



**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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Website: <http://www.firstresponder.gov/saver>

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Small Package X-Ray Systems

Small package X-ray systems are used to screen small luggage, briefcases, purses, outerwear, and other bags and packages for weapons, explosives, or other contraband. They are used in schools, government facilities, transportation venues, and at other building and event checkpoints. These systems are typically one component of a layered security structure that may also include operational procedures, security personnel, physical barriers, personnel screening equipment, and/or surveillance equipment. Small package X-ray systems consist of a cabinet containing an X-ray generator and a detector, a signal processing unit with display, and a conveyor to move packages through the cabinet. Trained operators use images on the display to identify threats.

Background

X-ray systems for security screening are available in a range of sizes for different applications. They are often distinguished by the maximum size of the package that can be scanned. There are versions for letters and mail, small packages and parcels, larger bags and luggage, cargo and pallets, and building-sized equipment large enough to accommodate a tractor-trailer.

Portable X-ray units are available that can be hand-carried to the site of a suspicious package without moving it, and truck-mounted mobile systems can scan other vehicles. While there may be some overlap in applications for similarly sized equipment, small package X-ray systems are typically used for briefcases, backpacks, purses, and other hand-carried packages at security checkpoints of buildings or other venues.

The primary function of small package X-ray systems is to alert security personnel to the presence of a weapon or other contraband concealed in a closed bag or package. Small package X-ray systems are often paired with walk-through metal detectors for personnel screening at entrances and checkpoints.



Small Package X-ray

Photo courtesy of
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How They Work

A conveyor belt activated by the machine operator moves the bag or package into the X-ray cabinet. The cabinet contains shielding that keeps X-rays inside the enclosure and serves as a physical barrier to exclude people from the space. Typically, an automated system detects the bag and signals the device to generate X-rays. X-rays are a form of electromagnetic radiation with wavelengths in the range of 0.01 to 10 nanometers (nm). X-rays with wavelengths below 0.2 to 0.1 nm can penetrate most objects but are attenuated to varying degrees by different materials. A multi-layer detector receives the X-rays that have passed through the bag. Electronic circuitry processes signals from the detector and produces an image based upon the type and density of material in the bag. This image is then sent to the display unit for a trained operator to inspect. The image may be color-coded to indicate organic, inorganic, and metallic materials. X-ray machine operators are trained to recognize suspicious items like guns and knives, and since most explosives are organic, they are also trained to recognize improvised explosive devices.

If no threat object is identified, the package is conveyed through the machine for pickup. If an object is found, security personnel follow the protocol of their facility to protect themselves and the public.

Features

Small package X-ray systems are available with a variety of features and options. Different overall sizes, footprints, conveyor lengths, and weather protection ratings are available. Some units are designed for mobility and have wheel kits or are sized to fit through standard doorways. Many have luggage counters, two-way conveyor operation, image-review modes, and image-zoom features.

Many small package X-ray systems have sophisticated software that automatically detects weapons, explosives, and narcotics, and aides the operator in identifying threats. Displays range from basic to upgraded options for large-size, high-resolution, color, or dual displays. Image display and control functions such as pan, zoom, and the ability to strip organic or inorganic objects and high- or low-density objects help operators to detect well-concealed threats.

Some X-ray systems can provide multiple views of the package and can store, archive, or export images. Some have built-in training software with the ability to intermittently project a fictional digital image of a weapon into the bag or package image. This serves to test, track, and improve operator performance.

The features required must be considered in the context of the threat scenario for the particular application. The small package X-ray system is only one component of a layered security plan that may include additional screening equipment, trained security personnel, operational procedures, and a secure facility perimeter.

Radiation Safety

Manufacturers are required to certify that their X-ray systems meet U.S. Food and Drug Administration (FDA) radiation safety performance requirements. The FDA standard requires that external radiation emission from the cabinet not exceed an exposure of 0.5 milliroentgens in one hour at any point five centimeters from the external surface.^[1] The standard also requires safety features such as interlocks, warning lights, and labels to protect users and the public.^[2] While the FDA regulates manufacturers of X-ray systems, state governments and the U.S. Occupational Safety and Health Administration (OSHA) regulate their use.^[3] Federal regulations do not require use of personnel radiation monitoring, such as dosimeters, for X-ray screening system operators; however, some employers may require it.

References

1. U.S. Food and Drug Administration. *Cabinet X-Ray Systems (Closed X-Ray Systems)*. <http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/SecuritySystems/ucm227196.htm>. Accessed September 8, 2014.
2. U.S. National Archives and Records Administration. 2011. *Code of federal regulations*. Title 21. Cabinet X-Ray Systems.
3. U.S. National Archives and Records Administration. 2011. *Code of federal regulations*. Title 29. Ionizing Radiation.