# RAPISCAN RTT™110

# Operators Manual

Rapiscan systems

An OSI Systems Company

# Preface

## Copyright Notice

This manual covers the operation and general maintenance of the RTT110 Explosives Detection System.

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We have made an effort to ensure that the information in this manual is accurate as of the date of publication. However, the product that you have purchased may contain options, upgrades or modifications not covered by this manual. As a result, there may be discrepancies between the information contained in this manual and the product you have purchased.

If you have any questions about the content of this manual or the product that you have purchased, please contact *Rapiscan Systems Customer Service*.

## Revisions

With continual development of our products, Rapiscan Systems reserves the right to amend the specifications without notice.

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## Additional Options/Features (*)

* The asterisk signifies features or equipment that are not included by default and are an additional option, that may involve additional costs or design.

# Revision History

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RTT110 Operators Manual

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# Table of Contents

# 1 Introduction

This chapter provides an introduction to the RTT110 Operators Manual, the information contained and how it is displayed:

## 1.1 Scope of this Manual

This manual provides the following information for the RTT110, displayed in Figure 1;

- RTT110 Explosives Detection System - introduction, role, functions, and capabilities
- Relevant Warning, Cautions and Safety instructions, for safe prolonged operation
- Description of the working environment, operation and components the user will interact and operate within
- Detailed reference material & instructions describing the Security screening software, used to analyze and determine threats identified by airport baggage screening systems
- RTT110 Explosives Detection System basic operating procedures and processes
- Support & Contacts - details of local Rapiscan Systems offices in your area or nominated partners

As technology progresses, Rapiscan Systems may implement changes to the components used in their products. This manual describes the most recent version of the product at the time of writing.

*Figure 1* RTT110 Explosives Detection System *(EDS)*

The information and procedures presented in this manual are intended for personnel who have been trained and authorized to operate the above equipment.

## 1.2 Symbols used in this Manual

Table 1: Manual Symbols

| | |
|---|---|
|  | **Radiation symbol**<br>This symbol indicates that the unit has components that emit X-radiation. |
|  | **X-ray Radiation symbol (Canada)**<br>This symbol indicates that the unit has components that emit X-radiation. |
|  | **High Voltage symbol**<br>This symbol indicates that hazardous voltages are present. |
|  | **Book symbol**<br>This symbol indicates that information should be written down in a report or repair ledger, etc. |
|  | **Warning / Alert symbol**<br>This symbol indicates a warning, alert, or important note. |
|   | **Caution / Alert symbol with Book symbol**<br>This symbol indicates that referenced manual(s) should be read. This may include manuals from OEMs. |

## Symbols used in this Manual, continued

Table 2: Manual Symbols - continued

| | |
|---|---|
|  | **Earth symbol**<br>This symbol indicates that this is the safety earth point for the system, or a subsystem. |
|  | **ESD Anti-Static symbol**<br>This symbol indicates that anti-static electricity precautions should be used to prevent damage occurring to components. |
|  | **CE Mark**<br>Is the official marking required by the European Community for all Electric and Electronic equipment that will be sold, or put into service for the first time, anywhere in the European community. |
|  | **UL Mark**<br>Is a mark showing compliance with the safety standards of Underwriters Laboratories Inc., an independent, not-for-profit product-safety testing and certification organization in the United States of America (USA). |

## 1.3 External Document References

- RTT110 Site Preparation Checklist
- RTT110 Maintenance Manual

## 1.4 Glossary of Acronyms

| | | |
|---|---|---|
| AC | = | Air Conditioning |
| ac | = | Alternating Current |
| BHS | = | Baggage Handling System |
| CAT | = | Computed Axial Tomography |
| CIP | = | Common Industrial Protocol |
| DAS | = | Data Acquisition System |
| DIN | = | Deutsche Institut fuer Normung |
| EDS | = | Explosives Detection System |
| Gb | = | Gigabit |
| GB | = | Gigabyte |
| HD-SDI | = | High Definition Serial Digital Interface |
| HMI | = | Human-Machine Interface |
| IEC | = | Image Engine Controller |
| IP | = | Internet Protocol |
| JD | = | Job Dispatcher |
| LCD | = | Liquid Crystal Display |
| LED | = | Light Emitting Diode |
| MCB | = | Main Circuit Breaker |
| PCI | = | Peripheral Component Interconnect |
| PFC | = | Perfluorocarbon |
| PLC | = | Programmable Logic Controller |
| PSU | = | Power Supply Unit |
| QC | = | Queuing Conveyor |
| QRC | = | Quick Release Coupling |
| RAID | = | Redundant Array of Independent Disks |
| RAM | = | Random Access Memory |
| REC | = | RTT Engine Controller |
| RRE | = | Reconstruction Engine |
| RSI | = | Reconstruction Engine Scanner Interface |
| RTT | = | Real Time Tomography |
| TCP | = | Transmission Control Protocol |
| TDE | = | Threat Detection Engine |
| USB | = | Universal Serial Bus |
| UPS | = | Un-interruptible Power Supply |

# 1.5 Limitation on Liability and Warranty

Rapiscan Systems will not accept liability for damage or personal injury caused directly or indirectly by either incorrect or poor quality termination of the local main power supply or power cables. Rapiscan Systems is not responsible for damage or injury caused by unauthorized modification, maintenance, operation or tampering with this equipment.

Service of Rapiscan machines shall be performed only by Rapiscan Systems authorized service personnel. Any modification/alteration made to the system after purchase, by the customers or their agents without written authorization from Rapiscan Systems management will void any warranty issued to the customer.

Additionally Rapiscan Systems is not liable for any damage that might be caused by any unapproved changes. Rapiscan Systems is an ISO 9001:2008 compliant company and adheres to the guidelines for inspection and testing for all materials prior to assembly. Rapiscan Systems RTT110 Explosives Detection System meets stringent quality control and testing criteria at both the component and system level.

Rapiscan Systems maintains sales and service offices worldwide. If you have questions or need assistance with any Rapiscan Systems product contact one of the offices listed under ‘Service Departments’ see page 24 or ‘Sales Offices’ see page 25.

# 1.6 Regulatory Standards

All x-ray equipment, whether used for security, industrial applications or medical use, is subject to approval by the end user's National Regulatory Authority. The end user is responsible for applying for a license and obtaining approval to operate the x-ray inspection system.

These requirements may differ from requirements in your country. Make sure to check with the appropriate authorities in your area.

### European Community

The Ionizing Radiations Regulations 1999 were issued to comply with the European Community requirements outlined in the European Atomic Energy Community (Euratom) Directives on Radiation Protection. IRR99 applies to all work places in the EU where radiation equipment is used. Various sections of the document reference the customer's responsibility to personnel who work with or near x-ray equipment. (Ionizing Radiation is described in *Radiation Safety Requirements in 5-46*).

**Specific provisions of IRR99 are excerpted as follows:**

(a) IRR99, No. 6, Part 2, outlines the requirement for employers to notify the appropriate Health and Safety Executive, at least 28 days prior to installing radiation equipment or at such shorter times as may be agreed.

(b) IRR99 No. 31, mandates that new ionizing equipment or ionizing equipment that has been significantly modified, or moved to another location, undergo a critical examination of the installation to ensure safe operation and protection from exposure to ionizing radiation. Such examination should be under the guidance and consultation of an appointed Radiation Protection Supervisor (RPS).

(c) IRR 99, No. 17, Part 1, requires the customer to create a list of Local Rules to ensure that employees working with radiation equipment are fully aware of and adhere to work practices which comply with the requirements of IRR99. Part 4 states that the RPS shall take all responsible steps to ensure that relevant procedures identified in the Local Rules are observed.

(d) IRR 99, No 19, Part 1, requires the customer to identify the routine equipment checks that will ensure its ongoing operation and safety. Specifically, the customer must demonstrate how the requirements for checking the adequacy of x-ray shielding will be met.

## 1.6.1 United Kingdom

The United Kingdom requires that the surface radiation should not exceed 1µSv/hr (0.1mRem/hr) whereas other countries stipulate 5µSv/hr (0.5mRem/hr).

### 1.6.2 United States

The RTT110 meets the requirements of the United States Health and Safety Executive Statutory Requirement, Ionizing Radiation Regulations, No. 1333.

The RTT110 complies with CFR 21 Part 1020.40 of U.S. Food and Drug Administration, Performance Standards for Ionizing Radiation Emitting Products - Cabinet x-ray Systems.

# 1.7 System Design Standards

| Standard | Description |
|---|---|
| UL 61010-1 | Electrical safety |
| UL 60950-1 | Electrical safety, (IT equipment only) |
| IEC 61326-1 Class A | EMC |
| IEC 61000-6-2:2005 | EMC – Industrial Immunity |
| IEC 61000-6-4:2007 | EMC – Industrial emissions |
| IEC EN 61010-1 | Electrical Safety |
| IEC EN 60204-1 | Electrical Safety of Machinery |
| IEC EN 60950-1 | Electrical Safety, (IT equipment only) |
| FCC Title 47 CFR Part 15 | RF emissions (US) |
| UK Ionizing Radiations Regulations 1999 (IRR99) | X-ray safety (UK) |
| 21 CFR 1020.40 | X-ray safety (US) |
| CSA C22.2#61010-1:2004 | Electrical Safety, (IT equipment only) |
| 2004/108/EC | EC Directive for EMC |
| 2006/42/EC | EC Machinery Directive |
| 2006/95/EC | EC Low voltage Directive |

# 1.8 Diagnostics

The RTT110 Explosives Detection System includes extensive diagnostic facilities, commencing with a comprehensive power-on check procedure. Further details of the system diagnostics may be found in the RTT110 Maintenance Manual.

# 1.9 Options and Accessories

Rapiscan Systems has made available a wide range of accessories for use with x-ray machines to assist security personnel. Contact Rapiscan Systems Sales department for further details, see *Sales Offices on page 25*.

* The asterisk signifies features or equipment that are not included by default and are an additional option, that may involve additional costs or design.

# 1.10 Service Departments

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# 2 RTT110 System Overview

The following chapter provides an introduction to the RTT110 system and its capabilities:

# 2.1 RTT110 EDS - Overview

The RTT110 Explosives Detection System is a high speed baggage x-ray screening system used primarily to identify and highlight explosive threats concealed in baggage that requires security screening and clearing.

The RTT110 EDS is used in baggage screening systems, either within a complex airport Baggage Handling System (BHS) or as an individual point for example a screening check point.

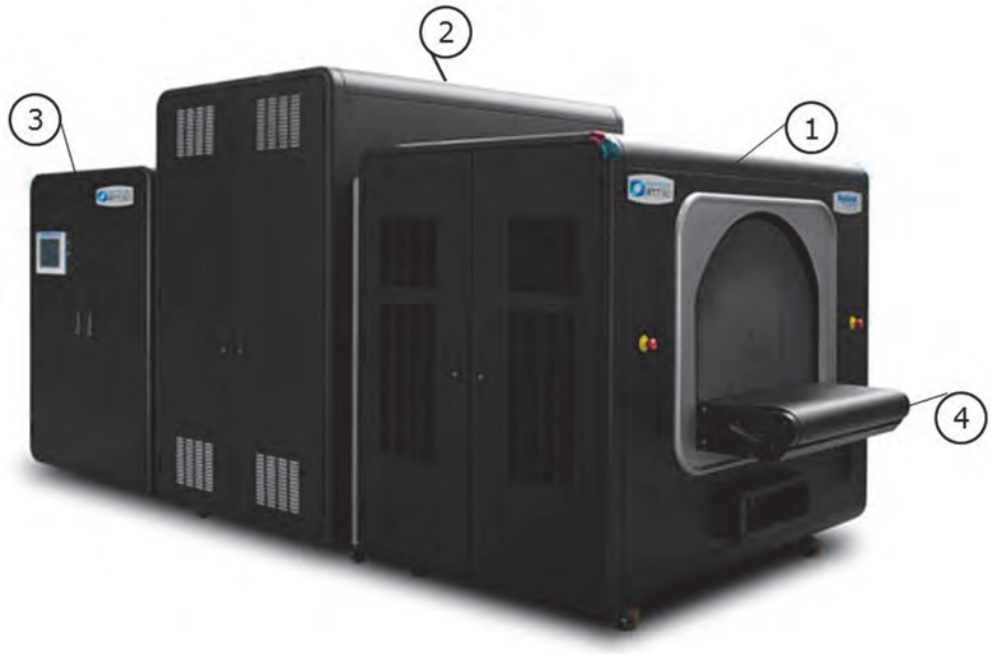



*Figure 1 RTT110 system, (x-ray scanner only)*

The below table contains details of the RTT110 system displayed in *Figure 1*:

| Number | Component description |
|---|---|
| 1 | **Entry Section:** The first section of the system to receive baggage, when in operation. |
| 2 | **Centre Section:** The centre section of the system, which houses the x-ray scanning equipment, receives bags from the Entry section (1) via the systems internal conveyor (4). |
| 3 | **Exit Section:** The Exit section the final section of the assembled scanner, where baggage exits from. |
| 4 | **Conveyor:** The systems conveyor used to moved the baggage along, through the scanners tunnel, through all three sections. |

A security screener fulfills the role of an Image Analyst (IA) by operating from an RTT Workstation. The bag scan images and 3D models are automatically sent to the Workstation and are viewed by the Image Analyst using the dedicated screening software - RTTVis.

The Image Analyst examines the bag scan views, both the cross sectional image & 3D model and either *Accepts* or *Rejects* the identified threats in a preset period of time using the RTT Workstation and RTTVis software.

