PRODUCT SPECIFICATION

HRX 650
Conventional X-Ray System
ENVIRONMENTAL REQUIREMENTS

TEMPERATURE

- Environmental Requirement – Operating Temp.: -10°C (14°F) TO 50°C (122°F)
- Environmental Requirement – Storage Temp.: -20°C (-4°F) TO +60°C (140°F)
- Environmental Requirement – Humidity: 0 TO 95% (non-condensing)

HEALTH AND SAFETY

System complies with applicable international health and safety regulations including:
- USA FDA for cabinet X-ray Systems (Federal Standard 21 CFR 1020.40)
- Health and Safety at Work Act 1974 - Section 6, amended by the Consumer Protection Act 1987

System includes the following safety features:
- External radiation leakage of less 0.1mR/Hr (1µv/hr) as measured in contact with outer panels. Radiation leakage measurements are performed with a scatter block device in path of the x-ray beam to identify the worst-case radiation leakage.
- Two "Emergency Stop" buttons are placed on each side of the X-Ray machine, and one additional "Emergency Stop" button located on the Operator Control Panel.
- Power-ON and X-ray ON indicator lights are located at both ends of the x-ray inspection tunnel and on the Operator Control Panel.
- Interlock switches are located on critical access panels. The interlock switches disables conveyor belt operation and x-ray generation in the event of a critical panel is opened or removed.
- Circuit breakers that disconnect power from the main AC input into the HRX if the unit becomes overloaded.
- A key-switch that requires that a key be inserted and turned to the "ON" position to power up and operate the HRX unit.
- Password protected access to the application software.
- Prominent labels that warns users to not insert any part of their body when the x-rays are produced.
Physical Specifications

PHYSICAL DIMENSIONS

- **L x W x H:** 1725 mm x 873 mm x 1313 mm.
  67.91" x 34.37" x 51.7"

- **Tunnel Opening (W x H)** 651 mm x 453 mm
  25.6" x 17.84"

- **Max Object Size (W x H)** 645 mm x 445 mm.
  25.4" x 17.5"

- **Net Weight:** 650 Kg (1430 lbs)
- **Gross Weight** 805 Kg (1770 lbs)

CONVEYOR SYSTEM

- **Speed:** 0.23 m/s (45 ft/min) in either (forward or reverse) direction
- **Motor Type:** Sealed, maintenance free drum
- **Conveyor Type:** Seamless Low Maintenance Belt
- **Load Capacity:** Conveyor is capable of carrying an evenly distributed load of 165 kg (364 lbs)
- **Conveyor Height:** 730 mm (28.75")

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Electrical Specifications

POWER REQUIREMENTS

- Power Requirements for 110 VAC input: 96-132 VAC, 60HZ (15-amp max.). Optional VAC voltage regulators are available for 100 VAC operations.

- Power Requirements for 220 VAC input: 183-253 VAC, 50 HZ (10-amp max). Optional VAC voltage regulators are available for 200 VAC operations.

X-RAY GENERATOR

- The x-ray generator is rated at 160 kVp, but operates at 150 kVp.

- The x-ray tube is rated at 0.7 mA operation.

- The x-ray generator is rated for 100% duty cycle operation.

- The x-ray beam direction is vertically upward.

- The x-ray tube uses a dielectric oil bath with forced air for cooling.

- An x-ray controller protects the x-ray generator from abnormal over-voltage and over-current operation.

DETECTION SYSTEM

- System utilizes a multi-energy (i.e. dual energy) stacked array x-ray detector assembly with total of 1280 high energy and low energy x-ray detectors.

- The HRX measures and compares the transmission of High Energy (high frequency) and Low Energy (low frequency) x-rays through items that are being imaged. From this comparison, the HRX is able to determine approximate material composition.

- Detector assembly is L-Shaped. If left unchecked, the displayed image would present a skewed object image due to the size of the object and the variable distance from the X-ray source. As the diagram below shows, the closer the object is to the X-ray source, the more compressed the image becomes.
• HRX On-board PC automatically performs geometric correction to prevent any image skewing during the scanning process. The X-Ray client reconciles the size of the object with the distance from the X-ray source to present a uniformly thick object. As you can note on the images below, the image on the left without the geometric correction is bent, with compression becoming dramatically pronounced towards the bottom. As a result of the distortion, the image on the left is noticeably smaller than the corrected image on the right.

No Geometric Correction                  Automatic Geometric Correction

• X-ray detector assembly uses scintillating crystals and high-gain electronic amplifiers.
• The X-ray detector scans and displays the entire image without corner cutoffs.

