System Assessment and Validation for Emergency Responders (SAVER)

Small Package X-ray Systems Market Survey Report

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Prepared by the National Urban Security Technology Laboratory

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FOREWORD

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 assessments and validations on commercially available equipment and systems, and develops knowledge products that provide relevant equipment information to the emergency responder community. The SAVER Program mission includes:

- Conducting impartial, practitioner-relevant, operationally oriented assessments and validations of emergency response equipment; and
- Providing information, in the form of knowledge products, that enables decision-makers and responders to better select, procure, use, and maintain emergency responder equipment.

SAVER Program knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the responder community: "What equipment is available?" and "How does it perform?" These knowledge products are shared nationally with the responder community, providing a life- and cost-saving asset to DHS, as well as to Federal, state, and local responders.

The SAVER Program is managed and executed by the National Urban Security Technology Laboratory (NUSTL). NUSTL is responsible for all SAVER activities, including selecting and prioritizing program topics, developing SAVER knowledge products, coordinating with other organizations, and ensuring flexibility and responsiveness to first responder requirements. NUSTL provides expertise and analysis on a wide range of key subject areas, including chemical, biological, radiological, nuclear, and explosive weapons detection; emergency response and recovery; and related equipment, instrumentation, and technologies. In support of this tasking, NUSTL conducted a market survey of commercially available small package X-ray systems. Small package X-ray systems fall under AEL reference number 15SC-00-PPSS, Systems, Personnel/Package Screening.

Visit the SAVER website at www.firstresponder.gov/SAVER for more information on the SAVER Program or to view additional reports on small package X-ray systems or other technologies.

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1. INTRODUCTION

Small package X-ray systems, also called cabinet X-ray systems, are devices used to screen small luggage, briefcases, purses, outerwear, and other bags and packages for weapons, bomb components, or other concealed contraband. They are used for security in schools, government facilities, transportation venues, or at other building and event checkpoints. To provide security personnel with information about this detection technology, the System Assessment and Validation for Emergency Responders (SAVER) Program conducted a market survey of commercially available small package X-ray systems.

This market survey report is based on information gathered between September and October 2014 from Internet searches, industry publications, and a government-issued Request for Information (RFI) accessible from the Federal Business Opportunities website.[1] For inclusion in this report, the systems had to be:

- Cabinet-type systems where the X-ray generator is installed in a shielded enclosure and designed for inspection of parcels at security checkpoint locations (i.e., not open bomb-squad systems, or X-ray tubes installed within a shielded part of a building)
- Sized with tunnel dimensions no greater than 70 centimeters (27.6 inches) in either width or height
- Commercial off-the-shelf (COTS) products.

Due diligence was performed to develop a report that is representative of products in the marketplace.

2. SMALL PACKAGE X-RAY SYSTEMS OVERVIEW

Small package X-ray systems are used at airports, transportation venues, government facilities, and other buildings to screen parcels for concealed weapons, bomb components, or other contraband. 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 usually 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.

X-ray systems for security screening are available in a range of sizes for different applications, often distinguished by the maximum size of the package that can be scanned. Small- to medium-sized models handle letters, small packages, bags and luggage; large systems are used for cargo and pallets, with building-sized models able to accommodate a tractor-trailer. In addition, 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 be used to scan other vehicles.

[1] Federal Business Opportunities, RFI-15-02, *Small Package X-ray Systems,* www.fbo.gov/spg/DHS/OCPO/DHS-OCPO/RFI-15-02/listing.html (October 15, 2014)

For cabinet-type systems, there is no consensus as to the dimensions of a small, medium, or large package X-ray system, and different manufacturers categorize their products differently. Those with a tunnel width greater than 40 inches are typically classed as "large" or "cargo/pallet" X-ray systems, as they would accommodate the standard North American pallet (40 x 48 inches). Many manufacturers categorize systems with tunnel openings of less than about 30 inches wide by 20 inches high as small package systems, suitable for the inspection of carry-on baggage, outerwear, briefcases, and parcels at security checkpoints.[2] The American National Standard for cabinet X-ray systems (N42.44-2008) distinguishes between systems with tunnel dimensions less than or greater than or equal to 70 centimeters (27.6 inches). This reflects the fact that imaging performance may be degraded with greater source-to-object distance if a large tunnel is used with smaller bag.

Hence, this market survey covers X-ray systems with tunnel sizes less than 27.6 inches (width or height). Such systems are applicable to the detection of weapons, explosives, drugs, or other contraband in backpacks, parcels, and carry-on luggage at checkpoints of buildings or transportation venues.[3]

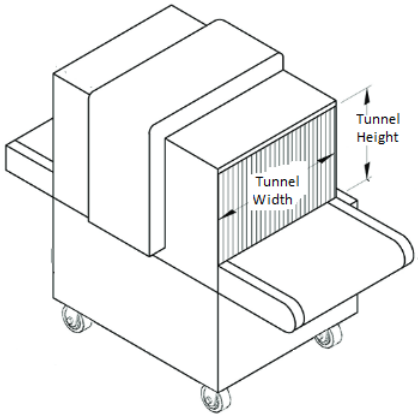

Figure 1. Small Package X-ray System Showing Tunnel Opening
Image courtesy of AutoClear LLC

2.1 Current Technologies

Security X-ray systems employ a conveyor belt that 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 energies in the range of 100 electron volts (eV) to 100 kiloelectron volts (keV). When X-rays encounter an object, absorption, transmission, or scattering occurs in proportion to the energy of the X-rays and the characteristics of the material. X-rays with energies above 5 to 10 keV can penetrate but are

[2] For perspective, typical airline rules specify that the sum of the length, width, and height may not exceed 45 linear inches for a carry-on bag and 62 inches for a checked bag. For carry-on bags, this corresponds to approximately 22 x 14 x 9 inches to fit into the metal sizers located near many airline check-in counters.
[3] Systems larger than this and smaller than cargo/pallet sized systems could be considered "medium" systems.

attenuated to varying degrees by different materials. Transmitted and reflected (backscattered) rays are collected by detectors and used to create images for these systems. Security X-ray systems may use one or more of the following technologies to generate images of scanned objects:

- **Standard Transmission:** In standard transmission systems, a fan-shaped X-ray beam scans items as they are transported past a linear array of diodes acting as detectors. The X-rays pass through the object and are attenuated to varying degrees by the composition, density, and thickness of the object in the path of the X-ray beam. The attenuated rays received at the detectors are used to create a monochromatic or pseudocolor image of the object.
- **Dual or Multi-Energy Transmission:** Dual or multi-energy systems expose objects to two or more X-ray energies and analyze the transmitted energy. By comparing the interaction of X-rays with different energy levels, a multi-energy system can discriminate between various types of materials. These systems display this material classification according to atomic number with a continuous color scale indicating organic, inorganic, and metallic materials.
- **Backscatter:** Backscatter systems examine the reflected X-ray energy. Since low Z (atomic number) materials backscatter X-rays more efficiently than high Z materials, backscatter systems discriminate between high and low Z materials. They do not discriminate among different low Z materials well, so these systems typically display both the transmission and backscatter images.

Most X-ray systems contain a single X-ray source that generates the single or multiple X-ray energies needed. However, a number of systems contain two or more X-ray generators that can simultaneously provide top, side, or other views of the item being scanned. These dual or multi-view systems may enhance detection by showing objects from different perspectives.