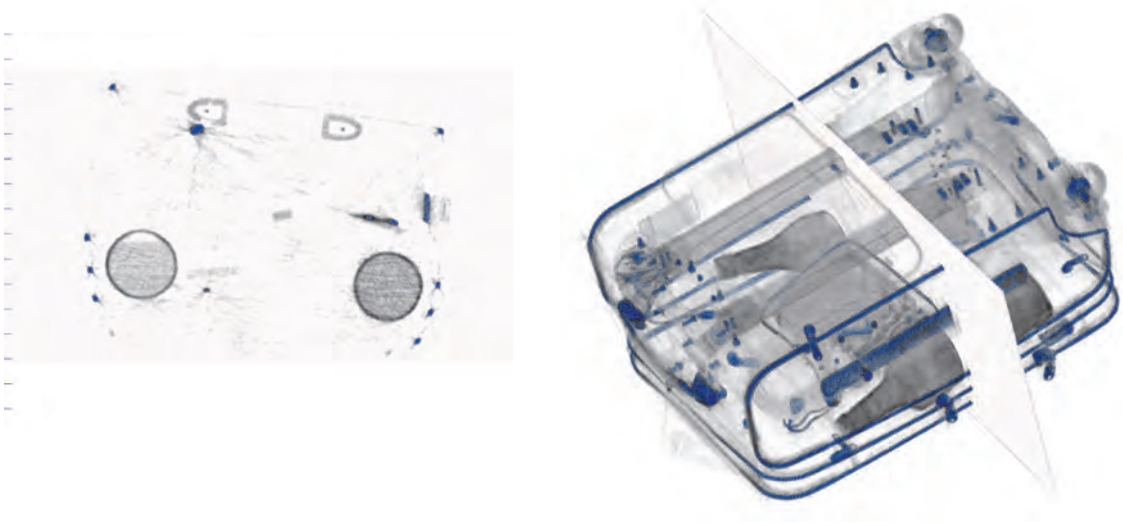


*Figure 2 RTT Bag Scan Image (left), and 3D Model (right)*

## 2.1.1 Basic Operation - Description

The screening method used during the baggage inspection stage is a safe, non intrusive inspection using a form of x-ray, Computed Tomography (CT).

The RTT110 system uses various computer systems and a non rotating x-ray generator to create detailed, 3D high resolution full volumetric maps of the bag and the contents contained within as it moves through the x-ray beam and exits the other end on the conveyor belt.

The images are processed by the on board computer systems in 'real time' using fast reconstruction algorithms to determine the presence and position of threats based upon context, material density, size, and effective atomic number. The results are compiled to produce a bag scan 3D image and an interactive rendered model (see *Paragraph 2.2*) indicating the possible highlighted threats.

### RTT110 Operation Sequence / Summary

#### System Start up (power on)

The system is started by an operator, and providing the User profile is approved the system starts up automatically and advises the operator when ready or at Standby.

#### Log in

To operate the RTT110 x-ray scanner an operator must log in using the Human Machine Interface (HMI).

#### Bag Image Views

To view bag images the operator must log in to the Operators Workstation, using the Security screening dedicated software called RTTVis.

#### Scan Sequence

- The exact method by which a bag enters the scanner will depend on the configuration of the machine (i.e. standalone or integrated in a baggage system)
- Once a bag enters the scanner it is detected by photo-electric cells and is imaged by a form of rotating gantry CT imaging system
- The image will be passed to the threat detection engine, part of the system and temporarily stored while being processed

### Automatic Bag Decision

- A threat detection algorithm will analyze each bag in turn
- Bags which have objects in them with properties consistent with threat materials or materials that can mask threat materials, will be identified and the bag will be rejected as a threat

### Operator - Screen Resolution (RTTVis)

Bags that need to be resolved by an operator will appear on a workstation.

- The operator will make a decision on whether or not a bag should be accepted and allowed to make its way to the aircraft and fly or be rejected for further screening
- The protocol and method by which the operator determines a bag to be an accept or reject may depend from location to location
- It is vital that the operator ensures the operating protocols to be used with the RTT110 system are clear before using

### Simple Trouble shooting

In the event that a bag becomes jammed or stuck in the system, it will be automatically detected. There are a number of conveyor reverse, jog and flush functions available for use if a bag jams. These are activated via the HMI.

In the event that these are used and the bag jam can not be cleared, then either "lock down mode" can be invoked or the E-stop pressed and bags can be manually cleared.

**WARNING!**

It is extremely important that no attempt is made to manually free jammed bags unless either of these methods is used as danger of death or serious injury could occur.

Only trained qualified personnel should operate the RTT110 system.

In the event of a system fault, errors and warnings will be visible on the HMI. The majority of faults will be detected by the system and a Fault message displayed in the HMI.

### Daily Test

The RTT110 is supplied with a test bag known as the OTK (Operational Test Kit).

The exact protocol applied will vary from installation to installation, however, it is typical that once the RTT110 system is started every day the daily test is conducted.

The OTK test function will be invoked from the HMI, the operator then follows the on screen instructions on the HMI, passes the OTK bag through the system and will be told by the HMI whether the RTT110 system is functioning correctly and is safe to operate as a screening device.

### E-stop Recovery

In the event of an E-stop being invoked the RTT110's conveyor system, high voltage power supply and x-ray generation will switch off immediately.

E-stops can be invoked by pressing the E-stop buttons on the four corners of the RTT110 scanner. E-stops may also be present on standalone scanner console desks and can be invoked by signals coming in from baggage handling systems or from external in-feed or out-feed conveyors if present.

See *E-stop Recovery in 10-152* for further information.

# 2.2 RTT110 Specifications and Operational Parameters

**Inspection**

| | *Metres (Inches)* |
|---|---|
| Inspection Tunnel Opening | |
| Width: | 1.02 (40.16) |
| Height: | 0.75 (29.53) |
| Conveyor Height: | 0.86 - 0.91 (33.86 - 35.83), configurable |
| Conveyor Belt Speed | 0.5 m/sec continuous |
| Bag Rate: | Up to 1800 BPH |
| Scan Mode: | Bag scan on automated conveyor |
| Scan Direction: | Forward only, Entry to Exit Module direction |
| X-ray Beam Orientation: | 360° to inspected object |

**System Configuration**

| | |
|---|---|
| Types: | Standalone |
| | BHS Semi Integrated |
| | BHS Fully Integrated (In-line) |

**Description**

| | |
|---|---|
| | Minimal Maintenance (no rotating Gantry) |
| | 3D High Resolution Full Volumetric Images |

**Deployment**

| | |
|---|---|
| System Start up: | <15 minutes |

**Imaging Performance**

| | |
|---|---|
| X-ray Energy: | 163 kV |

**Electric Power Requirements**

| | |
|---|---|
| Power Requirements (Overall): | <16kW |
| Current Rating: | 30A |
| RTT110 System: | 400 Volts, 50hz 3 Phase + Earth, (EU) |
| | 415 Volts, 50hz 3 Phase + Earth, (UK) |
| | 480 Volts, 60hz 3 Phase + Earth, (USA) |

**Environment** (Ambient Limitations)

| | |
|---|---|
| Temperature | |
| Storage: | between 0° and 50°C |
| Operation: | between 0° and 40°C |
| Humidity: | between 10% and 90%, Non-Condensing |
| | Altitude up to 2000m |

# 3 System Configurations

The following chapter describes briefly the possible RTT System installation configurations and network capabilities:

# 3.1 System Configurations - Overview

Following are several examples of how the RTT110 system can be installed and operated. The RTT110 system is designed for Hold Baggage Screening, there are numerous ways that hold baggage screening systems can be implemented, the exact configurations can vary form airport to airport and the exact screening protocols may vary between locations.

The examples that follow demonstrate some of the more common configurations, however the RTT110 system has been designed such that it is flexible enough to fit into virtually any hold baggage screening process and, due to its high throughput, it is possible that it will be deployed in ways that have not been used to-date.

## 3.1.1 Standalone Configuration


*Figure 1* RTT110 *Standalone Configuration - with Dedicated Workstation*

In this configuration the RTT110 is operated completely independently of any airport baggage handling system. Bag management is a manual operation, typically, the responsibility of the scanner operator. This type of configuration would typically be used for concourse deployments of the RTT110 or for out of gauge operations.

## 3.1.2 BHS Integrated - (Multiple Scanners & Workstations)

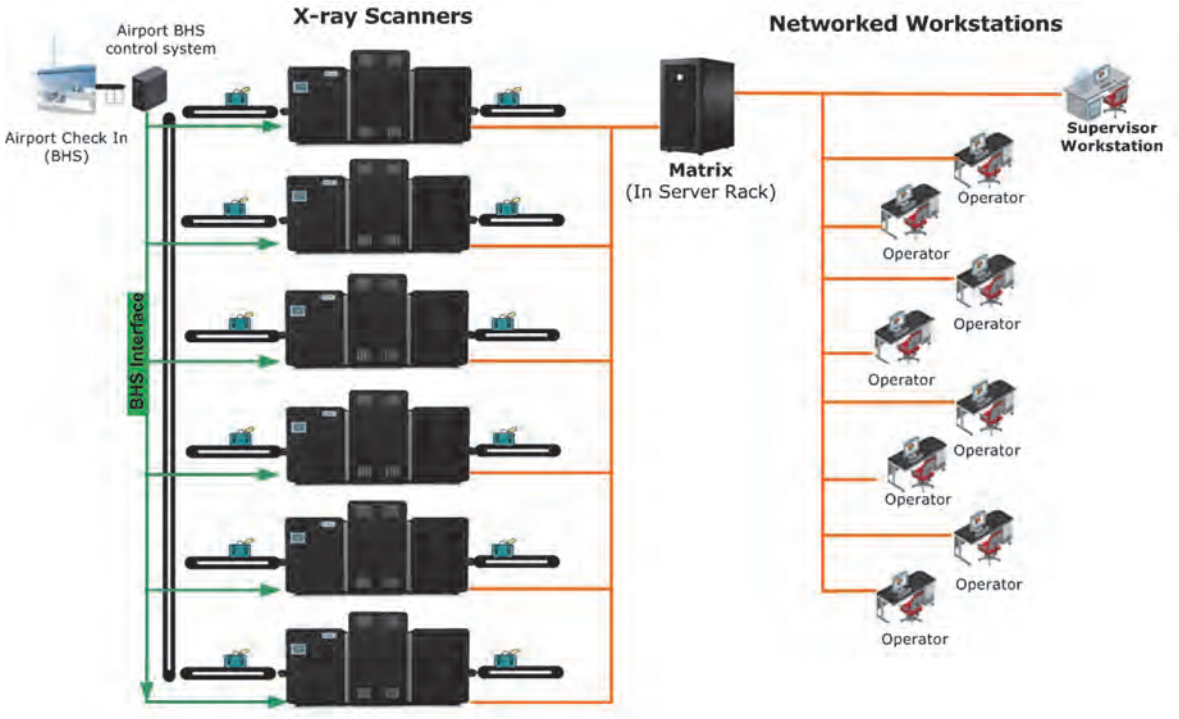



*Figure 2 BHS Integrated - Multiple* RTT110*'s Scanner with Multiple Networked Workstations*

In this type of configuration the individual RTT110's systems are integrated into baggage lines. The RTT110 scanners are typically interfaced with the baggage handling system's (BHS) control system such that the result for a bag can be sent after it has been;

- firstly, automatically screened by the RTT110
- and, secondly, been screened by an operator at the operators workstation using dedicated software (RTTVis)

The result of the bag screening process will typically be used to automatically divert bags that are deemed suspect such that they go for further screening rather than go directly to their destination aircraft.

In this configuration a number of operator workstations are supported. The operator workstations need not be close to the RTT110 scanners, instead, the operator workstations can be located hundreds of metres from the scanners. The results for scanners for multiple terminals could be processed in one location.

Images of bags that need to have decisions made on them will be queued, the RTT Matrix system will dispatch images to operators for processing as they become free.

Using this approach, the number of operators required can be optimized to the number of bags that need to be screened, regardless of the number of machines that are in operation.

### 3.1.3 BHS Integrated - (1 Scanner & Multiple Workstations)


*Figure 3 Single* RTT110 - *Integrated with Multiple Matrixed Workstations*

The RTT110 is specifically designed for high throughput, when running at its optimal throughput it is unlikely that a single operator would be able to resolve alarm bags at the rate at which the RTT110 system could process them.

With a system configured as illustrated, multiple operators can process bags from a single RTT110 scanner.

Rejected bags can be removed from the stream of commerce by automated divert units when the result of the screening process is communicated to the baggage handling system.

# 4 Warning & Cautions

The following chapter lists information regarding Warnings & Cautions to be adhered to whilst operating the RTT110 system:

# 4.1 Warning & Cautions - Overview

The Rapiscan RTT110 Explosives Detection System is equipped with both conventional safety equipment and radiation safety equipment. This equipment is designed to reduce the possibility of accidents and keep areas safe during x-ray operation.

To make the RTT110 as safe as possible to operate, the entire system must be operated and maintained in accordance with the supplied maintenance procedures and guidelines.

Operational and radiation safety are key factors during operation of the RTT110. It is important that all personnel be aware of the safety features, equipment, and procedures of the RTT110 System.

Information presented in this section highlights the special attention that needs to be paid in order to keep personnel safe at all times.

## 4.1.1 Definitions

**WARNING!**

Signifies a possible risk of injury or death.

**CAUTION!**

Signifies a possible risk of damage to equipment.

## 4.1.2 IMPORTANT NOTE

The warnings, cautions and instructions should be read and followed by all personnel and operators of this equipment. Failure to follow all warnings, cautions and instructions may result in damage to the equipment and/or injury or death to personnel. It may also nullify any warranties provided by the manufacturers.

When used in its intended manner this equipment is completely safe. To maintain this level of safety when maintenance is being carried out, special precautions must be taken.

**WARNING!**

Always follow these General Safety Considerations to ensure safe operations of the RTT110.