Interface Specifications

ONBOARD PC
• Processor:       Intel Core II DUO Technology, 3.0 GHz.
• Memory:         2.0 GB RAM,
• Storage:        160 GB HDD
• Graphics Interface:  SVGA Graphics Adapter with 256 MB Video RAM
• Operating System:  Windows XP Pro
• Expansion Ports:  Multiple USB Ports.
• Uninterruptible Power Supply (UPS) to maintain power to PC and electronics in case of power outage. UPS is programmed to initiate PC shutdown after a pre-defined time has elapsed at which time it turns itself off in order to preserve its battery. Once power is restored, UPS restarts without human intervention and then the PC restarts normally.
CONTROL PANEL

- Ergonomic, alphanumeric design with touch pad mouse and multiple buttons dedicated to the different image manipulation options.
- Controlled by a key switch to enable operation of control panel.
- Lights displaying the status of the machine, and a speaker that can be used for audible alarms.

MONITORS

- Dual 19” high resolution, low radiation, ergonomic, LCD color monitors
- Each monitor has an image resolution of 1280 x 1024 pixels.
- Monitor 1 displays color imaging, enhanced organic material separation imaging, and enhanced inorganic material separation imaging.
- Monitor 2 displays B&W (black on white) imaging, reverse B&W (white on black) imaging, and pseudo color imaging.
IMAGING TECHNOLOGY

PERFORMANCE CHARACTERISTICS

• Spatial Resolution: 38 AWG guaranteed / 40 AWG – typical.

• Simple Penetration: 35 mm - guaranteed / 37 mm – typical.

• Organic/Inorganic Material Discrimination: The system is capable of discriminating between organic and inorganic materials as measured by the ASTM F792-88 Test Piece - Test #7.

• Organic Differentiation: The system is capable of classifying organic material masked by 0.48 mm of steel as measured by the ASTM F792-88 Test Piece - Test #9.
**IMAGE MANIPULATION OPTIONS**

- **6 Color Atomic Display**: The default display option utilizes atomic number analysis and assigns colors based on their respective densities.

<table>
<thead>
<tr>
<th>Z-Number</th>
<th><strong>Material Type</strong></th>
<th><strong>3-Color</strong></th>
<th><strong>6-Color</strong></th>
<th><strong>Examples</strong></th>
<th><strong>Possible Threats</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>0-8</td>
<td>Organic</td>
<td><strong>Orange</strong></td>
<td><strong>Brown</strong></td>
<td>Wood, Oil</td>
<td>C-4, TNT, Semtex</td>
</tr>
<tr>
<td>8-10</td>
<td>Low Inorganic</td>
<td><strong>Orange</strong></td>
<td><strong>Orange</strong></td>
<td>Paper, Alcohol</td>
<td>Cocaine, Heroin</td>
</tr>
<tr>
<td>10-12</td>
<td>High Inorganic</td>
<td><strong>Green</strong></td>
<td><strong>Yellow</strong></td>
<td>Glass</td>
<td>Propellants</td>
</tr>
<tr>
<td>12-17</td>
<td>Light Metals</td>
<td><strong>Green</strong></td>
<td><strong>Green</strong></td>
<td>Aluminum, Silicon</td>
<td>Gunpowder, Trigger Devices</td>
</tr>
<tr>
<td>17-28</td>
<td>Heavy Metals</td>
<td><strong>Blue</strong></td>
<td><strong>Blue</strong></td>
<td>Iron, Steel</td>
<td>Guns, Bullets, Knives</td>
</tr>
<tr>
<td>28+</td>
<td>Dense Metals</td>
<td><strong>Blue</strong></td>
<td><strong>Violet</strong></td>
<td>Gold, Silver</td>
<td>High-Value Contraband</td>
</tr>
<tr>
<td>-</td>
<td>Impenetrable</td>
<td><strong>Black</strong></td>
<td><strong>Black</strong></td>
<td>Lead</td>
<td>Shielding for Above Threats</td>
</tr>
</tbody>
</table>

**Image contents from left to right, top to bottom**: Stack of paper, Ashtray, Bar of Soap, Sheet of Metal, Set of Keys #1 Sign (silver), Lead Curtain, cell phone, Glass bottle and Peanut Butter.
- **Black and White**: This option provides a standard grey scale display of the image.

- **Reverse Black and White**: This option provides a reverse grey scale display of the image.
• **Organic Emphasis**: This option emphasizes the organic portions of the image by highlighting the organic areas in orange and displaying the rest of the image in grey.

• **Inorganic Emphasis**: This option emphasizes the inorganic portions of the image by highlighting all of the inorganic areas in blue and displaying the rest of the image in grey.
- **Pseudo Color**: This option applies multiple color palettes to produce unique images. The operator may scroll through available color options using the contrast button on the control panel.
- **Clarify**: This option automatically analyzes and normalizes an image so all areas of the scanned image are visible to the operator. When Clarify is activated, an image containing multiple, layered objects will become very clear for identification. This feature can be utilized in both color and black and white mode.
• **Edge sharpening (Sharp):** This option instantly enhances the outline and shape of each individual item in the screened image to aid operators with their threat assessment.