2.2 Applications

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. They may be used in mailrooms or receiving docks of facilities to screen incoming mail and packages. They are often paired with walk-through metal detectors at facility checkpoints to screen people and their bags for contraband before entering.[4] Facilities that use X-ray systems include schools, prisons, courthouses and other government buildings, private buildings, and transportation venues. Transportation venues such as airports, and train, bus, and ship boarding areas have unique security requirements and may be subject to greater regulation than other facilities. Small package X-ray systems may also be set up on a fixed or temporary basis for special events, concerts, and sporting events.

3. FEATURES

Small package X-ray systems are available with a variety of features and options. Different tunnel sizes, overall sizes, and conveyor features are available. Some units are designed for

[4] SAVER reports on walk-through metal detectors can be found under AEL number 15SC-00-PPSS, Systems, Personnel/Package Screening, at www.firstresponder.gov/SAVER.

mobility and have wheel kits or are sized to fit through standard doorways. Some have different conveyor heights and lengths to allow for easy loading and unloading of parcels. Many have luggage counters, two-way conveyor operation, and system diagnostics.

X-ray images are displayed to the operator on single or multiple monitors. Monitors are typically liquid-crystal display (LCD) screens and many products have optional upgrades to larger-size or dual displays.

Images may be presented in black and white, color, and/or pseudocolor. In a black and white image, objects are shaded in gray levels (4,096 levels) according to their X-ray absorption. High X-ray absorbing materials are represented in dark gray tones and low absorbing materials in light gray tones. In a pseudocolor image, a color is assigned to the level of grayscale. Since the human eye differentiates colors better than gray levels, pseudocolor representations assist the operator in perceiving forms. Pseudocolor images are not to be confused with color images from dual or multi-energy systems that contain more information. In dual or multi-energy systems, items are color-coded according to their atomic number, such that different groups of materials are distinguished by a scale of colors. Orange typically represents elements of low atomic number such as elements occurring in organic materials, green represents elements of medium atomic number such as mixed materials or aluminium, and blue represents higher atomic number elements such as those occurring in copper or steel. Information on material thickness is shown by varying the degree of the brightness of the color.

Image control functions such as pan, zoom, and image-review modes assist the operator in examining the image for threats. Most systems also have a range of image enhancement and evaluation tools. Some examples are edge enhancement, reverse black and white, and organic and inorganic stripping functions. Organic stripping removes items identified as organic material from the image, leaving a less cluttered view of inorganic materials (e.g., weapons). Inorganic stripping removes the images of inorganic material for a better view of organic material (e.g., narcotics, explosives). Some systems also have high- or low-density material stripping that remove either high- or low-density material from view so that the operator can better identify remaining material. Some systems can enhance dark and light objects by increasing the contrast of those sections of the image. Others have the ability to display objects with absorption degrees within a selected range.

Systems with automated threat alerts further assist the operator in detecting contraband. Some highlight or frame materials of particular atomic numbers, and others alert on materials above a set density threshold. Software algorithms use size, mass, and atomic number to automatically identify suspected explosives and narcotics.

Most X-ray systems can store, archive, or export images. Many have built-in training software. Some have the ability to intermittently project a fictional digital image of a weapon onto 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 includes additional screening equipment, trained security personnel, operational procedures, and a secure facility perimeter.

3.1 Standards/Regulations

Several standards and guides relate to the use of small package X-ray systems:

- *American National Standard for the Performance of Checkpoint Cabinet X-Ray Imaging Security Systems.* American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) N42.44-2008
  This standard specifies test procedures and minimum requirements for imaging performance; electrical, mechanical, and environmental requirements; and radiation limits.
- *Standard Practice for Evaluating the Imaging Performance of Security X-Ray Systems.* American Society for Testing and Materials (ASTM) F792-08
  This standard establishes methods for evaluating X-ray screening systems with tunnel apertures up to 1 meter wide by 1 meter high by using a standard test object.
- *Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use- Part 2-091: Particular Requirements for Cabinet X-ray Systems.* International Electrotechnical Commission (IEC) 61010-2-091: 2012
  This specifies safety requirements for cabinet X-ray systems, the cabinet of which must provide radiation attenuation and exclude personnel from the interior.
- *Performance Standards for Ionizing Radiation Emitting Products, Section 1020.40—Cabinet x-ray systems.* Code of Federal Regulations, Title 21, Part 1020 (21 CFR 1020.40)
  This U.S. Food and Drug Administration standard requires that external radiation emission from the cabinet not exceed an exposure of 0.5 milliroentgens in 1 hour at any point 5 centimeters from the external surface. The standard also requires safety features such as interlocks, warning lights, and labels to protect users and the public.
- *Occupational Safety and Health Standards, Section 1910.1096 – Ionizing Radiation.* Code of Federal Regulations, Title 29, Part 1910 (29 CFR 1910.1096)
  This Occupational Safety and Health Administration standard regulates personnel use of ionizing radiation equipment. The use of personnel monitoring devices such as dosimeters for X-ray screening system operators is not required by this standard; however, some employers may require it.

As with many devices, additional standards for fire, electrical, and mechanical safety, as well as electromagnetic compatibility and radio frequency, may apply.

For X-ray equipment that is used to screen air cargo on passenger aircraft, the Transportation Security Administration (TSA) has developed the Air Cargo Security Technology List (ACSTL).[5] The ACSTL is used by regulated parties to procure equipment necessary to meet the 100 percent air cargo screening mandate outlined in Public Law 110-53. The ACSTL lists equipment that has undergone a formal evaluation process and is qualified, approved, or grandfathered for use by air carriers, indirect air carriers, independent cargo screening facilities, and shippers to screen domestic and outbound air cargo. Section 4 identifies which small package X-ray systems in this market survey are on the ACSTL.

[5] The current version of the ACSTL at the time of this report is 9.4, dated 3/17/2015.

3.2 Emerging Technologies

X-ray technology for baggage screening at airports has been in use since the 1970s. While it is a mature technology, manufacturers have made continual advances in imaging, software algorithms, and user interface and system features. Emerging techniques for baggage screening supplement or replace conventional X-rays with other technologies such as computed tomography (CT), X-ray diffraction, and nuclear quadrupole resonance. The complexity and cost of these technologies may be appropriate for certain high-throughput facilities such as airports, but are unlikely to be required at most building security checkpoints.

4. PRODUCT INFORMATION

The market survey identified 39 X-ray systems that range in price from approximately $14,000 to $165,000. This includes four products that are variations of other listed products. Table 3-1 summarizes general product specifications, and subsequent sections provide additional product-specific information. Product information was obtained directly from manufacturers' responses to the RFI, and by Internet research using manufacturer and vendor websites. The information has not been independently verified by the SAVER Program.

The specifications in Table 3-1 are defined as follows, listed in column order:

Vendor is the manufacturer or distributor of the product.

Product is the name or number of the particular model. Note that manufacturers give their products similar names, as many models have been named according to their tunnel size. For example, a model "6040" will have a tunnel size of approximately 60 centimeters (cm) (23.6 inches) wide by 40 cm (15.7 inches) high.

Cost is the price, or price range, dependent on options. Prices for the same product may vary among vendors and may differ from the manufacturer's suggested retail price.

Tunnel Size is the size of the X-ray cabinet opening and is an indication of how large of a package can be scanned. Only systems with tunnel sizes less than 70 cm (27.6 inches) in width or height are included in this market survey. "W x H" means width by height.

Overall Size is the size of the base system, which typically does not include the display monitors. "L x W x H" means length by width by height.