## 4.1.3 Machine Labeling

| | |
|---|---|
|  | **Radiation symbol**<br>This symbol indicates that the unit has components that emit X-radiation. |
|  | **High Voltage symbol**<br>This symbol indicates that hazardous voltages are present. |
|  | **Book symbol**<br>This symbol indicates that information should be written down in a report or repair ledger, etc. |
|  | **Warning / Alert symbol**<br>This symbol indicates a warning, alert, or important note. |
|  | **Alert symbol with Book symbol**<br>This symbol indicates that referenced manual(s) should be read. This may include manuals from OEMs. |
|  | **Earth symbol**<br>This symbol indicates that this is the safety earth point for the system, or a subsystem. |
|  | **Anti-Static symbol**<br>This symbol indicates that anti-static electricity precautions should be used to prevent damage occurring to components. |
|  | **CE Mark**<br>Is the official marking required by the European Community for all Electric and Electronic equipment that will be sold, or put into service for the first time, anywhere in the European community. |
|  | **UL Mark**<br>Is a mark showing compliance with the safety standards of Underwriters Laboratories Inc., an independent, not-for-profit product-safety testing and certification organization in the United States of America (USA). |

### 4.1.4 General Safety Considerations

To ensure that the safety and integrity of the system are maintained, the following precautions must be observed:

- Ensure that warning notices, lights and signals are installed and in good working condition before operating the system
- High Voltages and x-rays are present in and around the system. Do not remove any unit cover during operation
- Follow local regulations regarding the use of x-ray systems
- If the system is damaged such that it impacts the integrity of the radiation shielding, interlocks or any other component that controls or potentially affects radiation output, the system must be checked by Rapiscan Systems trained and authorized personnel with the appropriate radiation monitoring equipment before resuming operations
- When dangerous objects (e.g., explosives, guns or other weapons) are identified in the x-ray image, follow the procedure established at your facility to safely resolve such events
- If liquids are spilled on components or inside of the system, press an E-

**WARNING!**

Do not modify the equipment in any way. Do not touch the electrical wire terminals by hand or by conductive tool. Do not remove safety ground cables.

stop button and power down

### 4.1.5 X-ray Safety

While Rapiscan Systems are designed for completely safe operation, they do use x-rays, and caution is advised when performing maintenance operations.

If any part of the unit has been changed, the unit must be checked with an appropriate x-ray radiation monitor used by qualified personnel.

### 4.1.6 Technically Trained Personnel

Only authorized personnel trained by Rapiscan Systems are permitted to install, operate and maintain the RTT110 System. Do not attempt to install, operate, adjust or service the equipment without prior training and authorization from Rapiscan Systems.

Any maintenance or operational work carried out by any untrained or unauthorized personnel may result in invalidation of system Warranties.

### 4.1.7 Emergency Stop Switches (E-stops)

All operators of this equipment, and all maintenance personnel, must familiarize themselves with the Emergency Stop (E-stop) buttons and the location of related equipment.

See the following for further details Chapter *6 Safety Systems on page 55*.

### 4.1.8 Electricity

The x-ray system uses single and three phase high voltage mains supplies throughout. The x-ray equipment uses extremely high voltages. Serious injury or death can result from human contact with these voltages.

Do not work on live equipment. Ensure that the relative local or main power supply has been isolated before any maintenance is carried out.

Where mains supplies or equipment is isolated by key operation, ensure that the key is removed and carried about the person at all times while maintenance is undertaken.

# 5 Radiation Protection Fundamentals & Safety

The following chapter lists information regarding Radiation Safety requirements which must be followed whilst operating the RTT110 system:

# 5.1 Radiation Safety Requirements

The purpose of this chapter of the manual is to provide information about basic radiation fundamentals, written specifically for facilities with an installed Rapiscan Systems RTT110 system, and for personnel who will operate and/or maintain this radiation generating equipment.

**IMPORTANT:**

This chapter is not intended to be a substitute for a radiation safety course, which is required to be reviewed or administered by the appropriate radiation protection regulatory authority or their approved designee, or by the system manufacturer.

**WARNING:**

Radiation emitting devices are regulated machines which may require regulatory licensing or registration. It is the System Owner's responsibility to determine and/or obtain any required licensing or registration through the applicable radiation protection regulatory authority.

### 5.1.1 Safe Use & Operation

The RTT110 system is a machine specifically designed to generate x-rays in the low to medium keV energy region for use in security screening operations. This chapter provides requirements and guidance necessary to ensure the radiation risks associated with operating this x-ray system remains negligibly low (i.e., the same as the risks from unavoidable, natural background radiation levels). Specific responsibilities for the owner of the system, operator and maintenance personnel are provided, as well as, information on safety procedures, standards, surveillance and monitoring.

This approach is in accordance with the 1990 International Commission on Radiological Protection (ICRP) objectives (1) to prevent the occurrence of deterministic effects (those for which the severity of a biological effect increases with dose and for which a threshold may occur) and to reduce the incidence of stochastic (random) biological effects to acceptable levels.

X-rays are a form of electromagnetic ionizing radiation. While we know ionizing radiation can be harmful, the beneficial uses of ionizing radiations continue to be utilized in a variety of applications in medicine, industry, research and consumer products. Regulatory agencies worldwide recognize the widespread applications of ionizing radiation; the International Commission on Radiological Protection (ICRP) has recommended a system of radiological protection which, when followed, will ensure the risks from ionizing radiations remain low. In this context, x-ray inspection systems must be designed and constructed to conform with regulatory standards, and persons who install, use and maintain them must know the x-ray hazards inherent with such systems and adhere to recommended procedures.

If radiation risks are to remain low, personnel in every facility where x-ray systems are installed must maintain strict adherence to the responsibilities charged to them.

### 5.1.2 System Owner

The ultimate responsibility for the radiation safety of the x-ray inspection system rests with the owner. The system owner must ensure the x-ray system(s) meets all applicable radiation safety standards. In every facility where an x-ray inspection system is in use, the system owner or designee is responsible for:

- Ensuring the x-ray inspection system(s) is positioned in a location for its intended use
- Ensuring all operators and maintenance personnel have received training on the proper operation and x-ray radiation hazards relevant to the x-ray system(s) installed (prior to using the x-ray inspection system)
- Ensuring the training program is reviewed by the appropriate radiation protection regulatory authority
- Prescribing radiation safety guidelines, safe operating and emergency procedures, and making readily available a copy of these guidelines, procedures and applicable regulatory standards for use and reference by operators and maintenance personnel
- Implementing a method of verification, supervision and periodic review to ensure all operators and maintenance personnel have read and understood the relevant parts of the applicable guidelines, operating and emergency procedures, regulatory standards and operator and radiation safety training before operating the x-ray inspection system
- Establishing a maintenance program, taking into account the age and frequency of use of the x-ray inspection system, that ensures all safety devices and components critical to x-ray production and x-ray shielding are routinely checked and the defective parts replaced or repaired
- Ensuring trained maintenance personnel or designated contracted service engineer utilize a properly functioning and appropriately calibrated ionization-chamber or equivalent survey meter to perform radiation measurements when certain maintenance functions and other safety checks are required
- Conducting prompt investigations of all radiation incidents, accidents and/or unsafe events, and ensuring the results of this investigation, if applicable, are reported to the appropriate radiation protection regulatory authority and the manufacturer of the x-ray system
- Determining the appropriate corrective measures following radiation incidents, accidents and/or unsafe events and ensuring such measures are implemented effectively

### 5.1.3 System Operators

All operators of x-ray inspection systems must:

- Receive training, authorized by the system owner or designee, on the operation and x-ray radiation safety relevant to the x-ray inspection system(s) intended for use
- Demonstrate competence in the operation of the x-ray system and a working knowledge of safe operational procedures to the system owner or designee
- Read and understand all applicable radiation safety guidelines and proper operating procedures prescribed by the system owner or designee and by the appropriate radiation protection regulatory authority before operating the x-ray inspection system
- Secure the operation of the x-ray inspection system, if any radiation incidents, accidents and/or unsafe events occur and immediately notify the system owner or designee of such conditions; and
- Acknowledge persons who operate a x-ray inspection system are responsible for carrying out the work in a safe manner in order to ensure their own protection and that of others

### 5.1.4 Maintenance Personnel

All personnel responsible for the maintenance of x-ray inspection systems must:

- Attend and successfully complete a course, which:
  - is authorized by and acceptable to the system owner or designee or the system manufacturer
  - covers the operation, maintenance, repair and x-ray radiation safety hazards relevant to the x-ray inspection system(s); and
  - has the x-ray radiation safety part reviewed or administered by the appropriate radiation protection regulatory authority or the manufacturer
- Provide the system owner or designee with an explicitly written report of any imminent or foreseen user and/or operator procedure or action that can cause a radiation accident and/or unsafe event as soon as such a procedure or action is identified
- Respond and investigate promptly all user and/or operator reports of the x-ray inspection system malfunctions, device and component failures, emergencies, etc., and resolve the problem(s) satisfactorily before the x-ray inspection system is used; and
- Acknowledge maintenance personnel are responsible for carrying out the work in a safe manner consistent with the guidance presented in this section in order to ensure their own protection and that of others

## 5.1.5 Installation Requirements and Commissioning Tests

X-ray inspection systems must be used in a manner that will minimize the number of people in close proximity so as to lower the possibility of external x-ray radiation exposure. The following recommended requirements should be applied to all facilities:

- Every x-ray inspection system should be located in such a way that under conditions of normal use, individuals whose baggage (or other materials) is to be screened with the x-ray inspection system should be more than 1-2 feet away from the access openings of the access port openings while the x-ray beam is on; and members of the general public, excluding staff authorized to work with or near the system and those individuals whose baggage (or other materials) is to be screened, should be more than 4-6 feet away from the x-ray inspection system
- Every x-ray inspection system must be thoroughly tested and verified by trained personnel to ensure all radiation emitting critical components and safety devices, including warning lights and emergency stops, are installed and functioning, before the x-ray system is commissioned for use

## 5.1.6 Surveillance and Maintenance

The reliability and safety of any x-ray system decreases with age and use because of component wear. To ensure safe and reliable operation after x-ray inspection systems are installed, the system owner or designee must establish and enforce a suitable maintenance program that accounts for the age and frequency of use of that system.

### Surveillance Guidelines

Subsequent to the commissioning tests and before any x-ray inspection system is used; trained personnel must undertake the following procedures:

- Test, verify and document all safety devices (interlocks, switches, warning lights, indicators, and emergency stops) are functioning as intended
- Examine and verify all radiation shields (access panels, lead drapes, shrouds, etc.) are free from structural damage that could compromise barrier protection
- Verify the x-ray inspection system is not exposed to snow or rain, that liquid-filled containers are not placed on top of the x-ray system, and warning signs at the access openings of the access port openings, including the x-ray "ON" lights, are in clear view

## Maintenance Guidelines

It is not possible to provide guidance in this section for all scenarios that could cause unsafe events. When such events occur, the guidelines below should be followed:

- Moving and/or relocating an x-ray inspection system can affect components critical to safety. If an x-ray inspection system is moved and/or relocated, maintenance personnel and/or other qualified contracted service engineers must observe the following procedures:
  - Test and ensure all safety interlocks are functioning properly as intended by design
  - Examine and ensure all radiation shields are free from structural damage (i.e., puncture, hole, dent, missing part)
  - Conduct the normal in-beam quality imaging-tests and, if discrepancies exist, investigate the x-ray tube assembly, the collimator setting, and the radiation exposure parameters (tube current, high voltage, filters, etc.) for possible causes; and
  - Ensure all problems are resolved satisfactorily before the x-ray inspection system is used

**Note:** Moves of a few feet may not warrant all these procedures. If an ionization-chamber survey meter or equivalent is used for performing in-beam quality imaging-tests, the average meter readings should be compared with those taken before the x-ray inspection system was moved.

### 5.1.7 Radiation Protection Surveys

A radiation protection survey is intended to establish that the x-ray inspection system functions according to applicable performance standards and is used and maintained to provide maximum x-ray safety to all individuals.

- X-ray inspection systems must be surveyed regularly. While the frequency of surveys depends on the regulatory jurisdiction in which the x-ray system operates, the minimal survey frequency must be **Annually**. In some States in the US, the minimum survey requirement is **Quarterly**. The owner is responsible for determining the regulatory required minimal radiation survey requirements
- Surveys must be performed by trained personnel familiar with the type of radiation survey meter to be used, the use and limitations of the survey meter, knowledge of the applicable regulatory performance standard limitation for radiation emission leakage, and by trained personnel who possess an understanding of the units of measure and the meaning of the results of the survey
- Survey reports must include an identification of the x-ray inspection system revealing the system manufacturer, brand name, model number, serial number, operating parameters (i.e., kvP and mA x-ray tube settings) and year of manufacture
- After an x-ray inspection system has been decommissioned, all reports of surveys, accidents, radiation exposure incidents and x-ray system misuse must be retained for a period of at least three years by the system owner or designee at the facility at which the x-ray inspection system was last operated

### 5.1.8 Safe Operating Guidelines

- Even though operational x-ray inspection systems may conform to the requirements set out in the applicable regulations (e.g. FDA 21CFR1020.40) and preventive maintenance programs ensure safety and reliability; improper use may lead to unnecessary external x-ray exposures and accidents. To reduce this possibility, the following minimum guidelines apply to all facilities utilizing x-ray inspection systems:
  - No person must commit any acts that cause unsafe events on an x-ray system when it is in operation. Lifting the lead drapes for any reason when the x-ray beam is ON, or exposing any part of the body to the x-ray beam, or covering the x-ray ON lights or x-ray warning signs are examples of unsafe events. Appropriate written safety warnings must be legible and in clear view at the point where items are initially presented for x-ray screening
  - No person must create physical or mechanical conditions that ultimately make the x-ray inspection system unsafe to operate. Defeating safety devices, placing liquid-filled containers on an x-ray inspection system and operational test functions, and positioning x-ray inspection systems for use in areas exposed to rain or snow are examples of hazardous conditions
  - Operators and maintenance personnel must forbid unauthorized individuals from remaining near an x-ray inspection system longer than is warranted

# 6 Safety Systems

The following information explains the RTT110 safety features:

# 6.1 Safety System - Overview

The RTT110 system is manufactured to applicable US, European, and international standards and local regulations. The control system provides required interfaces with the safety subsystem, which includes;

- exterior warning lighting
- audible warning alarms
- safety devices/circuits
- emergency stop (E-stop) buttons
- safety interlocks

## 6.1.1 Safety Approval

The RTT110 system has been built to comply with the following safety standards:

**CE Mark**

For EU customers the RTT110 system is labeled with the CE mark.

