanit's LCG is a form-fitting garment with a network of thermally conductive tubing that extracts body heat and can be worn under all authorized personal protective equipment and chemical/biological protective clothing. Oceanit specifically designed and developed ThermoCore®, a thermally conductive polymer, for use in this apparel optimizing the product for thermal conductivity, mechanical properties, manufacturability, and performance temperatures. The fabrics, the design, and the tubing layout was designed and developed to fit the target population with just four sizes instead of five, thus potentially reducing the DoD logistical burden. Further, the custom components developed are modular and can be used to add accessories such as balaclava, shorts, sleeves, or pants to the vest to add further cooling capacity to the individual Warfighter.

Thermal Manikin tests were conducted in accordance with the ASTM test method, ASTM F2371, Standard Test Method for Measuring the Heat Removal Rate of Personal Cooling Systems Using a Sweating Heated Manikin, in an environmental chamber at USARIEM using a 20-zone sweating thermal manikin. Manikin test results have shown that Oceanit's LCG provides significantly higher heat extraction under the same environmental conditions than the currently fielded Environmental Control Vest (ECV), while at the same time reducing the weight. The LCG vests performed nearly 30% better in extracting body heat while weighing 15% less than the ECV. With a higher heat extraction rate, Warfighters will need to carry fewer batteries, further lessening their physiological and logistical burden. Human Factors Evaluation of the LCG vests were conducted at DEVCOM SC to assess any restrictions in mobility. The LCG can be seamlessly integrated into any protective garment using a cooling vest such as the JSTO-CBD funded S&T developing system, the Tactical All-Hazards Ensemble. The technology developed from this effort will transition to the Uniform Integrated Protective Ensemble Family of Systems program of record under the existing Technology Transition Agreement.

This presentation will show the benefits of the LCG in terms of thermal extraction performance, form factor, and reduced weight while meeting all the requirements of the ECV.