• **Hi-Resolution (Hi Res):** This option instantly increases the penetration level to maximum for immediate clarification in dense objects.
- **Zoom**: The HRX system is capable of zooming from 2x to 64x zoom, with no picture distortion up to 8x. Operators can zoom the images on each monitor independently of the other monitor. Additionally, the HRX Control Panel Touch pad permits operators to pan the image up and down while the conveyor is active.

- **9 Quadrant Zoom**: The HRX System features a 9 Quadrant Zoom based on the numeric keypad on the Operator Control Panel. This zooming function divides the screen into 9 sections, with the location of each number in the keypad corresponding to the location of the quadrant. This function permits operators to quickly jump and zoom in on individual quadrants for fast threat identification.
• **Contrast:** Operators can adjust the contrast and penetration power of the HRX System at the push of the button to either lighten or darken an area for improved image assessment.

• **Real Time Image Manipulation:** Please note that all image manipulation occurs in real time, and immediate response can be expected at the push of a button. Operators can change color modes, change Intensity Level, Zoom In Zoom out an Pan, change to Edge Enhancement mode and change to High Penetration mode without stopping the conveyor belt and independent of each Monitor.

**ADDITIONAL FUNCTIONS**

• **Atomic Number Selection:** When operators use the touchpad mouse to drag select an area on a scanned image, the HRX System will display the atomic number for that region. This option permits operators to accurately identify material groups and assess threat objects. The Atomic number displayed will be accurate to within 0.2 counts.

• **Automatic Image Archive:** The HRX System automatically archives the last 50,000 images scanned. When the capacity is reach, the system will start deleting oldest images to make room for the newest images. Additionally, the PC will always attempt to ensure an available storage space of 10 GB on startup.

• **Auto Centering:** The HRX System automatically centers all images scanned regardless of their location during the screening process. The centering function ensures that there are no corner cutoffs or image clipping.

• **Image Review:** The HRX System permits operators to review the last 100 images scanned in the HRX System. The operator may pick any one of the images that were scanned, and then either move forward and backward from that point.

• **Image processing:** The HRX System performs continuous automatic image optimization (adjusting for contrast and gamma), and also image enhancements (geometric distortion correction) to produce an accurate and sharp image. The HRX System utilizes 24-bit real time image processing to accomplish this.

• **Manual Image Storage:** Operators can manually save multiple images to a different folder on the HRX System. This permits operators to pick and choose which images he/she wants to review later with a supervisor, or print the image for a hardcopy.

• **Image Annotation:** This option allows operators to draw a frame around a suspect area a scanned image and enter three alphanumeric letters for reference. Operators can then save the image for later review, or transmit the image to a Supervisor Workstation or Suspect Search Station for secondary review.

• **Continuous Scanning:** This option allows operators to by-pass the photo-sensors located at the ends of the tunnel and enable the X-Ray generator to be excited as soon as the conveyor belt starts moving. This function allows operators to scan very long objects without image distortion and cutoff.

• **Computer Based Training (CBT):** The HRX System features an operator training program with a pre-scanned image library containing various normal and threat images. The Software will start scrolling both normal and threat images, giving operators time to identify the threat by pushing the ‘Suspect’ button the control panel. If the Operator misses a threat, the system will stop and flash the image. The Software is not meant to score the operator, but merely train him/her on possible threats that might appear in the system.

• **Print:** The HRX System features a print function that allows operators to print the current image at the push of a button. Though the HRX System does not include a printer, it is compatible with all Windows compatible printers with a USB connection.
The HRX System is equipped with a system health system and display which permits operators to view the status of the following information:

- Internal Power Supplies
- Environmental Temperature
- Relative Humidity
- X-Ray Generator Power
- Power Key
- Interlock Switch
- Emergency Buttons
- System Power On / Elapsed Time
- Operator Time
- Total Power On Time
- Diode Map Out.

The HRX System Health Display also features a message log so the HRX system may notify the operator of any potential failures or errors.
**HRX User Management Screen**

- **Multi-Tiered Security**: The HRX System interface features a multi-tiered security with different levels of accessibility and unique programmable passwords for each individual operator and administrator.