**UL Mark**

For US customers the RTT110 system is labeled with the UL mark.

| Standard | Description |
|---|---|
| 61010-1 | Electrical safety |
| 60950-1 | Electrical safety, (IT equipment only) |
| FCC Title 47 CFR Part 15 | RF emissions (US) |
| UK Ionizing Radiations Regulations 1999 (IRR99) | X-ray safety (UK) |
| 21 CFR 1020.40 | X-ray safety (US) |
| 2006/42/EC | EC Machinery Directive |
| 2006/95/EC | EC Low voltage Directive |
| CE Mark | Product complies with EU standards |
| UL Mark | Product complies with US standards |

For the System Design Standards, refer to *System Design Standards on page 21*.

## 6.1.2 Safety Features

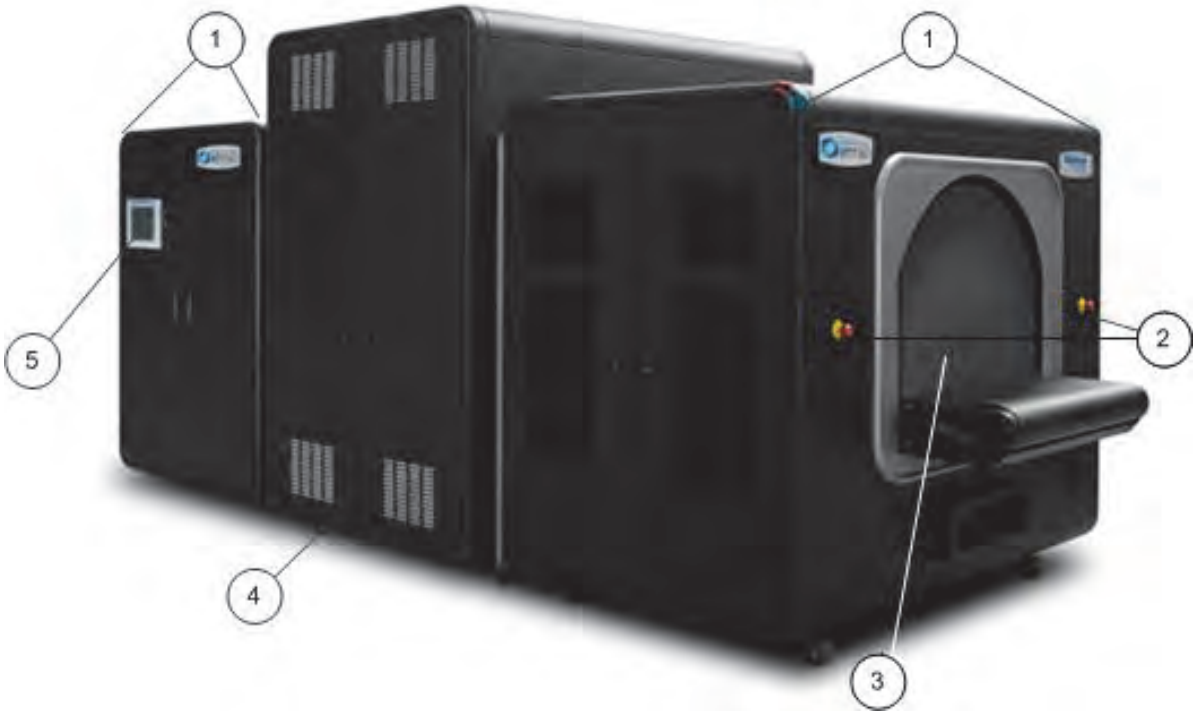



*Figure 1 RTT110 Safety Features*

**1 - Safety Lamps, X-ray & Power ON**

Located at the Entry and Exit section top corners. Two lamps indicate when the scanner is in operation, (the Exit section safety lamps are not displayed) - see *Safety Lamps on page 59*.

**2 - Emergency Stop (E-stop) Switches**

E-stop buttons near all 4 corners of the machine enable immediate manual
shutdown of the x-ray generator and conveyor movement. (The Exit section E-stop buttons are not displayed) - see *Emergency Stop (E-stop) Switches on page 61*.

**3 - Leaded Curtains**

Within the entrance and exit sections, curtains limit the amount of radiation that can be scattered out of the tunnel openings - see *Lead Curtains on page 63*.

**4 - Safety Interlocks**

Located internally, see *Safety Interlocks on page 64*.

**5 - Human Machine Interface (HMI) & key access**

The HMI built into each RTT110 x-ray scanner can located in the exit section door and prevents unauthorized access/control - *HMI & Key Access on page 62*.

## 6.2 Warning Alarms

The alarms advise the operator and people in the nearby vicinity, of the following conditions or a change in condition;

- When the scanner is in normal operation, see *Safety Lamps on page 59*
- In specific mode, for example Start Up, or Shut down (off-line)
- If a fault occurs, for example a Bag jam or an E-stop activation

The RTT110 has three (3) forms of alarm used to report the current status of the scanner or warn audibly, if a fault occurs, which are;

- Safety Lamps
  A twin lamp assembly - one side illuminates red and the other green, see *Safety Lamps on page 59*
- Alarm Sounder
  An audible alarm, fitted internally within the scanner sounds in certain fault, mode conditions - see *Alarm Sounder on page 60*
- Human Machine Interface (HMI) - Faults (Current and History)
  A message in the form of a pop up window appears in the HMI display screen, see *Faults in 7-93*

### 6.2.1 Safety Lamps


*Figure 2 RTT110 Safety lamps, Power On lamp illuminated*

There are two lamps fitted to each corner of the system, and the lamps illuminate according to the mode or function that the system is currently performing;

- **'Power On' lamp (Green)**
  The green lamp illuminates constantly when the system has been powered up (switched on) and is ready to operate, or is in actual operation - though no x-rays are being produced
- **'X-ray On' Lamp (Red)**
  The red light illuminates constantly to indicate x-rays are being produced, during normal operation

### 6.2.2 Alarm Sounder

As a general safety measure a single tone audible alarm sounder is incorporated into the RTT110 x-ray scanner. The alarm will sound if the following modes or conditions to the RTT110 scanner occur;

- Alarm, sounds with a slow pulse
  Indicates the systems status is Critical which prevents the system from running in normal operation. The audible alarm is only active (heard) for the initial 10 seconds
- Alarm, sounds with fast pulse
  Indicates when the scanner is in normal operation and starts an auto calibration mode, it beeps (sounds) shortly until calibration is finished

### 6.2.3 Emergency Stop (E-stop) Switches


*Figure 3 RTT110 Emergency Stop (E-stop) switch*

There are four emergency stop switches, each located near to a corner of the machine.

To activate an E-stop, push the red cap inward. The conveyor and x-ray generators stop. If processing is interrupted during a scan, an incomplete image may result. Bags in the tunnel when the conveyor stopped are not analyzed and are automatically rejected by the system.

The emergency stop switches cut the power for the motor and disables the conveyor. X-rays are also turned off.

### 6.2.4 HMI & Key Access

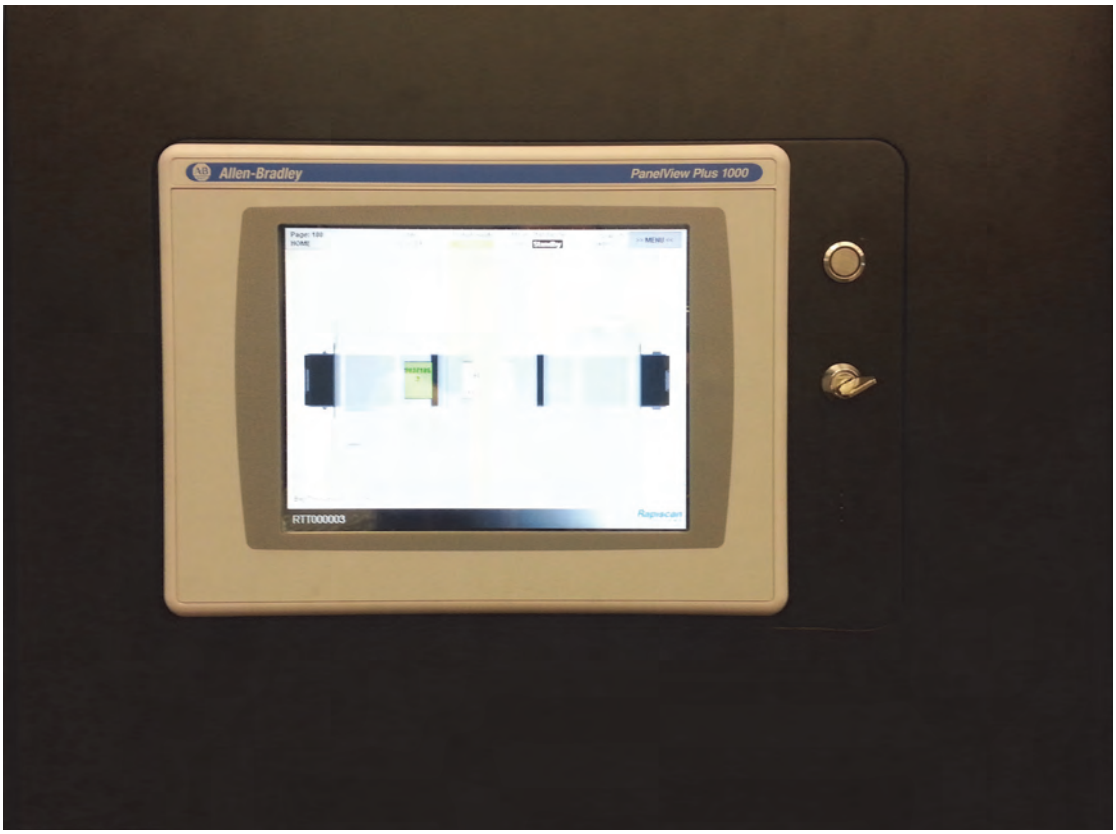



*Figure 4 RTT110 security features, Human Machine Interface (HMI), and key start switch*

Power up of the RTT110 x-ray scanner unit requires key access as shown above, providing additional security by preventing unauthorized operation of the equipment.

Both a key, and a preconfigured User account are required to connect, log on to the RTT110 x-ray scanner.

A further additional level of security is provided by the Human Machine interface (HMI), once the system is powered up, the HMI starts and requests the following information before any user access or controls are available.

- User Name
  Operator must enter a pre-configured User Name as part of the logon process, so the HMI recognizes the operator and can allow the relevant user access levels
- Password
  A password must be entered at the same time, with the relevant User Name

### 6.2.5 Lead Curtains

*Figure 5 RTT110 Safety feature, lead curtain*

Lead curtains are situated at the Entry and Exit sections of the RTT110 scanner, either end of the conveyor tunnel and help prevent any radiation being released along the length of the system's tunnel and out to the operating environment.

The lead curtains are flexible enough to allow baggage to pass through and into the scanner assembly, yet drop back into place and prevent any radiation passing through.

### 6.2.6 Safety Interlocks

Each x-ray door, located inside the centre section fitted to limit x-ray emissions during operation, has an active safety interlock.

If either of the x-ray doors which are lead lined, are opened the safety interlock is activated and turns off the power to the x-ray generator, preventing x-rays from being produced.

**Note:** Activation of the x-ray door safety interlock, (a safety interlock event), stops both the x-ray beam and conveyor operation.

In addition to the x-ray door safety interlocks, there is also a High Voltage Power Supply (HVPS) safety interlock that prevents system operation, unless the HVPS cable is installed correctly.

# 7 RTT Control System (PLC)

The following information describes the RTT Control System, and the available controls and options:

# 7.1 RTT Control System - Overview

The RTT Control System is fundamentally a Programmable Logic Controller (PLC) used to control various systems and subsystem processes, enabling the RTT110 to function efficiently.

The PLCs are used at multiple points throughout the system to control and coordinate the operation of individual components in order to automatically perform multiple processes.

Besides automating control of system and components, the RTT Control System provides an interface for Operators (humans) to interact, or control the system manually - through the use of a Human Machine Interface (HMI).

The RTT Control System provides extensive features, the following functions and controls listed below are a brief summary;

- system Start up and Shut down control
- secure local control of scanner, for qualified personnel
- defines operational status (Mode, State and System Health) during operation
- safety system - monitoring/reporting
- system condition - monitoring/warnings
- bag information (Bag ID, Bag tracking etc)
- BHS communication
- system tests (OTK & Radiation Survey)

## Start up & Shut down

The RTT Control System manages both Start up (switching On) and Shut down (switching Off) processes automatically without any operator control during either stage, once either of the options has been selected and started by an approved Operator.

The below briefly describes each process and function the Control system applies;

### Start up

When an operator starts the RTT110 scanner, the Control system automatically runs a 'start up process' and ensures the following;

- Powers up all internal subsystems, including all on board computer systems that control the RTT110
- Ensures the system is safe for operation through communications with the Safety system circuits & controls
- Brings the System up to operational state and temperature
- Informs the operator when the system is ready for operation

### Shut down

When an operator switches off the RTT110 EDS, the Control system automatically runs a 'shut down process' to ensure the following;

- The x-ray generator system is shut down in a safe manner
- Cooling is maintained whilst subsystems shut down gradually, to prevent heat soak
- All computer systems are shut down gracefully, in a controlled manner, preventing data loss or corruption

See *Chapter 10 Basic Operations, RTT110, Switching ON & OFF on page 125*.

