



Flame Resistant Combat Uniform Fabrics and Clothing Systems

Overview:

U.S. Army tankers, and aviators of all services, are required to wear flame resistant clothing made from Nomex/Kevlar blend fabrics. Although these materials receive high user ratings they are too expensive to issue to all military users. The infantry, which uses a nylon and cotton blend fabric, needs flame protection, but Nomex/Kevlar uniforms are too expensive to issue to every infantryman. A number of new materials and systems protection strategies were developed that are affordable, quickly deployable, and improve the survivability of the individual soldier.

Description:

Prior to material development, the flame threat and hazard was investigated and characterized. Flammability test methods were reviewed. The thermal flux commonly used in the instrumented manikin test ASTM F 1930, which is 2 cal/(cm² sec), is representative of the most common military scenario. Using this test method, safe exposure limits were established for summer through winter weight military protective clothing systems. In addition, it was determined that the first line of defense against the flame assault is the outer-layer, which needs to be flame and ignition resistant. Each additional clothing under-layer adds insulation and increases protection time.

Fibers, fiber blends, and fabrics were investigated and developed including: Basofil, flame retardant treated (FRT) cotton, FRT cotton/nylon, FRT Tencel, FRT cotton/Kevlar/nylon, carbonized rayon/Nomex, Kevlar/FR rayon, Nomex/FR rayon, PBI, and PBI/FRT cotton. While these developmental materials met the flame resistance requirements, dyeing and printing capabilities and strength, other durability related characteristics fell short. Overall the best performing flame resistant fiber, in terms of strength continued to be Nomex, but it was still one of the most expensive. A novel approach was pursued to use the military standard grade Nomex/Kevlar but use non-woven fabric technology, which is direct fiber to fabric manufacturing and save on yarn spinning, fabric weaving, and finishing and ultimately using a simplified over-garment design. Instrumented manikin testing demonstrated that when worn over the standard Battledress Uniform (BDU) the total body burn was reduced from 88 to 8 percent. Safe exposure limits of up to 5 seconds were established.

Status:

When worn over the BDU, the configuration provides a 40 percent cost savings over the camouflage printed Nomex/Kevlar Aircrew BDU used by the aviators. An effort is underway to develop a military unique version of the coverall that includes enhancements to the fabric such as the addition of water and oil repellency, as well as, garment design and sizing enhancements.

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