**HRX Interface Task Bar**

- **Baggage Counter**: The HRX Interface screen features a baggage counter.
- **Date/Time Display**: The HRX interface screen features a date/time display.
- **Operating Mode Display**: The HRX Scanning Screen displays a task bar indicating the image manipulation mode the operator is currently in.
Optional Software/Hardware Accessories

SOFTWARE

- **Threat Image Projection (TIP) Software**: TIP is important training software for all operators and administrators. The software operates by inserting various threat objects into objects scanned by the operator. When a threat object is detected, operators can push the 'Suspect' button on the control panel to identify the threat. If the operator fails to identify a threat, the system will stop and the image will flash on the screen to warn of the missed threat. TIP permits administrators and trainers to improvise various baggage and cargo to evaluate the skill of each operator in detecting and identifying threats. The TIP software may be enabled and disabled from the administrator menu, as to not disrupt the standard screening process.

![Screener Assist](image)

- **Screener Assist Software**: The Screener Assist Software is a real-time programmable detection tool designed to aid operators in threat assessment and identification. Operators can define the atomic numbers that they are searching for (i.e., guns) using the utility included in Screener Assist. The Software will then proceed to draw ellipses around any areas with the atomic numbers that the operator specified. Up to four different atomic number ranges may be specified, and the Screener Assist software will actively search for these ranges in real time during the screening process.

- **Localized Language Support**: Multiple languages are offered and may be set as the default operator interface language (Arabic, Chinese, English, French, Italian, Japanese and Spanish are available; additional languages available on request).

HARDWARE

- **Extended Roller Tables**: The HRX System may be supplemented with extended roller tables for longer clearance and larger objects. The HRX 650 Roller Tables are available for the Entry and Exit in lengths of 0.5 M, 1.0 M, 1.5 M and 2.0 M.
• 24” LCD Monitors: The HRX System can be upgraded to dual 24” LCD monitors for super large and sharp image display as oppose to the standard 19” LCD Monitors.

• Radiation meter: Customers may choose from Multiple Radiation Meters to perform on-site checks for possible radiation leakage and ensure the health and safety of all present.

• System Drape: The System drape is an additional cover for the HRX System when the unit is not utilized. The cover protects the system from potentially damaging particulate accumulation.

• Constant Voltage Stabilizer: The Constant voltage stabilizer is an external device mean to serve as a buffer between the localized power source and the HRX System. The stabilizer protects the HRX System by compensating for unpredictable energy spikes and abrupt drops in power.

• Footmat: The Footmat is an additional safety interlock system to ensure that the operator is present at the designated location during the HRX System operation. Unless the operator places his/her foot on the mat, the system will not function.

• Test Bags: Customers may choose from Multiple ASTM and Test Bags to perform on-site checks for consistency and reliability of units after repeated scans. The ASTM Test kits serve as a baseline for which the performance of multiple units may be evaluated.

ENVIRONMENTAL KITS

• Tropical Kit: The Tropical Kit add-on mounts additional fans and desiccants within the HRX System so the unit remains unaffected in areas with high precipitation and humidity.

• Desert Kit: The Desert Kit add-on mounts additional fans within the HRX System so the unit remains within the optimal operational temperature in areas of extreme heat.

• Polar Kit: The Polar Kit add-on mounts additional heating devices within the HRX System unit remains within the optimal operational temperature in areas of extreme cold.
**SUSPECT SEARCH STATION**

- The HRX Suspect Search Station is an integrated workstation featuring the latest GE PC and software revisions designed to address any potential threat objects that may pass through the initial screening process by serving as a secondary image analysis and manipulation station.

- At the touch of a button, the operator of an HRX X-Ray Inspection System can send a suspect image to a reviewer at the Suspect Search Station via an Ethernet or local area network connection. The reviewer can then utilize the image manipulation tools and help the operator conclusively identify potential threat objects. Operators can continue screening more objects while the reviewer conducts a detailed examination and manipulation of the suspect image. In this configuration, the Search Station minimizes the amount of time necessary to scan multiple objects without sacrificing any security.

- The Search Station includes a Dell PC, dual 19" (upgradeable 24") LCD Monitors, operator control panel, and worktable.
SUPERVISOR WORKSTATION

- The HRX Supervisor Workstation is an integrated workstation featuring the latest GE HLP PC and software revisions designed for Administrators and supervisors to monitor the screening process of multiple HRX Systems.

- When the workstation is properly configured and connected to a local connection, administrators can monitor the activities of all Remote and Suspect Workstations to ensure operators stay focused and alert. By displaying the desktops of all networked operators on the Supervisor Workstation Monitor, administrators can view exactly how each operator screen and manipulate scanned images and intervene if necessary. The workstation also permits Administrators to access all linked HRX Systems remotely to revise the accessibility of operators, add / remove operators, set passwords, and schedule shift schedules.

- The Supervisor Workstation includes a Dell PC, dual 19” (upgradeable 24”) LCD Monitors, keyboard/mouse, and worktable.