



**Homeland
Security**

Science and Technology

TechNote

U.S. Department of Homeland Security



System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program by e-mail or visit the SAVER website.

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Public Safety Personal Protective Equipment for Disposal of Explosive Devices

Personal protective equipment (PPE) is used by first responders and bomb technicians when an improvised explosive device (IED) or other potentially life-threatening explosive is suspected or confirmed to be present. The PPE, otherwise known as a bomb suit, is a heavy suit of body armor designed to withstand the pressure released from an explosion and to provide protection from any debris produced. Modern bomb suits include layers of Kevlar[®], ballistic plating, and foam placed strategically throughout the suit to provide the wearer maximum protection.

Background

The main objective of a bomb technician's mission is to render hazardous explosive devices safe by defusing them or blowing them up in the most controlled way possible. Bomb technicians often run the risk of a device exploding while it is being worked on, making it necessary for technicians to protect themselves with PPE.

The PPE used by public safety bomb technicians and other specialized first responders is designed to protect them from IEDs and old and unserviceable ammunition, called ordnance, found during their operations. Military-grade bomb suits, on the other hand, provide protection during operations such as demining and disposing of IEDs with potential chemical or biological agents.

When selecting a bomb suit it is important to compare the performance of different designs with expected threats. Ergonomics must also be taken into consideration, since the bomb technician must wear the bomb suit while performing a stressful task that requires fine motor skills.

Technology Overview

Bomb suits are designed to protect against the characteristics of an explosive event that could result in human injury. Blast injuries can be classified into primary, secondary, tertiary, and quaternary injuries. Primary injuries are caused by blast overpressure waves, or shock waves. Secondary injuries are caused by bomb fragments and other objects propelled by the explosion. Tertiary injuries occur when air is displaced by the explosion, creating a blast wind that can throw victims against solid objects, causing additional injuries. Quaternary injuries are all other injuries not included in the first three classes, such as flash burns, crush injuries, and respiratory injuries.

Due to the extent of injuries that may result from an explosion, bomb suits are designed to provide comprehensive, head-to-toe protection against a blast. They use ballistic plates to withstand the pressure released from a

bomb and deflect or stop projectiles that may be produced, thereby protecting against primary and secondary injuries. The force of the explosion is diminished by the suit's tightly woven fibers, which spread the blast's force throughout the suit. The heat and flames produced by a bomb are neutralized by flame-resistant materials used in the suit. In order to achieve a sufficient level of protection, the suits produced are invariably heavy and bulky, causing



Blast Resistant Suit

Photo courtesy of Med-Eng™

restricted body movement, fatigue, heat stress, and potentially reduced operational performance of the user.

The main materials found in bomb suits are para-aramid fibers, such as Kevlar[®], other aramid fibers, or aramid-based products. Aramid fibers are a class of strong, heat-resistant, synthetic fibers. Aramid's outstanding strength-to-weight ratio makes it an ideal fabric for bullet-resistant and blast-resistant clothing. Additional foam or other padding may be incorporated throughout the

bomb suit to protect the wearer from flying debris and the force of impact that occurs when the wearer of the suit is thrown to the ground.

Bomb suits usually have internal pockets consisting of webbing and Velcro[®], where additional ballistic plates can be inserted. These plates are made of steel, aramid, or coated ceramic. They are generally arranged to protect the throat, chest, arms, legs, ribcage, and groin areas from bomb fragments.

Some bomb suits include a blast-resistant helmet that may be constructed with an aramid core, some type of molded protective outer layer, and a suspension harness for comfort. Helmets have a clear, anti-ballistic visor. Advanced helmet models also have built-in headphones and a microphone, and the ability to transmit signals (e.g., radio). Some specialized helmets have an internally powered ventilation system that cools the wearer and de-mists the visor. They may also have brackets where the technician can mount a hands-free video camera or light.

Usually, a high collar protects the neck and extends up to the helmet. Overshoes are typically sewn onto the

bomb suit and fit over the technician's footwear. The bomb suit also has quick-release straps that allow an injured technician to be freed of the suit for transport or medical aid.

Most suits are designed without protection for the user's hands because the technicians need their hands to have maximum dexterity and maneuverability in order to defuse a bomb.

The materials used in bomb suits do not release body heat generated by the user. This is dangerous because it can result in heat stress that can lead to illness and/or disorientation, reducing the ability of the technicians to complete their task. Some bomb suit manufacturers have addressed this issue by including a battery operated cooling system in the suit that circulates water collected from a melting ice pack throughout a network of tubes. These tubes are sewn into the suit or a separate vest worn beneath the suit. This allows the user to wear the suit longer and improve his or her operational effectiveness.

Standards

To address the safety needs of bomb technicians, the National Institute of Justice (NIJ) released a voluntary performance standard, *Public Safety Bomb Suit Standard*, NIJ Standard-0112.00, May 2012. This standard defines both performance requirements and the methods used to test performance against fragmentation, impact, heat, and some blast overpressure associated with an explosion. Minimum blast pressure protection requirements are addressed through a bomb suit integrity test to determine if the suit remains intact during an explosion. Blast overpressure will be fully addressed in a subsequent version of the standard once additional research provides NIJ with a better understanding of the threats posed by blast overpressure. Also, the standard does not address chemical, biological, radiological, and nuclear (CBRN) protection, which may be addressed in the future when additional research is completed.

NIJ also released the *Public Safety Bomb Suit Standard Certification Program Requirements*, NIJ CR-0117.00, which provides the requirements a certification body must satisfy in order to receive and retain accreditation. The program requirements in this document help ensure that manufacturers and suppliers of bomb suits adhere to the *Public Safety Bomb Suit Standard*.

Additional guidance on selection and application of bomb suits can be found in the *NIJ Selection and Application Guide to Bomb Suits*, NIJ Guide-0117.00.