## User Level & Access

**CAUTION!**

Only trained qualified personnel should operate the RTT110 system.

Before an Operator controls the system, access to the RTT Control system must be granted. This is achieved by *Logging In* to a pre-configured User Account stored in the Matrix Network Server using the HMI touch screen.

Various levels of User Access can be configured, to offer specific User accounts, which in turn enables different levels of users to access the system, which have different system responsibilities/roles, for example a basic User or a Supervisor.

Numerous access levels are supported and each level up is a super-set of the previous level in terms of gaining access to functionality.

**Note:** That the same User Access levels are used for accessing Matrix functions at the Matrix Control station.

See *Login on page 85*, for details.

See also *Chapter 10 Basic Operations*, *HMI - Logging In/Out on page 135*, for further details.

## Mode, State and System Health

The RTT Control system defines Operational Mode (system behavior), State and System Health, these are constantly displayed at the top of HMI display in the *Status* toolbar.
The following tables describe Status toolbar conditions;

### System Health Conditions

| System Health | Description / meaning |
|---|---|
| OK | All subsystems operating within normal limits. |
| WARNING | One or more subsystems is operating outside normal limits but within acceptable limits. Scanning will continue. |
| Critical | One or more subsystems are operating outside acceptable limits. Scanning has stopped. |
| Critical/E-stop | An E-stop has been activated (pressed). |
| TRANSIENT | During startup or shutdown one or more subsystems are out of operational parameters. |

**CAUTION!**

Contact Rapiscan Systems if the System Health Indicator continues to display ***Critical***.

Only trained qualified personnel should operate the RTT110 system.

### Modes

The RTT110 scanner can operate in one of the following modes:

| Mode | Description / meaning |
|---|---|
| Standalone | The scanner is not integrated with a BHS, a standalone workstation is sited next to the scanner for image analysis/resolution. |
| BHS | The scanner is fully integrated with a BHS. |
| BHS Semi Integrated_MU | The scanner is semi-integrated with a BHS. Bags are automatically loaded into the scanner but manually unloaded. |
| BHS Semi Integrated_ML | The scanner is semi-integrated with a BHS. Bags are manually loaded into the scanner. |
| Test, OTK Daily | Daily test mode to confirm scanner operation. |
| Pass Through | Bags pass through the scanner without being scanned. |
| Test, Radiation Survey | Period test mode used to evaluate x-ray emissions. |
| Conditioning | The RTT control system is carrying out an x-ray generator conditioning operation. It can only be invoked if the system is in the Standby state. |

See *States on page 71*, for further details.

See also, *Status & Control Indicators on page 77*, for further details.

### States

Within any *Mode*, the scanner can be in any of the following *States*:

| State | Description / meaning |
|---|---|
| Standby | No bags are being scanned, but the scanner is otherwise ready to operate, providing *System Health* is not *Critical*. |
| Scanning | Bags are being scanned. |
| Calibration | The scanner is calibrating. |
| Start Up | The scanner has started but is not yet ready for scanning. |
| Shut Down | The scanner is shutting down. |
| Lock Down | X-rays cannot be emitted and no moving parts will move. |
| Power Off | The scanner is off but not isolated from mains power. |
| Low Power | The scanner is on but major subsystems have been turned off to save power. |
| Power Loss | Mains power has been interrupted, the scanner is running on the internal UPS. |

See *Modes on page 70*, for further details.

See also, *Status & Control Indicators on page 77*, for further details.

### Safety systems, monitoring / reporting

The Control system monitors and reports the current condition, or any change in the Safety system, which covers:

- Safety E-stops, located on the Entry Section
- Safety E-stops, located on the Exit Section
- Safety Interlocks, located on the Centre Section

If any of the above are activated the condition will be indicated in the *Status bar* on the HMI display.

### General system, monitoring / warnings (faults)

The Control system monitors the complete system and subsystems for any faults, or items that operate outside their relevant specification - see below for examples:

- Conveyor Bag jams
- Cooling systems overheating
- Ambient conditions exceed acceptable limits
- A loss of communications with Matrix or BHS, depending on installation type

Depending on the type of fault that appears, the operator will be notified of the possible fault using one of the following methods;

- Current Fault Menu
- HMI Status toolbar
- Message Menu

### Bag information

The Control system can provide the operator with information with the following Bag information during normal operation;

- Bag information - Bag IDs of bags on conveyor
- Bag History View - Bags Acceptable & Abandoned
- Performance Data - Operational statistics
  Bag Throughput (Bags Per Hour)
  Bag Decision (Cleared/Failed)

### System tests

The Control system is used to perform specific systems test to regulate and ensure accurate operation, see below;

- Operational Test Kit (OTK)
  A test mode used to confirm the scanner is operating within acceptable performance limits
- Radiation Survey Test
  A test mode to used to confirm if the scanner surface radiation levels are within required Health & Safety specified limits

For further details see *Chapter 10 Basic Operations*, *System Test Procedures on page 156*.

## 7.2 Human Machine Interface (HMI)


*Figure 1 RTT110 - Human Machine Interface*

The Human Machine Interface (HMI) provides local control of the scanner, for qualified personnel as it enables Operators to interact, view and control operation of the RTT110 system through screen menu options displayed.

This is located in the Exit section of the RTT110 system and is one the major parts of the Control system.

**CAUTION!**

Only trained qualified personnel should operate the RTT110 system.

### 7.2.1 HMI - Start up page

The Start up page is present once the RTT110 system has completed its start up cycle, after being switched on/activated.

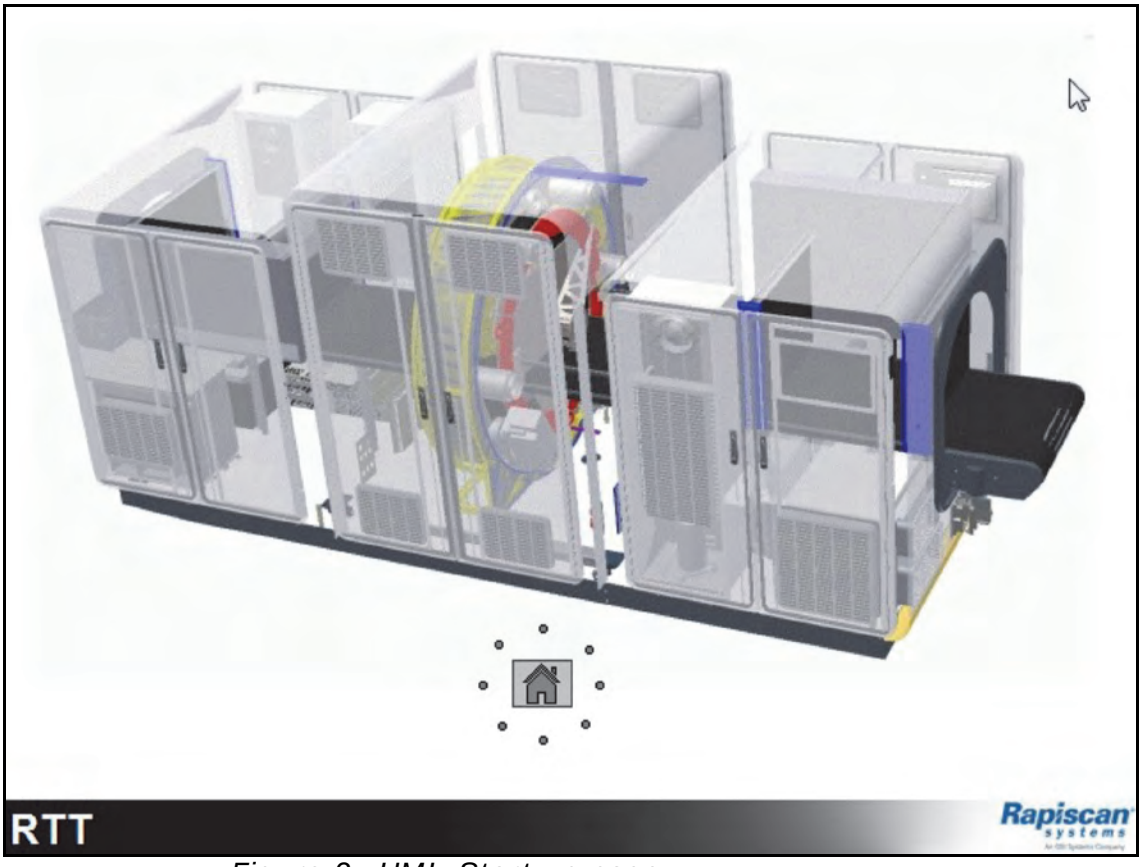



*Figure 2 HMI, Start up page*

### 7.2.2 HMI - Home page

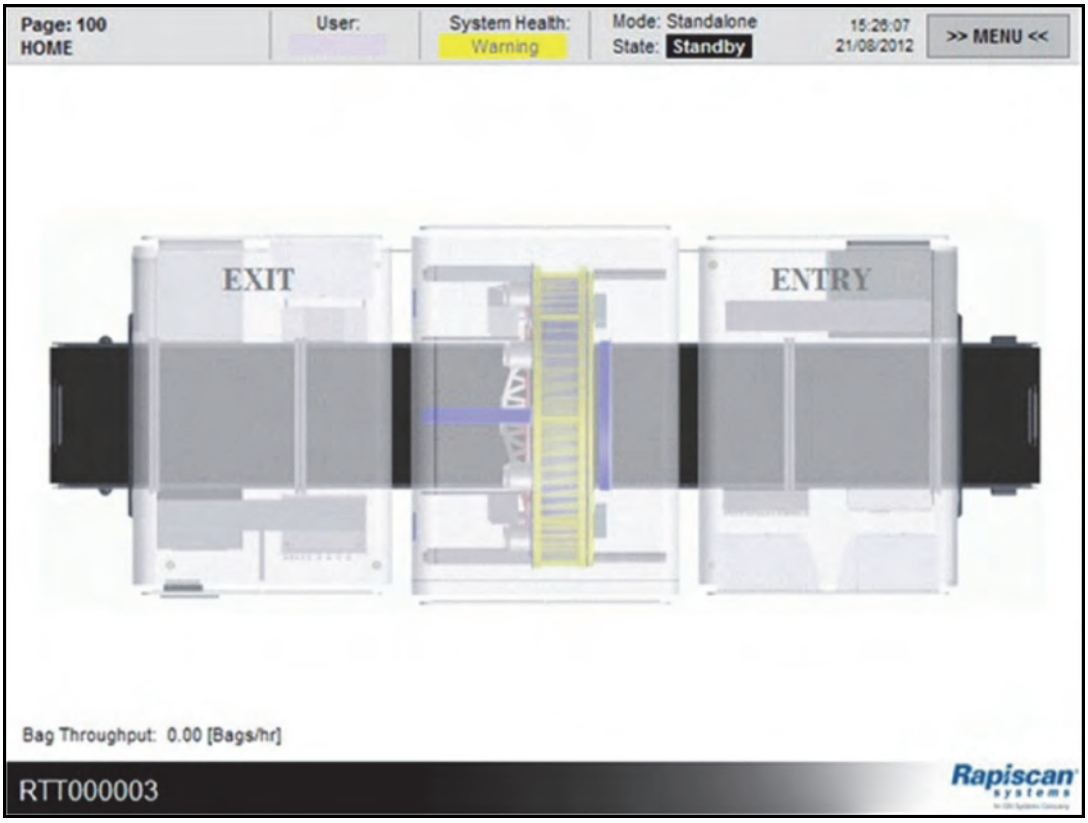



*Figure 3 HMI, HOME page*

Select the *HOME* button on the Start up page, to access the HOME page.

The HOME page provides various functions for an Operator's interaction, see below:

- Constantly displays the current operating status (health) of the RTT110 and subsystems, and keeps the operator up to date
- Provides the operator the ability to launch, navigate additional HMI Menus, or control Options via the *MENU* button
- Displays current Bag status, using an animated (moving) graphic

The HMI is simple to use and interact with, once located. To use, view display, select any option(s) on display by pressing the HMI touch screen.

### Status & Control Indicators

The Status Indicator toolbar is located at the top of every HMI page. The toolbar constantly displays information for the Operator, informing them of the status of the system.

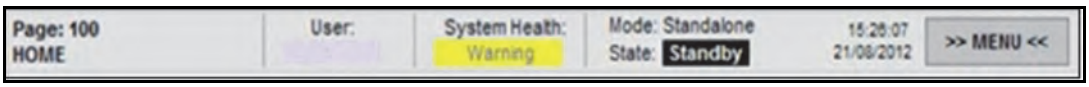


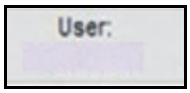

*Figure 4 HMI - Status Indicator Toolbar*

The following listed below is an explanation of the Status Indicators & one control options available from the *HMI HOME* page:

**Page:**

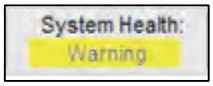

Displays the HMI Page number 100 in this example, and the relevant HMI Page Title/name HOME.

**User:**




Displays the current User logged in (connected) to the HMI and in control of the system.

**System Health:**




Displays the current Health condition of the system, see *Mode, State and System Health on page 69*.

**Mode:**


Displays the current Operating Mode that the system is operating in, see *Mode, State and System Health on page 69*.

**Time / Date:**


Displays the current time and date.

### HMI Home page

The Home page represents the quantity and flow of baggage being scanned and displays the following data;

- Current bag throughput
- Bag ID
- Real-time bag decisions

**Menu button:**


The *Menu* button is located on the far right of the *Status* toolbar, on the *HMI HOME* page.

When selected (pressed) the *HMI Page Navigation Menu* appears on top of the *HOME* page to provide access for the Operator to further system control settings, see *HMI - Page Navigation Menu on page 79*.