Conveyor refers to the conveyor belt system that moves parcels into and out of the X-ray cabinet. **Height** is the conveyor height above the floor, **capacity** is the maximum load for the belt (assumes evenly distributed weight), and **speed** is the rate at which the belt moves.

Monitor describes the size and type of display screen supplied with the X-ray system. The monitor may be light-emitting diode (LED), liquid-crystal display (LCD), extended video graphics array (XVGA), or other types. Some systems may be supplied with a single monitor, some with dual monitors, and in many cases, the standard monitor can be upgraded to a larger size or multiple monitor option.

Technology is the X-ray technique used to produce the images. In this table, "DET" is used for dual-energy transmission systems, "MET" for multi-energy transmission systems and "BKS" for backscatter systems. Section 2.1 describes the different technologies.

Multi-View refers to whether the system has an additional X-ray source or capability to provide top, side, or other views of the parcel scanned. A check mark in this column indicates that the system has this capability.

Penetration is the maximum thickness of steel in millimeters (mm) behind which an object can be seen; this is used as a measure of the system's imaging performance. Penetration is determined using a standardized test piece and procedures described in ASTM F792-08. Manufacturers report values for both typical and guaranteed performance. Penetration is directly related to the voltage in kilovolts (kV) of the X-ray generator; systems with higher voltage have greater penetration.

Wire Resolution is an indication of the smallest wire that the X-ray system is capable of detecting and is used as a measure of system imaging performance. Resolution is determined using a standardized test piece and procedures described in ASTM F792-08. Manufacturers report values for both typical and guaranteed performance. Wire sizes are described using a standardized system called American wire gauge (AWG) where higher AWG numbers indicate smaller diameter wires (e.g., 36 AWG = 0.005-inch diameter; 10 AWG = 0.102-inch diameter).

Stripping is a software tool used by the operator to help interpret the X-ray image. Organic stripping removes items identified as organic material from the image, leaving a less cluttered view of inorganic materials (e.g., weapons). Inorganic stripping removes the images of inorganic material for a better view of organic material (e.g., narcotics, explosives). High- or low-density stripping removes images of material identified as high or low density so that the operator can better identify remaining material. Some systems also can strip images of metallic items or items of certain atomic number coded by color.

Automatic Alert refers to a number of software tools that alert the operator to suspect items. Some software automatically highlights or puts a frame around objects above a certain density threshold. Some software algorithms analyze information like effective atomic number, mass, density, and physical characteristics to highlight suspicious items such as bomb threat items, explosives, or narcotics. In many cases, these software tools are not standard features but are available as options.

ACSTL, or Air Cargo Screening Technology List, is a list of devices that have undergone formal testing and deemed qualified by the TSA for screening purposes. The current version of the ACSTL is 9.4, dated 3/17/15. A check mark in this column indicates that the product is on the list.

The notation "NI" means that no information was available on the feature.

Table 3-1. Small Package X-ray Systems Specifications

Vendor	Product	Cost ($)	Tunnel Size W x H (in)	Overall Size L x W x H (in)	Conveyor height (in) capacity (lbs) speed (ft/min)	Monitor size (in) type	Technology	Multi-View	Penetration# typical, guaranteed (mm)	Wire Resolution# typical, guaranteed (AWG)	Stripping	Automatic Alert	ACSTL
American Science and Engineering Inc. (AS&E)	Gemini® 6040*	48,777†	25 x 17.3	78 x 33.5 x 53.3	27 300 46	dual 22 LED	DET, BKS		30	40	organic, inorganic high density low density	density	✓
Astrophysics Inc.	6545VI*	32,500	25.6 x 18	85.5 x 37 x 51.5	28.7 364 45	dual 22 LCD	DET		43, 41	41, 40	organic inorganic high density low density	density explosives	✓
	XIS-5335/ 5335S*	14,306†/ 20,500	21 x 14	52 x 30 x 48.4	28.7 364 45	single 17 LCD	DET		12, 10 39, 37	39, 38 40, 38	organic inorganic high density low density	density explosives	
	XIS-6040*/ 6040M	24,500	23.6 x 15.7	56 x 33 x 49/ 56 x 33 x 54	28.5/31.5 364 45	single 19 LCD	DET		39, 37	40, 38	organic inorganic high density low density	density explosives	✓
	XIS-6545*	28,500	25.6 x 18	85.1 x 34.3 x 52	28.7 364 45	dual 19 LCD	DET		39, 37	40, 38	organic inorganic low density	density explosives	✓
	XIS-6545DV*	56,500	25.6 x 17.7	84 x 42 x 51	27.2 364 45	dual 19 LCD	DET	✓	41, 39	41, 40	organic inorganic high density low density	density explosives	✓
Autoclear LLC	400+	22,866†	24.4 x 16.5	60.9 x 31.9 x 49.8	28.5 NI 47	single 17 monitor	MET		10	40	organic inorganic high density low density	density suspect materials‡	
	4535*	14,500	17.7 x 13.8	33.7 x 26.2 x 42.3	25.1 331 48	single 17 LCD	MET		11, 10	40	organic inorganic high density low density	density explosives narcotics	

Vendor	Product	Cost ($)	Tunnel Size W x H (in)	Overall Size L x W x H (in)	Conveyor height (in) capacity (lbs) speed (ft/min)	Monitor size (in) type	Technology	Multi-View	Penetration# typical, guaranteed (mm)	Wire Resolution# typical, guaranteed (AWG)	Stripping	Automatic Alert	ACSTL
Autoclear LLC	5333* 100 kV/ 160 kV	17,500/ 19,500	20.9 x 13	49.4 x 28.4 x 43.6	26.14 331 48	single 17 LCD	MET		11, 10/ 29, 28	40, 38/ 40, 38	organic inorganic high density low density	density explosives narcotics	
	6040*	24,900	24.4 x 16.5	60.9 x 31.9 x 49.8	28.5 331 48	single 17 LCD	MET		29, 28	40, 38	organic inorganic high density low density	density explosives narcotics	✓
	6040-DV	NI	24.4 x 16.5	72.8 x 46.7 x 49.8	NI 221 47	dual 17 monitors	MET	✓	28	40, 38	organic inorganic high density low density	density suspect materials‡	
	6848*	27,900	26.8 x 18.9	73 x 34.7 x 52.3	28.5 331 48	single 17 LCD	MET		29, 28	40	organic inorganic high density low density	density explosives narcotics	
JCCY Technologies LLC (distributor for Nuctech Company Ltd)	CX6040BI*	19,300 to 22,000	23.9 x 16.5	80.4 x 33.5 x 51.2	26.8 353 39	single 20 LCD	DET		30	40	organic inorganic	explosives narcotics	✓
L-3 Communications Security & Detection Systems Inc.	ACX® 6.4	NI	25.2 x 16.9	88 x 34 x 53 optional lengths: 67 or 119	30 to 32 220 43	19 flat panel	DET		32	40, 38	organic inorganic metallic item	density explosives suspect items	✓
	ACX® 6.4-MV	136,604 †	25.2 x 16.9	83 x 34 x 51.2 optional lengths: 109 or 135	30 to 32 220 49	20 flat panel	DET	✓	32	40, 38	NI	explosives liquids suspect items	✓
	PX™ 5.3*	21,000	20.3 x 13	48.3 x 28.8 x 50.4	33.3 220 51	single 19 LCD	DET		32	40, 38	organic inorganic metallic item	density suspect items	
	PX™ 6.4*	27,000	25.2 x 16.9	88 x 34 x 51.2	30 220 51	single 17 LCD	DET		38, 37	42, 40	organic inorganic metallic item	density suspect items	✓