### 7.2.3 HMI - Page Navigation Menu

Select the *MENU* button on the *HMI HOME* page to access the *Page Navigation Menu*. All pages are accessible from here.

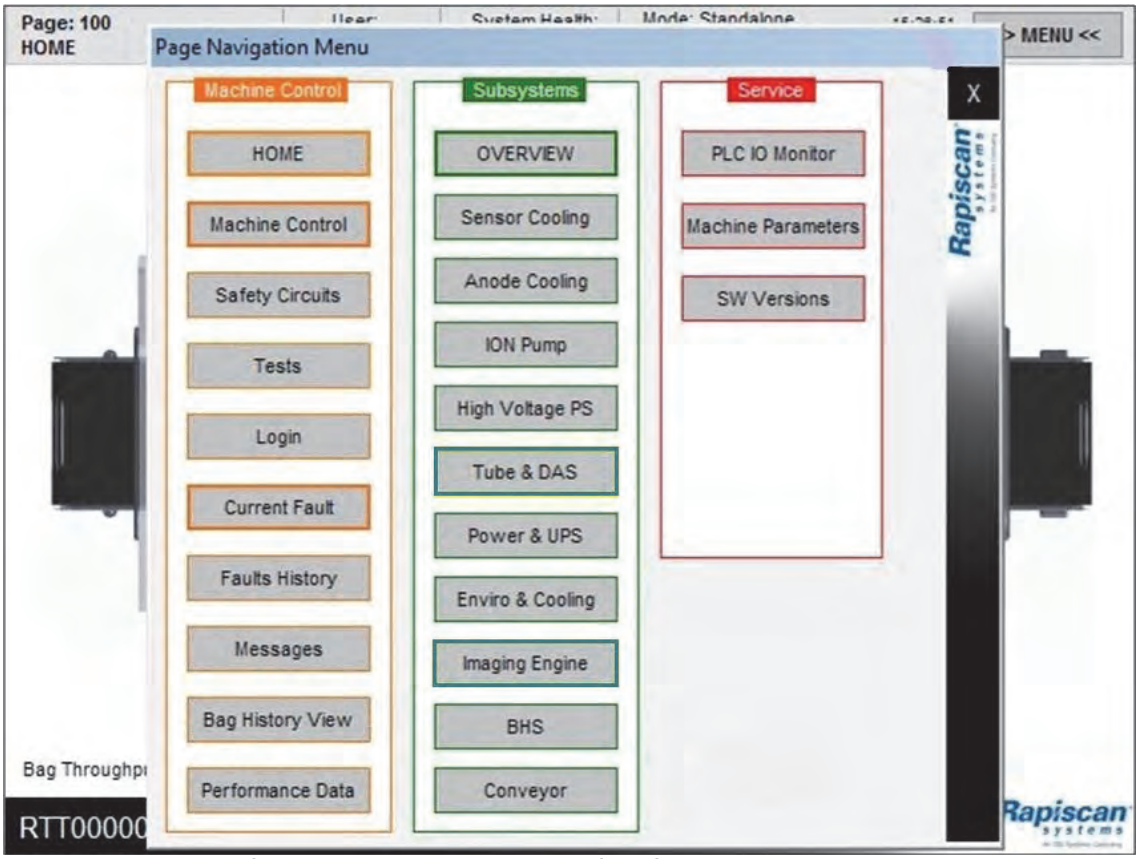



*Figure 5 HMI, Page Navigation Menu*

**Machine Control toolbar:**
Enables the Operator to access, and review operation & performance of the RTT110 scanner.

**Subsystems toolbar:**
Enables the Operator to access individual subsystems of the RTT110 scanner, to monitor or control various subsystem features.

**Service toolbar:**
Enables the Operator to access Service options during scheduled maintenance and test procedures.

## 7.3 Machine Control Toolbar

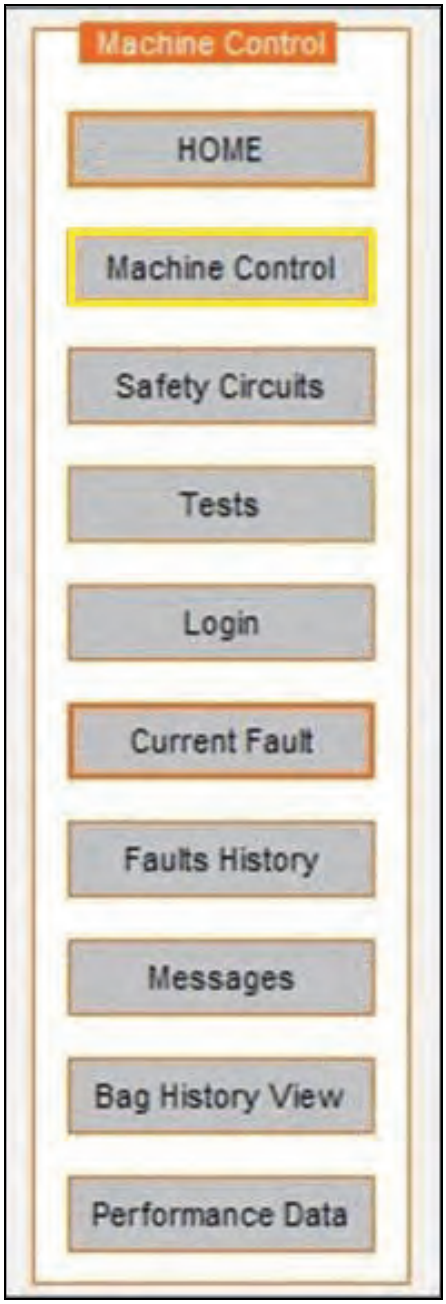



*Figure 6 HMI Page Navigation Menu, Machine Control toolbar*

## 7.3.1 Machine Control Toolbar, Options

The below explains the following Operator options, the *Machine Control* toolbar. To see a brief summary of all the available options, see *Machine Control Toolbar on page 80*.

### Home

The *HMI HOME* page is the default page displayed on the HMI screen during normal operating conditions, see *HMI - Home page on page 76*.

## Machine Control

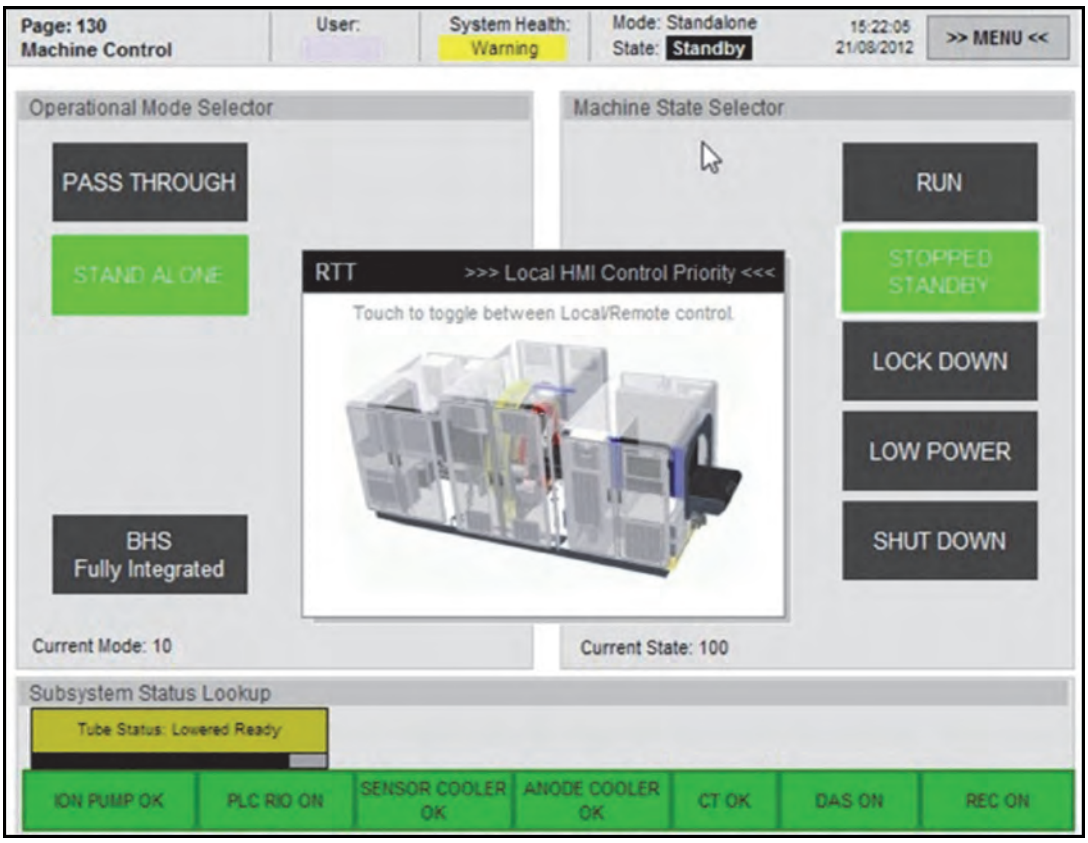



*Figure 7 HMI, Machine Control toolbar, Machine Control page*

To start the *Machine Control* page, select and press the *Machine Control* button from the *Machine Control* toolbar on the *Page Navigation Menu*.

The *Machine Control* page displays and provides two (2) major options for the operator when selected - see below:

### Operational Mode Selector

On the left side the Operator can request from the *Operational Mode Selector* field, options such as Pass Through, Stand Alone - general scanner mode settings.

### Machine State Selector

On the right side the Operator can request from the *Machine State Selector*, such as Run (Scanning), Stop/Standby etc.

**Note:** Certain states, or options are not accessible for all operators.

## Safety Circuits

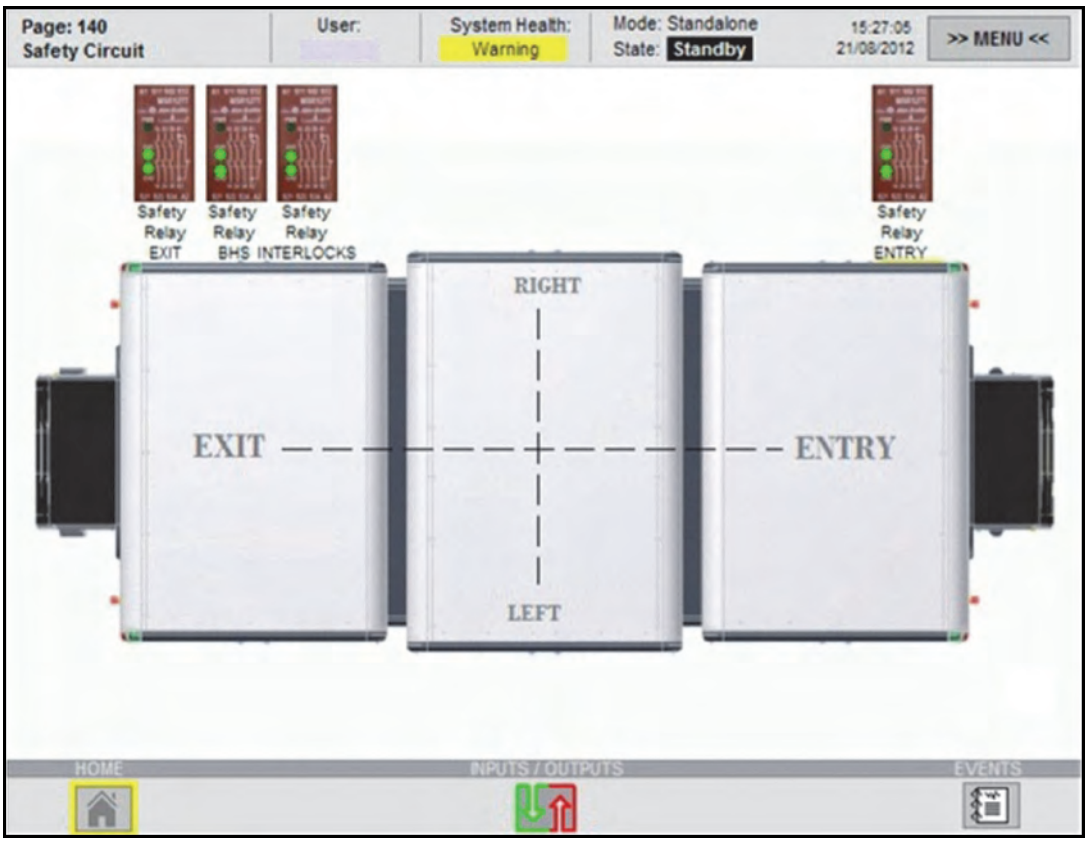



*Figure 8 HMI, Machine Control toolbar, Safety Circuit page*

The *Safety Circuit* page allows the operator to review the current safety circuit status.

It enables the operator to visualize which safety circuit (or device) is preventing the safety circuit being reset.

The *Safety Circuit* page displays the following safety circuits, with their relevant features;

- opened doors (all)
- E-stop buttons, activated
- safety interlocks, for scanner centre section
- BHS E-stop buttons, activated

The *Safety Circuit* page can be displayed by pressing the *Safety Circuits* button on the *Machine Control* toolbar.