Vendor	Product	Cost ($)	Tunnel Size W x H (in)	Overall Size L x W x H (in)	Conveyor height (in) capacity (lbs) speed (ft/min)	Monitor size (in) type	Technology	Multi-View	Penetration# typical, guaranteed (mm)	Wire Resolution# typical, guaranteed (AWG)	Stripping	Automatic Alert	ACSTL
Mobjac Bay LLC (distributor for ADANI)	BV 5030CA*	13,000 to 15,000	20 x 12	49.2 x 28.9 x 52.6	39 (on cart) 353 43	single LCD	DET		14	40	organic inorganic	density narcotics explosives firearms	
Morpho Detection LLC	HRX 500™	NI	20.9 x 13.8	52 x 30 x 48	28.8 363 45	single 19 LCD	NI		12, 10	39, 38	NI	density	
	HRX 550™	NI	20.9 x 13.8	52 x 30 x 48	28.8 363 45	single 19 LCD	NI		39, 37	40, 38	NI	density	
	HRX 600™	NI	23.6 x 15.7	55.9 x 32.9 x 49.3	28.5 363 45	single 19 LCD	NI		39, 37	40, 38	NI	density	
	HRX 650™ *	26,500	25.6 x 17.7	67.9 x 43.1 x 51.7	28.8 364 45	dual 19 LCD	DET		39, 37	40, 38	organic inorganic	density explosives narcotics	✓
	HRX 650 DV™ *	59,000	25.8 x 17.7	84 x 41.9 x 50.8	28.8 NI 45	dual 19 LCD	DET	✓	41, 39	41, 40	organic inorganic	density explosives narcotics	
Rapiscan Systems Inc.	515	NI	25.2 x 16.9	79.4 x 32.7 x 53	31.1 365 43	single 17 XVGA	DET		29, 27§	40, 38§	organic inorganic variable color	density explosives	
	618XR*	19,245†	21.7 x 14.2	65.4 x 28.9 x 53.8	32.9 364 39	single 19 LCD	DET		30, 28	40, 38	organic inorganic high density low density variable color	density explosives narcotics	
	620DV*	82,525	25.2 x 16.9	113 x 56.3 x 55.8	32.6 364 43	dual 19 LCD	DET	✓	40, 35	40, 38	organic inorganic high density low density variable color	density solid and liquid explosives narcotics	✓
	620XR*	27,362†	24.4 x 16.5	82 x 33.1 x 54.4	31.6 364 39	single 19 LCD	DET		30, 28§	40, 38	organic inorganic high density low density variable color	density explosives narcotics	✓

Vendor	Product	Cost ($)	Tunnel Size W x H (in)	Overall Size L x W x H (in)	Conveyor height (in) capacity (lbs) speed (ft/min)	Monitor size (in) type	Technology	Multi-View	Penetration# typical, guaranteed (mm)	Wire Resolution# typical, guaranteed (AWG)	Stripping	Automatic Alert	ACSTL
Smiths Detection Inc.	HI-SCAN 5030si	19,345†	21 x 13	47.2 x 27.8 x 28.6	30.6 on cart 132 43	single LCD	MET		16, 14	39, 38	organic inorganic	density explosives narcotics	
	HI-SCAN 6030di	27,687†	24 x 12.6	54.3 x 31.4 x 44.1	27.2 220 47	single LCD	MET		30, 27	39, 38	organic inorganic	density explosives narcotics	
	HI-SCAN 6040-2is	NI	24.2 x 16.1	92.0 x 51.7 x 54.0	31.4 352 47	single LCD	MET	✓	37, 35	40, 39	organic inorganic	explosives narcotics liquids	
	HI-SCAN 6040aX/ 6040aTiX	89,000†/ 165,009 †	24.4 x 16.5	130 x 51.6 x 55.1	21.5 352 39	dual LCD	MET	✓	37, 35	41, 40	organic inorganic	density explosives narcotics	✓
	HI-SCAN 6040ds	NI	24.2 x 16.1	68 x 31.4 x 46.5	25.6 221 47	single LCD	MET		30, 27	39, 38	organic inorganic	density narcotics explosives	✓
	HI-SCAN 6040eX	NI	24.4 x 16.5	79 x 33.5 x 50.2	27.3 364 47	single LCD	MET		37, 35	40, 39	organic inorganic	density explosives narcotics	
	HI-SCAN 6040i	28,094†	24.2 x 16.1	78.9 x 33.5 x 50.6	27.3 352 47	single LCD	MET		31, 30	40, 39	organic inorganic	density explosives narcotics	✓
	HI-SCAN 6046si	38,892†	24.2 x 17.9	78.9 x 33.5 x 50.6	27.3 352 47	single LCD	MET		37, 35	41, 40	organic inorganic	density explosives narcotics	✓

Notes:
✓ - System is equipped with this feature
ACSTL - Air Cargo Screening Technology List
DET – dual energy transmission; MET – multi-energy transmission; BKS – backscatter
NI – No information is available on this feature
In instances where only one number is shown for penetration or wire resolution, the manufacturer did not specify whether the value is typical or guaranteed.
* Information from website and vendor's response to RFI. For other products, the information is from website sources only.
† General Services Administration (GSA) price
‡ An optional feature that highlights suspect materials based on a specific atomic number range and density
§ Model has a higher resolution option. Rapiscan Systems 515 with a 180 kV generator has a steel penetration of 29 mm typical, 27 mm guaranteed and wire resolution of 40 AWG typical, 38 AWG guaranteed. Rapiscan Systems 620XR with a 180 kV generator has steel penetration of 40 mm typical, 35 mm guaranteed.

4.1 AS&E Gemini 6040

Gemini 6040
Courtesy of AS&E

The AS&E Gemini 6040 features dual-energy transmission X-ray and backscatter technologies for detecting contraband at airports, mailrooms, and correctional and high-security facilities. The dual-energy transmission technology provides a colorized image of objects based on material type. The backscatter technique provides further information about low-Z organic materials such as plastic explosives by highlighting them in white. Dual displays show transmission and backscatter images simultaneously. This instrument has a 140 keV[6] dual-energy X-ray source, and a 160 keV backscatter source. Available image display tools include color, black and white, reverse black and white, pseudocolor, and color coding according to atomic number. Other tools include 16x zoom, dark and light object enhancement, edge enhancement, and display of objects within a selected atomic number range. The system software provides the ability to review 10 to 20 images, depending on the length of baggage scanned, and storage of up to 15,000 images in non-volatile memory. Images can be exported to tagged image file format (TIFF) or Joint Photographic Experts Group (JPEG) formats and be transferred to external storage media.

4.2 Astrophysics Inc. 6545VI

6545VI
Courtesy of Astrophysics Inc.

The Astrophysics 6545VI is a dual-energy X-ray scanner for baggage and parcel inspection at security checkpoints. It has an X-ray generator rated at 180 kV and operating at 165 kV. Optional heavy-duty rubber casters can be used for mobility. Dual monitors display images using black and white, reverse black and white, and six-color imaging according to atomic number. Other image tools include 32x zoom, light object enhancement, edge enhancement, geometric image distortion correction, and display of objects within a selected atomic number range. Other features include review of 100 images, automatic archiving for 150,000 images, and the ability to save images in red, green, blue (RGB) or bitmap formats.

4.3 Astrophysics Inc. XIS-5335/XIS-5335S

XIS-5335
Courtesy of Astrophysics Inc.