## Tests

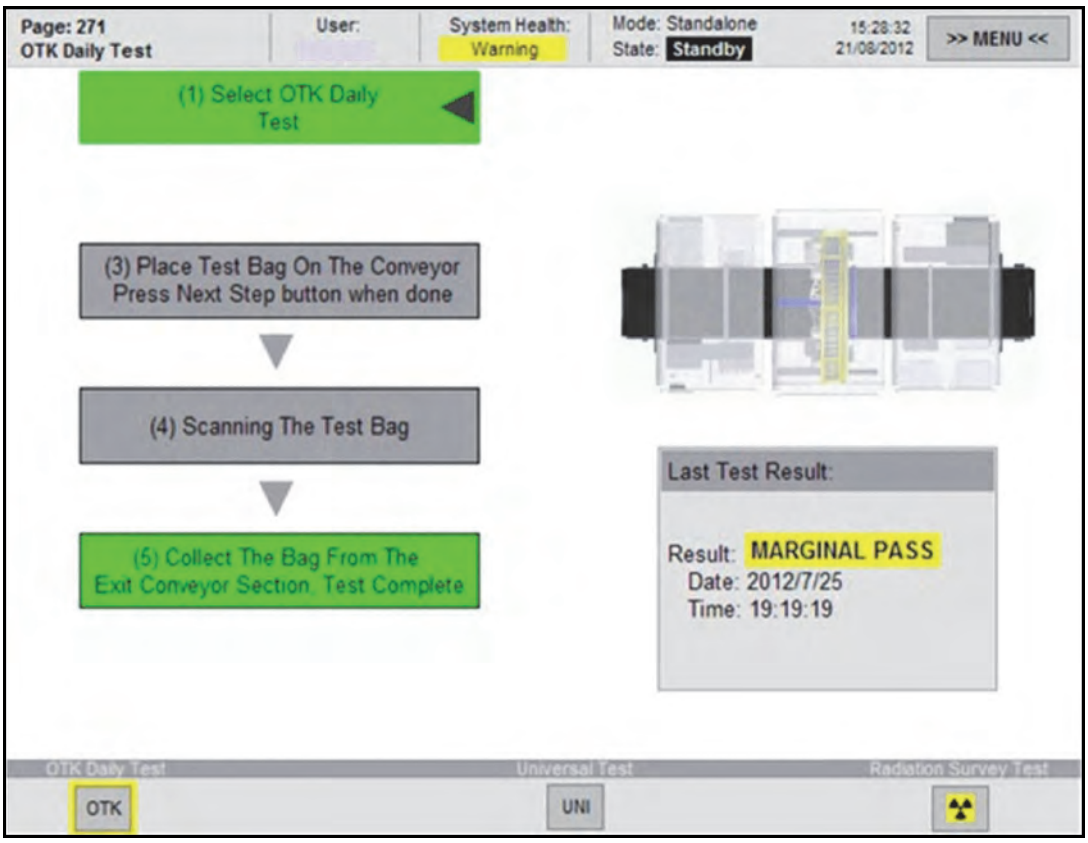



*Figure 9 HMI, Machine Control toolbar, Tests page*

The *Tests* page provides the operator with automated test, with on screen instructions at each stage.

The *Tests* page can be displayed by pressing the *Tests* button on the *Machine Control* toolbar.

## Login

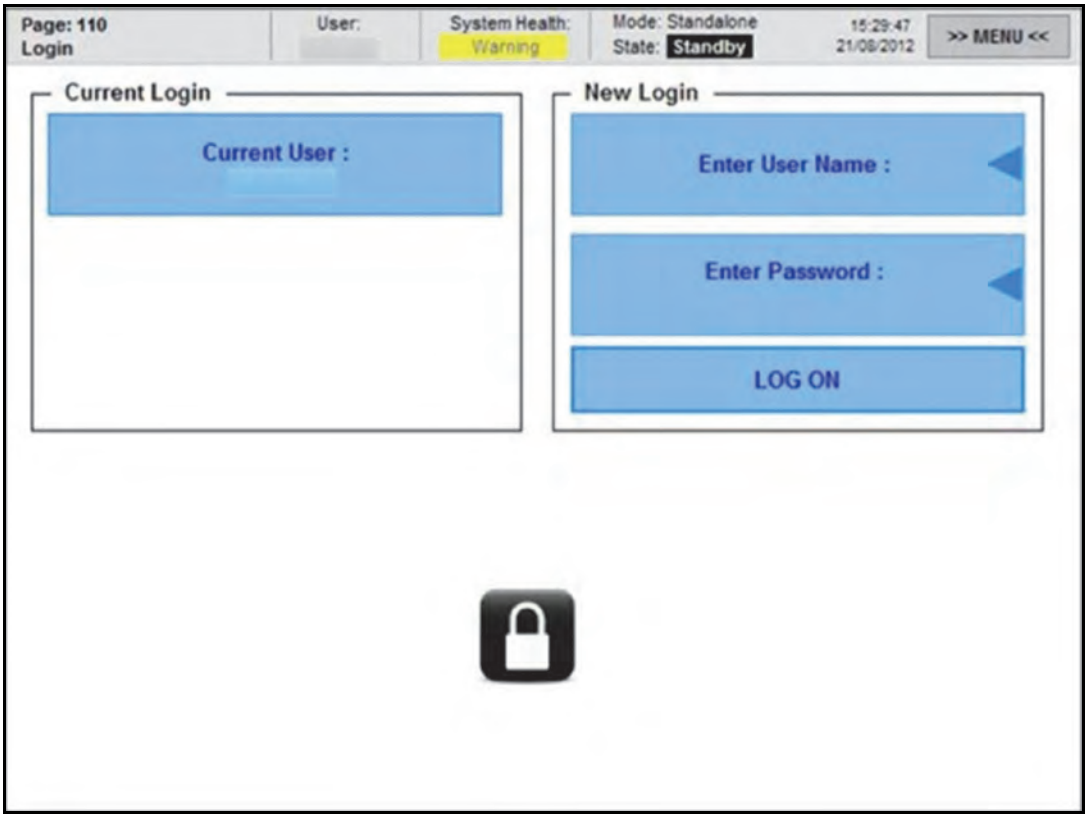



*Figure 10 HMI, Machine Control toolbar, Login page*

The Machine Control option *Login* is selected from the *Machine Control* toolbar, on the *HMI Page Navigation Menu*. When selected the *HMI Login* page opens.

The *Login* option provides secure access to HMI control options and settings, protecting the system from non-permitted adjustments or untrained staff by granting access for configured users only.

A user/operator profile logon must exist in advance to logon.

See *Chapter 10 Basic Operations, HMI - Logging In/Out on page 135*.

## Current Fault

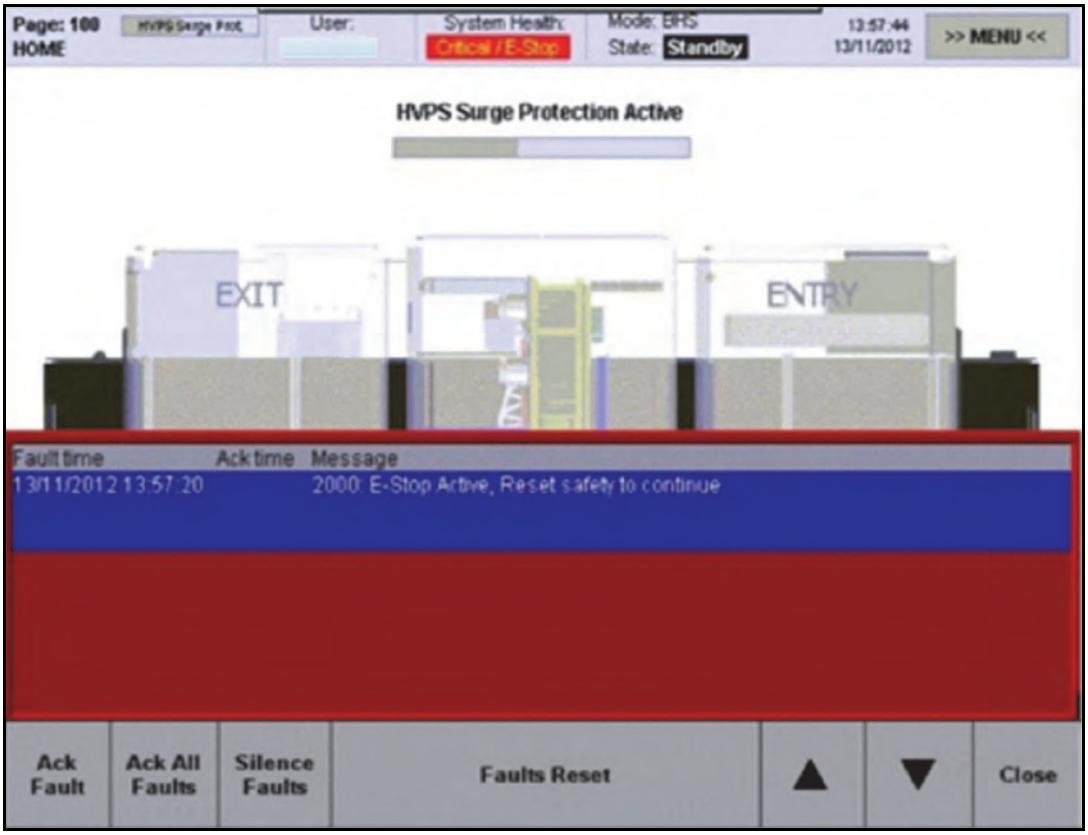



*Figure 11 HMI, Machine Control toolbar, Current Fault page*

The *Current Fault* window is a pop up window covering the lower half of the HMI screen, when activated.

It shows any current or unacknowledged faults. It can be launched from the *Machine Control* toolbar by pressing the *Current Fault* button.

*Current Faults* are marked with a star on the left side.

The following navigation buttons exist;

 Scroll down one place

 Scroll down one place

The operator can acknowledge a single fault by selecting the *Ack Fault* button.

Multiple faults can be acknowledged by selecting the *Ack All Faults* button.

Selecting the *Silence Faults* button stops the audible alarm, but does not clear the fault.

Selecting the *Faults Reset* button removes all faults that are no longer current, from the *Current Fault* window.

Selecting the *Close* button, shuts the *Current Fault* window.

## Faults History

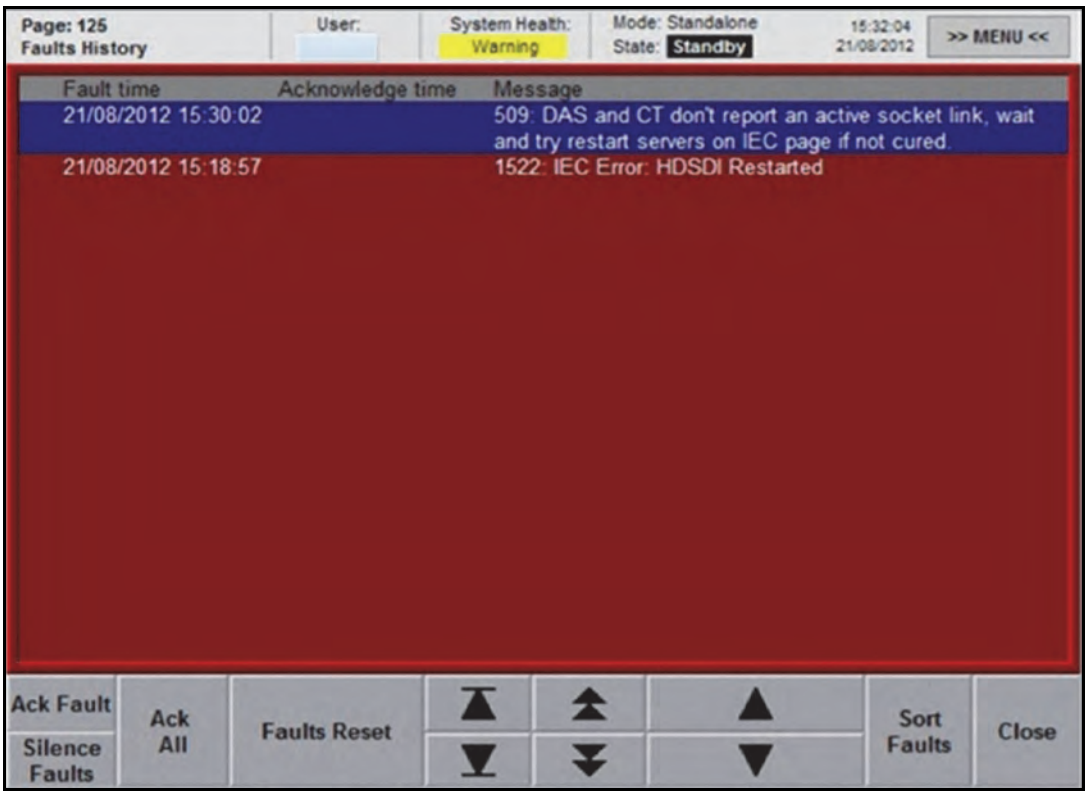



*Figure 12 HMI, Machine Control toolbar, Faults History page*

The *Faults History* page displays the following information on the HMI display, when selected:

- details of the last 256 faults
- the time and date they occurred
- the time and date they were acknowledged

The operator can scroll down through the list of faults to view details of previous faults.

The *Faults History* page can be displayed by pressing the *Faults History* button on the *Machine Control* toolbar.

The following navigation buttons exist;

 Navigate to top of list

 Navigate to bottom of list

 Fast scroll up

 Fast scroll down

 Scroll down one place

 Scroll down one place

The operator can acknowledge a single fault by selecting the *Ack Fault* button.

Multiple faults can be acknowledged by selecting the *Ack All Faults* button.

Selecting the *Close* button, shuts the *Current Fault* window.