The Astrophysics XIS-5335 and XIS-5335S are multi-energy X-ray scanners designed for mail or parcel screening at government and corporate facilities. The XIS-5335 features a 90 kV (operating at 80 kV) X-ray generator and the XIS-5335S features a 160 kV (operating at 150 kV) X-ray generator. These instruments fit in most elevators and doorways and can be equipped with heavy duty casters for mobility. Available image display tools include black and white, reverse black and white, pseudocolor, and six-color imaging according to atomic number.

[6] Most manufacturers specify the anode voltage of the X-ray tube in kV, others specify keV. X-rays are typically created by converting energy from electrons into photons within an X-ray tube. The amount of energy carried by each electron is determined by the kV applied to the X-ray tube. For each kV, each electron has 1 keV of energy, and the maximum photon energy in keV, therefore, is numerically equal to the maximum applied potential in kV.

Other tools include 64x zoom, dark and light object enhancement, edge enhancement, geometric image distortion correction, and display of objects within a selected atomic number range. The software allows review of 100 images, the ability to save images in RGB and bitmap formats, and automatic archival of 150,000 images.

4.4 Astrophysics Inc. XIS-6040/6040M

The Astrophysics XIS-6040 is a multi-energy X-ray system designed for screening small baggage and parcels at hotel, prison, transportation, or government security checkpoints. The XIS-6040M is the mobile version of the XIS-6040, featuring heavy duty pneumatic wheels, handle bars, and a fold-up control panel. The system has a 160 kV X-ray generator operating at 150 kV. Available image display tools include black and white, reverse black and white, pseudocolor, and six-color imaging according to atomic number. Other tools include 32x zoom, edge enhancement, dark and light object enhancement, geometric image distortion correction, and display of objects within a selected atomic number range. The system allows the review of 100 images, the ability to save files in RGB and bitmap formats, and archival of 150,000 images.

4.5 Astrophysics Inc. XIS-6545

The Astrophysics XIS-6545 is a dual-energy X-ray scanner designed for screening small- to medium-sized parcels at airports, government facilities, or other checkpoints. It has a 160 kV X-ray generator (operating at 150 kV). Available image display tools include black and white, reverse black and white, pseudocolor, and six-color imaging according to atomic number. Other tools include 32x zoom, dark and light object enhancement, edge enhancement, and geometric image distortion correction. Software features include the ability to review 100 images, save images in RGB and bitmap formats, and automatic archival of up to 150,000 images.

4.6 Astrophysics Inc. XIS-6545DV

The Astrophysics XIS-6545DV is a dual-source, dual-energy X-ray scanner designed for high security checkpoints at airports, government facilities, and other facilities. The system has two X-ray generators creating two views that can be manipulated independently. The X-ray generators are both 180 kV (operating at 165 kV). Image display tools include black and white, reverse black and white, pseudocolor, and six-color imaging according to atomic number. Other tools include 32x zoom, dark and light object enhancement, edge enhancement, geometric image distortion correction, and display of objects within a selected atomic number range. Image review and transfer functions include the ability to review 100 images, save images in RGB format, and automatically archive up to 150,000 images.

4.7 Autoclear LLC 400+

The Autoclear 400+ is a single-source, multi-energy X-ray scanner designed to screen small- to medium-sized parcels in schools, mailrooms, and government or corporate facilities. It has a small footprint to fit in elevators and narrow spaces. The instrument has a 100 kV X-ray generator (operating at 90 kV). Available image display tools include color, black and white, and reverse black and white. Other tools include 128x zoom, edge enhancement, and dark and light object enhancement. Image review and transfer functions include the ability to review 10 images, to archive images, and to save a screen image to universal serial bus (USB) portable media.

400+
Courtesy of Autoclear LLC

4.8 Autoclear LLC 4535

The Autoclear 4535 is a single-source, multi-energy X-ray scanner designed for inspecting mail, hand-carried objects, and personal items for corporate or event security. It is lighter and shorter than other models by this manufacturer and can fit in standard elevators and doorways, and features casters for mobility. It has a 100 kV X-ray generator. Available image display tools include black and white, pseudocolor, reverse black and white, and color coding according to atomic number. Other tools include 128x zoom, dark and light object enhancement, edge enhancement, and display of objects within a selected atomic number range. Image review and transfer functions include the ability to review more than 10 images, archive 50,000 images, and export images in JPEG format to USB.

4535
Courtesy of Autoclear LLC

4.9 Autoclear LLC 5333 (100 kV/160 kV)

The Autoclear 5333 is a single-source, multi-energy X-ray scanner designed to screen small- to mid-sized items such as purses, briefcases, backpacks, or strollers. It is designed with a small footprint to fit in elevators or narrow spaces. The 5333 is available with either a 100 kV or 160 kV X-ray generator. Available image display tools include black and white, reverse black and white, pseudocolor, and color coding according to atomic number. Other tools include 64x zoom, dark and light object enhancement, edge enhancement, and display of objects within a selected atomic number range. Image review and transfer functions include the ability to review more than 10 images, archive 50,000 images, and export images as JPEG files to USB or optical storage.

5333
Courtesy of Autoclear LLC

4.10 Autoclear LLC 6040

The Autoclear 6040 is a single-source, multi-energy X-ray scanner designed to screen small- to mid-sized items at airports, government, or corporate facilities. It is compact and will fit in elevators, narrow halls, and tight spaces. It has a 160 kV X-ray generator (operating at 140 kV). A single monitor is standard and it can display images as black and white, reverse black and white, or color coded according to atomic number. Other tools include 128x zoom, dark and light object enhancement, edge enhancement, and

6040
Courtesy of Autoclear LLC

display of objects in a selected atomic number range. The software allows for the review of over 10 images, archival of 50,000 images, and export of images in JPEG format to USB.

4.11 Autoclear LLC 6040-DV

The Autoclear 6040-DV is a dual-source, multi-energy scanner designed for inspection of small- to medium-sized items at government or private security checkpoints, as well as mail and cargo screening. The dual-view system displays two perpendicular views of the item for one scan. It has 160 kV X-ray generators. Available image display tools include black and white, reverse black and white, and color. Other tools include 128x zoom, dark and light enhancement, and edge enhancement. Image review and transfer functions include the ability to review over 10 images, archive images, and export images to USB.

4.12 Autoclear LLC 6848

The Autoclear 6848 is a single-source, multi-energy X-ray scanner designed for inspecting small- to medium-sized parcels at airports, government facilities, special events, or other checkpoints. It can fit in standard elevators and doorways, and features a folding conveyor and casters for mobility. It has a 160 kV X-ray generator (operating at 140 kV). Available image display tools include black and white, reverse black and white, and color coding according to atomic number. Other tools include 128x zoom, dark and light object enhancement, edge enhancement, and display of objects within a selected atomic number range. Image review and transfer functions include the ability to review more than 10 images, archive 50,000 images, and export images in JPEG format to USB.

4.13 JCCY Technologies LLC (Distributor for Nuctech Company Ltd) CX6040BI

The CX6040BI is a dual-energy X-ray inspection system designed for inspection of hand-held or small, checked luggage at airports, mass transit venues, or government and corporate facilities. It has a 140 kV X-ray generator and the ability to display images in pseudocolor. The system allows review of 1,000 images, archival of 50,000 images, and export of images in TIFF or JPEG format.

CX6040BI
Courtesy of JCCY Technologies LLC

4.14 L-3 Communications Security & Detection Systems Inc. ACX 6.4

The L-3 ACX 6.4 is a dual-energy X-ray inspection system for small- to medium-sized objects at airports and other security checkpoints. It is available with three conveyor lengths and an optional bin return system. It has a 150 kV X-ray source. Available image tools include pseudocolor, continuously variable contrast adjustment, and tri-material imaging for discrimination among organic, inorganic, and metallic objects. The software has the ability to automatically select and present an optimal view to the operator. Other tools include 64x zoom, edge enhancement, and a tool for showing greater detail. Images can be reviewed in reverse

video, and up to 20,000 images can be archived. The system can be networked and can send or receive images along with other network capabilities.

4.15 L-3 Communications Security & Detection Systems Inc. ACX 6.4-MV

The L-3 ACX 6.4-MV is a multi-view, dual-energy X-ray system designed for airports and other security checkpoints. The multi-view system can display two or three (as an optional upgrade) views of an object; software interprets data from each view. It has 150 kV X-ray sources. The software contains a suite of image-enhancing tools, including the ability to show detail in cluttered images and 64x zoom. Up to 20,000 images can be archived. The system can be networked with remote monitoring, communication, and system management features. It is available with short, medium, or long conveyor lengths. The ACX 6.4-MV is approved by the European Union (EU) for Liquids Explosives Detection (LEDS) Standard Type C at aviation checkpoints.

4.16 L-3 Communications Security & Detection Systems Inc. PX 5.3

The L-3 PX 5.3 is a dual-energy X-ray system designed to screen small- to medium-sized objects at mailrooms, schools, courthouses, and corporate facilities, or other environments with space constraints. It is available with short and long conveyor options and features a side-mounted touchpad interface. It has a 150 kV X-ray generator. Available image tools include black and white, reverse black and white, pseudocolor, continuously variable contrast adjustment, and tri-material imaging for discrimination among organic, inorganic, and metallic objects. The software has the ability to automatically select and present an optimal view to the operator. Other tools include 64x zoom, edge enhancement, and a tool for showing greater detail. Images can be reviewed in reverse video and over 20,000 images can be stored in a customizable archive. The system can be networked and operated remotely.

4.17 L-3 Communications Security & Detection Systems Inc. PX 6.4

The L-3 PX 6.4 is a dual-energy X-ray system for screening small- to mid-sized objects such as backpacks and carry-on luggage at airports or transportation hubs, and government and critical infrastructure facilities. It is available in three conveyor lengths and features a side-mounted touchpad interface. It has a 150 kV X-ray generator. Available image tools include black and white, reverse black and white, pseudocolor, continuously variable contrast adjustment, and tri-material imaging for discrimination among organic, inorganic, and metallic objects. The software has the ability to automatically select and present an optimal view to the operator. Other tools include 64x zoom, edge enhancement, and a tool for showing greater detail. Images can be reviewed in reverse video and up to 20,000 images can be stored in a customizable archive. The system can be networked and operated remotely.

4.18 Mobjac Bay LLC (distributor for ADANI) BV 5030CA

The ADANI BV 5030CA is an X-ray system designed for the inspection of small baggage and parcels in mailrooms, schools, cruise ships, special events, or other security checkpoints. It can be configured on a desktop or mobile cart, and features a touch-screen interface. The BV 5030CA has a dual-energy 160 kV X-ray source (90 kV also available). Available image tools include black and white, reverse black and white, pseudocolor, and color coding according to atomic number. Other tools include 96x zoom, dark object and edge enhancement, and display

of objects within a selected atomic number range. Images can be saved, archived, and copied to external storage media.

4.19 Morpho Detection LLC HRX 500

The Morpho Detection HRX 500 X-ray system is designed for screening small parcels in airports or government and private security checkpoints. The HRX 500 has a 90 kV X-ray source (operating at 84 kV). Available image tools include black and white, reverse black and white, pseudocolor and six-color imaging. Other tools include edge enhancement and a clarify feature. The system allows review of the last 100 images, automated archiving of up to 100,000 images, manual archiving of images in bitmap format, and a print image function. The system can be networked and images transmitted over Ethernet Transmission Control Protocol/Internet Protocol (TCP/IP).

HRX 500
Courtesy of Morpho Detection LLC

4.20 Morpho Detection LLC HRX 550

The Morpho Detection HRX 550 X-ray system is designed for screening small parcels at airports, government, or business facilities. It has a 160 kV X-ray generator (operating at 150 kV). Available image tools include black and white, reverse black and white, pseudocolor and six-color imaging. Other tools include edge enhancement and a clarify feature. The system allows review of the last 100 images, automated archival of up to 100,000 images, manual archiving of images in bitmap format, and a print image function. The system can be networked and images transmitted over Ethernet TCP/IP.

HRX 550
Courtesy of Morpho Detection LLC

4.21 Morpho Detection LLC HRX 600

The Morpho Detection HRX 600 X-ray scanner is designed for screening small parcels in airports and other government and corporate facilities. It has a 160 kV X-ray generator (operating at 150 kV). Available image tools include black and white, reverse black and white, pseudocolor and six-color imaging. Other tools include edge enhancement and a clarify feature. The system allows review of the last 100 images, automated archiving of up to 100,000 images, manual archiving of images in bitmap format, and a print image function. The system can be networked and images transmitted with Ethernet TCP/IP.

HRX 600
Courtesy of Morpho Detection LLC

4.22 Morpho Detection LLC HRX 650

HRX 650
Courtesy of Morpho Detection LLC

The Morpho Detection HRX 650 is an X-ray scanner designed for screening small parcels in airports, government offices, and other facilities. It has a 160 kV X-ray generator (operating at 150 kV). Available image tools include black and white, reverse black and white, pseudocolor, and six-color imaging. Other tools include 32x zoom, dark and light object enhance, edge enhancement, a clarify feature, programmable contrast levels, and geometric image distortion correction. Image review and transfer functions include the ability to review the last 100 images and automatically archive up to 100,000 images. Images can be archived manually in bitmap format. The system is equipped with Ethernet TCP/IP data communication capability, and images can be transmitted to a central server for viewing, storing, or printing. The HRX 650 can also be networked with other systems.

4.23 Morpho Detection LLC HRX 650 DV

The Morpho Detection HRX 650 DV is a dual-view X-ray scanner designed for screening small parcels in airports, government offices, and other facilities. Both X-ray generators are rated for 180 kV, but operate at 165 kV. Images can be displayed in black and white, reverse black and white, pseudocolor, and six-color imaging. Other tools include 32x zoom, dark and light object enhance, edge enhancement, a clarify feature, display of objects within a selected atomic number range, and geometric image distortion correction. Image review and transfer functions include the ability to review the last 100 images and automatically archive up to 100,000 images. Images can be archived manually in bitmap format. The system is equipped with Ethernet TCP/IP data communication capability, and images can be transmitted to a central server for viewing, storing, or printing. The HRX 650 DV can also be networked with other systems.

4.24 Rapiscan Systems Inc. 515

515
Courtesy of Rapiscan Systems Inc.

The Rapiscan Systems 515 is a dual-energy X-ray screening system that features a removable control panel and compact footprint for space-constrained applications. It has a 160 kV X-ray generator (operating at 140 kV). A high-penetration option is available with a 180 kV X-ray generator (operating at 160 kV). Image display tools include black and white, pseudocolor, and four-color imaging. Other tools include edge enhancement and a function for clear visualization of threat objects. Images can be reviewed and manually archived. Automatic image archiving is available as an option.

4.25 Rapiscan Systems Inc. 618XR

618XR
Courtesy of Rapiscan Systems Inc.

The Rapiscan Systems 618XR is a dual-energy X-ray screening system designed for schools, hotels, and other facilities and events. It is designed with casters and a narrow width for mobility. It has a 160 kV X-ray generator, operating at 140 kV. Image display tools include black and white, reverse black and white, pseudocolor, and color coding according to atomic number. Other tools include 64x zoom, dark and light object enhancement, edge enhancement, and display of objects within a

selected atomic number range. Images can be manually archived and automatic archiving is available as an option. The 618XR is network-enabled and is available with optional computer-based and onboard operator training.

4.26 Rapiscan Systems Inc. 620DV

The Rapiscan Systems 620DV is a dual-view, dual-energy X-ray system designed for aviation and other high security applications. The dual-view technology generates horizontal and vertical views of the object in a single pass. It has two 180 kV X-ray generators (operating at 160 kV). Image display tools include black and white, reverse black and white, pseudocolor, and color coding according to atomic number. Other tools include 64x zoom, dark and light object enhancement, edge enhancement, and display of objects within a selected atomic number range. Images can be manually archived and automatic archiving is available as an option. The 620DV is available with optional computer-based and onboard operator training. The 620DV is approved by TSA for air cargo screening and the Advanced Technology checkpoint program, and by the EU for LEDS Common Evaluation Process for security equipment, and holds other global regulatory approvals.

620DV
Courtesy of Rapiscan Systems Inc.

4.27 Rapiscan Systems Inc. 620XR

The Rapiscan Systems 620XR is dual-energy X-ray system for scanning of parcels at transportation facilities, prisons, mailrooms, or other security checkpoints. It has a 160 kV X-ray generator (operating at 140 kV) and an option for a 180 kV model (operating at 160 kV). Image display tools include black and white, reverse black and white, pseudocolor, and color coding according to atomic number. Other tools include 64x zoom, dark and light object enhancement, edge enhancement, and display of objects within a selected atomic number range. Images can be manually archived and automatic archiving is available as an option. The 620XR is available with optional computer-based and onboard operator training.

620XR
Courtesy of Rapiscan Systems Inc.

4.28 Smiths Detection Inc. HI-SCAN 5030si

The Smiths Detection HI-SCAN 5030si is a compact, multi-energy X-ray system designed for use in mailrooms, schools, correctional facilities, and other security checkpoints. It can be deployed on a tabletop or with a cart and other modular accessories for different applications. It has a 100 kV X-ray generator. Available image tools include black and white, reverse black and white, pseudocolor, and color coding according to atomic number. Other tools include 16x zoom, dark and light object enhancement, and automatic optimum-contrast enhancement. Images can be reviewed, converted to JPEG, TIFF, or bitmap formats, or archived (up to 20,000 images on the local hard disk).

HI-SCAN 5030si
Courtesy of Smiths Detection Inc.

4.29 Smiths Detection Inc. HI-SCAN 6030di

HI-SCAN 6030di
Courtesy of Smiths Detection Inc.

The Smiths Detection HI-SCAN 6030di is a multi-energy X-ray system designed for screening small bags and packages at prisons, schools, and corporate, government, or other facilities. It is designed for mobility and use in space-constrained applications. The 6030di has a 140 kV X-ray generator. Available image tools include black and white, color, color coding according to atomic number, and display of objects within a select absorption range. Other tools include 16x zoom, dark object enhancement and automatic optimum-contrast enhancement. Images can be reviewed, converted to JPG, TIFF, or bitmap formats, or archived (up to 20,000 images on the local hard disk).

4.30 Smiths Detection Inc. HI-SCAN 6040-2is

HI-SCAN 6040-2is
Courtesy of Smiths Detection Inc.

The Smiths Detection HI-SCAN 6040-2is is a dual-view, multi-energy X-ray scanner designed for the inspection of hand luggage and small parcels at security checkpoints at airports, government, or other facilities. The system has two X-ray generators that create two views of the package scanned. The X-ray generators are 160 kV, and a higher resolution model is available. Images can be displayed in black and white, reverse black and white, color coded according to atomic number, or only as items within a select absorption range. Other tools include 64x zoom, dark and light object enhancement, and automatic optimum-contrast enhancement. Images can be reviewed, converted to JPG, TIFF, or bitmap formats, and archived (up to 100,000 images). The high-resolution version of HI-SCAN 6040-2is has recently obtained Standard 3 Type C, an extended approval as a LEDS under the requirements of the European Civil Aviation Conference.

4.31 Smiths Detection Inc. HI-SCAN 6040aX/6040aTiX

HI-SCAN 6040aTiX
Courtesy of Smiths Detection Inc.

The Smiths Detection HI-SCAN 6040aX and 6040aTiX are dual-view, multi-energy X-ray systems designed for airport, transportation, and other security checkpoints. The 6040aX has two independent 160 kV X-ray generators and the 6040aTiX has four, providing multiple views for each bag. Images on dual flat-screen monitors can be viewed in black and white, reverse black and white, or color coded according to atomic number. Other image tools include 64x zoom, dark and light object enhancement, and automatic optimum-contrast enhancement. Images can be reviewed, converted to JPEG, TIFF, or bitmap formats, and archived (up to 100,000 images). The 6040aTiX is approved as LEDS according to EU Standard 2 Type C.

4.32 Smiths Detection Inc. HI-SCAN 6040ds

The Smiths Detection HI-SCAN 6040ds is a compact X-ray system designed for screening small parcels at security checkpoints. It has a 140 kV X-ray generator. Images can be displayed in black and white, reverse black and white, and color. Other tools include 64x zoom, dark and light object enhancement, and optional automatic contrast enhancement. Images can be reviewed, converted to TIFF or JPEG formats, or archived.

HI-SCAN 6040ds
Courtesy of Smiths Detection Inc.

4.33 Smiths Detection Inc. HI-SCAN 6040eX

The Smiths Detection HI-SCAN 6040eX is a dual-energy X-ray system designed for security screening in airports, and government and corporate facilities. It is a higher-penetration upgrade to the Hi-SCAN 6040i. The X-ray generator is 160 kV. Image tools include black and white, color coding according to atomic number, and dark-object enhancement. Additional features and options for this system include 64x zoom, automatic optimum-contrast enhancement and contrast enhancement of areas with high X-ray absorption. A review function allows recall of previous images. Optional archive and export features allow storage of up to 100,000 images and export to TIFF or JPEG formats. The system also contains a USB interface.

HI-SCAN 6040eX
Courtesy of Smiths Detection Inc.

4.34 Smiths Detection Inc. HI-SCAN 6040i

The Smiths Detection HI-SCAN 6040i is a compact X-ray system for carry-on baggage screening at airports or other security checkpoints. It is part of Smiths Detection's iLane system where modular components can be added to create individually designed checkpoints. The HI-SCAN 6040i has a 140 kV X-ray generator. Image tools include black and white and color coding according to atomic number. Other available tools include 64x zoom, dark object enhancement, and automatic optimum-contrast enhancement. A review function allows recall of previous images. Optional archive and export features allow storage of up to 100,000 images and export to TIFF and JPEG formats. There is also a USB interface and optional Compact Disk-ReWritable (CD-RW) module.

HI-SCAN 6040i
Courtesy of Smiths Detection Inc.

4.35 Smiths Detection Inc. HI-SCAN 6046si

The Smiths Detection HI-SCAN 6046si is a multi-energy X-ray system designed for screening small- to mid-sized parcels at airports or other security checkpoints. It has a 160 kV X-ray generator. Image tools include black and white and color coding according to atomic number. Other available tools include 64x zoom, dark object enhancement, and automatic optimum-contrast enhancement. A review function allows recall of previous images. Optional archive and export features allow storage up to 100,000 images and export to TIFF and JPEG formats. There is also a USB interface and optional CD-RW module.

HI-SCAN 6046si
Courtesy of Smiths Detection Inc.

5. VENDOR CONTACT INFORMATION

Additional information on the X-ray systems included in this market survey report can be obtained from the companies listed below. The products listed in this survey may be available from multiple vendors not listed here.

Table 5-1. Vendor Contact Information

Company	Address/Phone Number	Website/E-Mail Address
American Science & Engineering Inc. (AS&E)	829 Middlesex Turnpike Billerica, MA 01821 (978) 262-8700	www.as-e.com sales@as-e.com
Astrophysics Inc.	21481 Ferrero Parkway City of Industry, CA 91789 (909) 598-5488	www.astrophysicsinc.com sales@astrophysicsinc.com
Autoclear LLC	2 Gardner Road Fairfield, NJ 07004 (973) 276-6000	www.a-clear.com sales@a-clear.com
JCCY Technologies LLC (Nuctech distributor)	2231 Oak Sand Drive Katy, TX 77450 (479) 445-5505	www.jccytech.com info@jccytech.com
L-3 Communications Security & Detection Systems Inc.	10E Commerce Way Woburn, MA 01801 (800) 939-3800	www.sds.l-3com.com sales.sds@l-3com.com
Mobjac Bay LLC (Adani distributor)	9076 Emma Ann Way Fairfax Station, VA 22039 (703) 795-3262	MBVA@mobjacbay.com
Morpho Detection LLC	205 Lowell Street Wilmington, MA 01887 (757) 639-3442	www.morpho.com info@morphodetection.com
Rapiscan Systems Inc.	2805 Columbia Street Torrance, CA 90503 (310) 349-2430	www.rapiscansystems.com sales@rapiscansystems.com
Smiths Detection Inc.	2202 Lakeside Boulevard Edgewood, MD 21040 (800) 297-0955	www.smithsdetection.com usa@smithsdetection.com

6. SUMMARY

This market survey report provides information on 39 models of small package X-ray systems from nine different companies. Prices range from approximately $14,000 to $165,000. The seven systems priced between $50,000 and $165,000 are dual- or multi-view systems, meaning they typically contain two or more X-ray generators to simultaneously provide images of the parcel from additional angles. The remaining 32 single-view systems are all priced under $50,000.

Figure 2 graphically displays the system's rated X-ray generator voltage and ACSTL listing as a function of tunnel size. For inclusion in this report, the system must have tunnel width and height of less than 27.6 inches (70 cm) each. The smallest tunnel size of the products in this survey is 20 inches wide by 12 inches high, and the largest almost 27 inches wide by 19 inches high. As can be seen from the figure, most products have tunnel sizes of approximately 21 inches wide by 13 inches high for smaller systems and 25 inches wide by 17 inches high for larger systems. Almost half (18 models) have X-ray generators rated at160 kV; six have a stronger source (180 kV), and the rest have X-ray generators rated 150 kV or below. Seventeen are on the ACSTL; all of these have at least a 140 kV generator or higher, and, as can be seen from the figure, tend to have larger tunnel sizes.

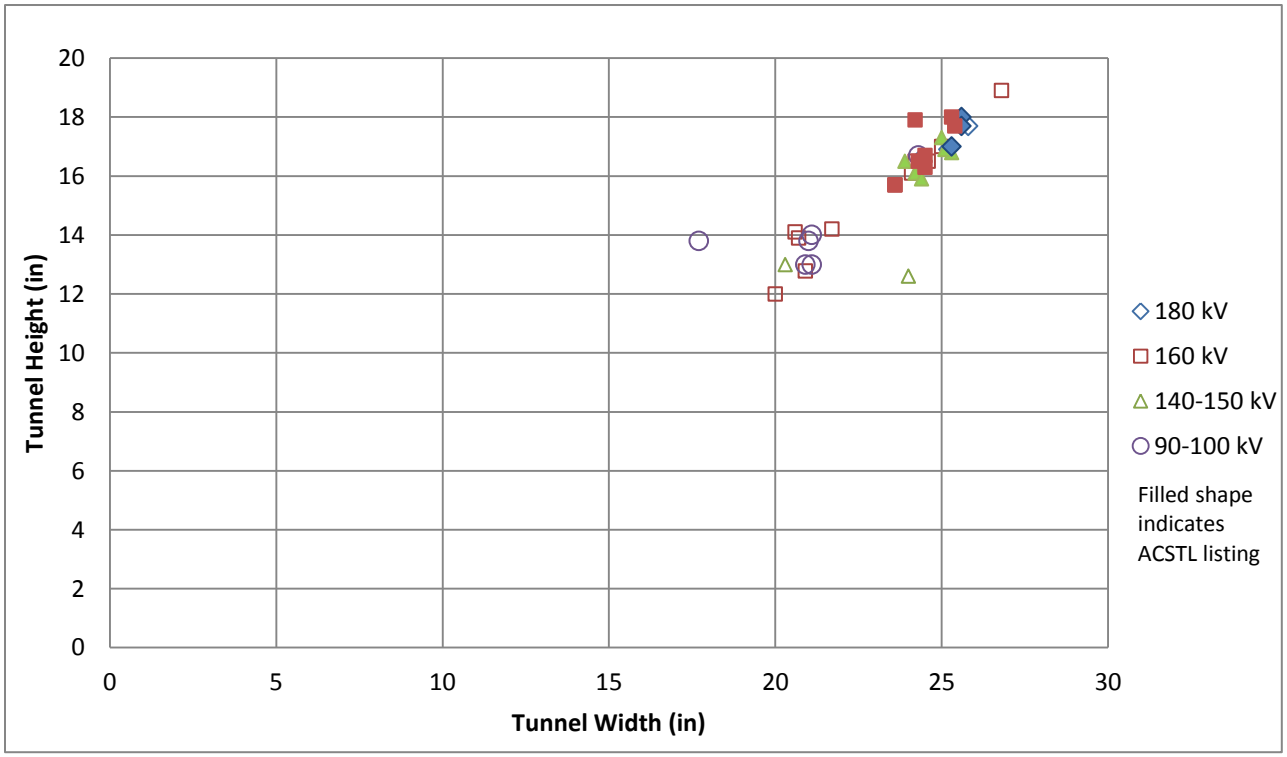

Figure 2. Graphical Display of Tunnel Size, X-ray Generator Voltage and ACSTL Listing
Each product is represented by a data point: its location on the graph indicates tunnel size, shape indicates rated X-ray voltage, and shading (filled shape) indicates whether the product is listed on the ACSTL.

All of the X-ray systems in this market survey have numerous image enhancement tools to aid the operator in perceiving threats. These come as both standard features or as options. All of the systems in this market survey have optional threat image projection, a training and quality

assurance tool that projects a fictional threat object onto an image of a scanned bag. All of the products have image storage, review, and export features with varying file formats. Many systems have network capabilities.

System size, type, and features must be considered in the context of the threat scenario for the particular application. Office building security, for example, would be unlikely to have the same requirements as an airport. The X-ray system is one component of a security plan that should include additional screening equipment, trained security personnel, operational procedures, and a secure facility perimeter.