## Messages

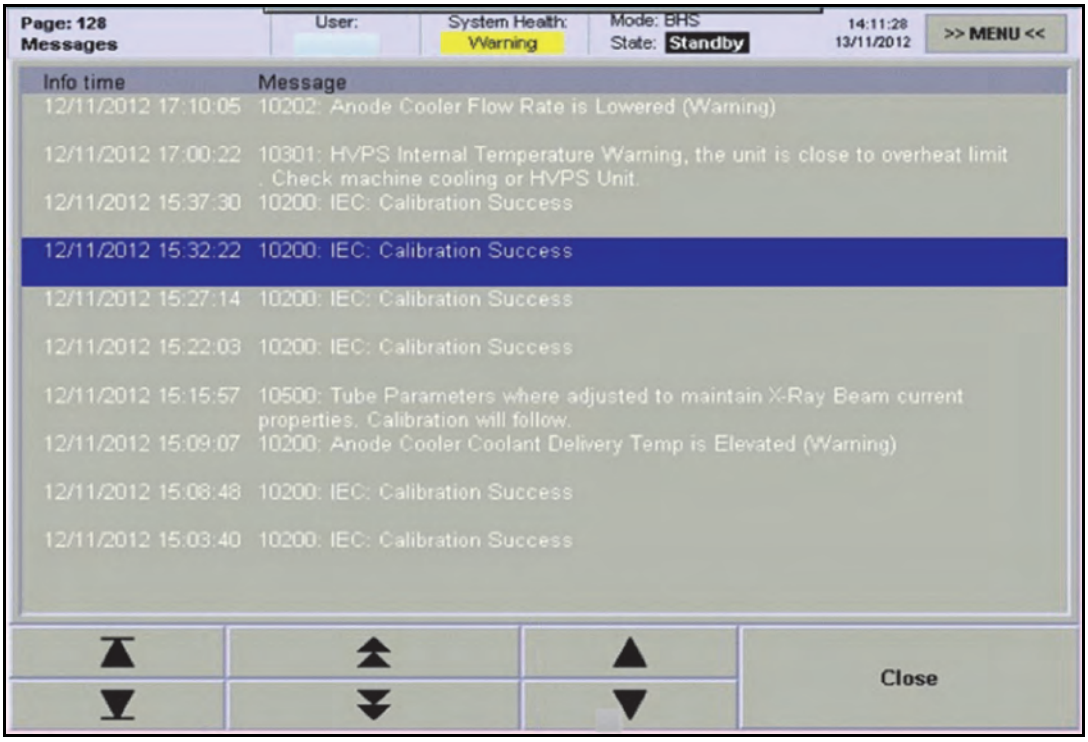



*Figure 13 HMI, Machine Control toolbar, Messages page*

The *Messages* page displays non-critical information, therefore the message window does not pop up, displays automatically when a message occurs.

The *Messages* page can be displayed by pressing the *Messages* button on the *Machine Control* toolbar.

The following navigation buttons exist;


Navigate to top of list


Fast scroll up


Navigate to bottom of list


Fast scroll down


Scroll down one place


Scroll down one place

Selecting the *Close* button, shuts the *Messages* window.

## Bag History View

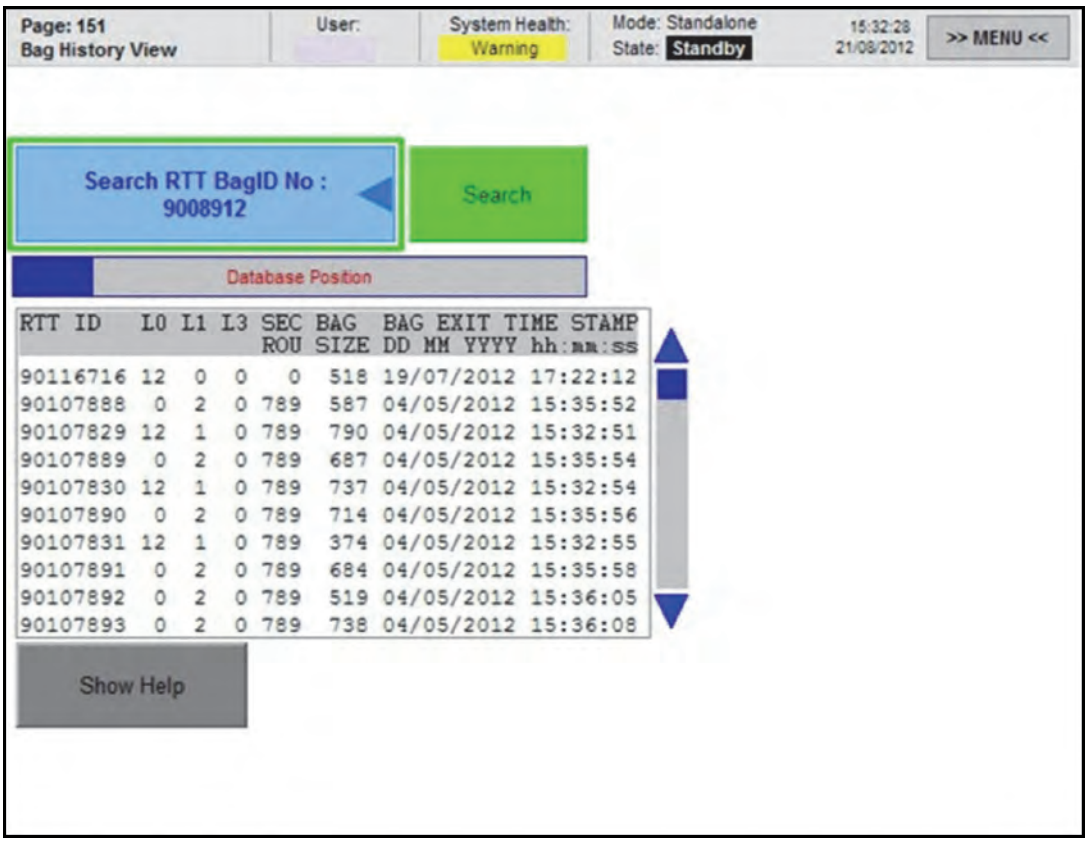



*Figure 14 HMI, Machine Control toolbar, Bag History View page*

The *Bag History View* page displays the following information on the HMI display, when selected:

- a detailed bag list of the last 1000 bags screened (scanned)
- the associated bag decision for each screened bag
- a search function, that allows operators to search for individual bags using the Bag ID attribute

The *Bag History View* page can be displayed by pressing the *Bag History View* button on the *Machine Control* toolbar.

## Performance Data

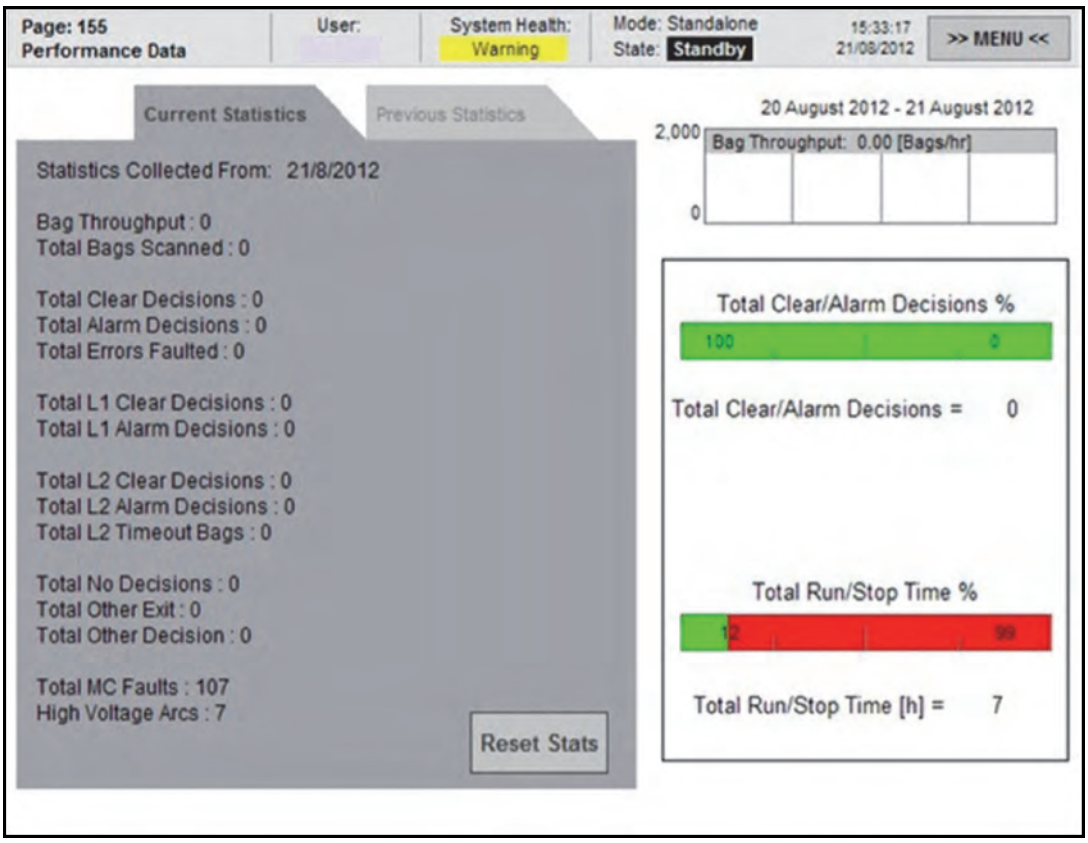



*Figure 15 HMI, Machine Control toolbar, Performance Data page*

The *Performance Data* page displays the following information on the HMI display, when selected:

- bag throughput
- alarm levels
- abandoned bags
- total bag count

The *Performance Data* page can be displayed by pressing the *Performance Data* button on the *Machine Control* toolbar.

# 7.4 HMI Functionality

The following describes some of the HMI options and basic procedures (operations) that may be required during normal operation, as part of a daily requirement or under specific conditions.

## 7.4.1 Faults

*Faults* are a method of reporting errors in the systems operation to the operator via the HMI display. The Control system will report all faults by displaying details such as subsystem type and description of suspected fault in a message pop up window, above the current HMI page.

The Control system can report most forms of errors and advise the operator appropriately - the 'follow up' action.

There are two (2) options of fault reporting, *Current Fault* and *Faults History*, which can be selected from the *Machine Control* toolbar on the *HMI Page Navigation Menu*.

**Current Fault**

The *Current Fault* pop up window is displayed above the HMI page on display, when an error appears during normal operation of the system.

Details of the subsystem, and a text string describing the possible fault are contained in the *Current Fault* pop up message page for the operator to view.

See *Current Fault on page 86*.

**Faults History**

The *Faults History* option enables the operator a method of viewing all the previous faults that have been reported.

When selected the *Faults History* page, similar to the *Current Fault* page appears and displays a list of all faults for the current session - if any were present.

The *Faults History* option is selected from the *HMI Page Navigation Menu* by pressing the *Faults History* button on the *Machine Control* toolbar.

See *Faults History on page 88*.

## 7.4.2 E-stop Fault

If an E-stop (Emergency Stop) button is activated on the RTT110 system, a *Fault* pop up window will appear in the HMI display - see below:

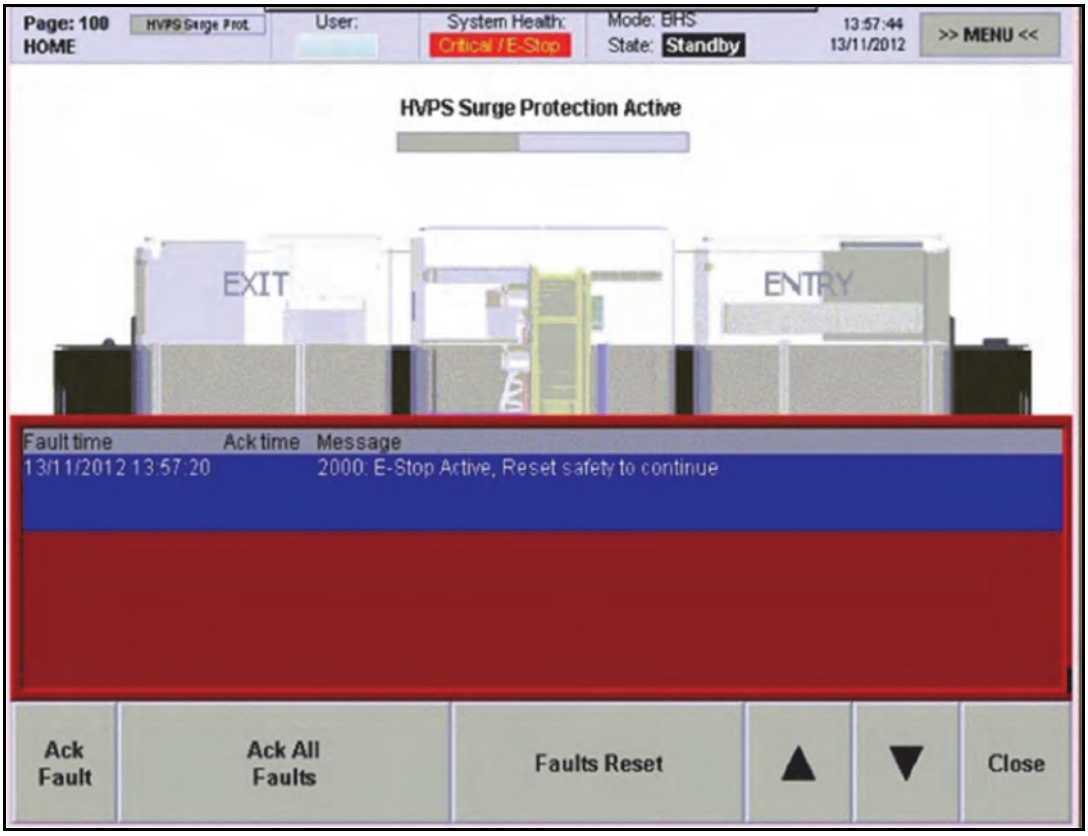



*Figure 16 HMI Fault - E-stop Active*

**Note:** The system sounds an audible beep for approximately 10 seconds, indicating the system has gone into Fault/Critical mode.

The HMI Status toolbar also displays the current condition, present fault using the *System Health* and *Mode* windows - see below:


*Figure 17 Status Toolbar - E-stop Fault*

See *Chapter 10 Basic Operations*, *E-stop Recovery on page 152*.

### 7.4.3 Bag Jam Fault

If a bag jams inside the RTT110 system a *Fault* pop up window will appear in the HMI display - see below:

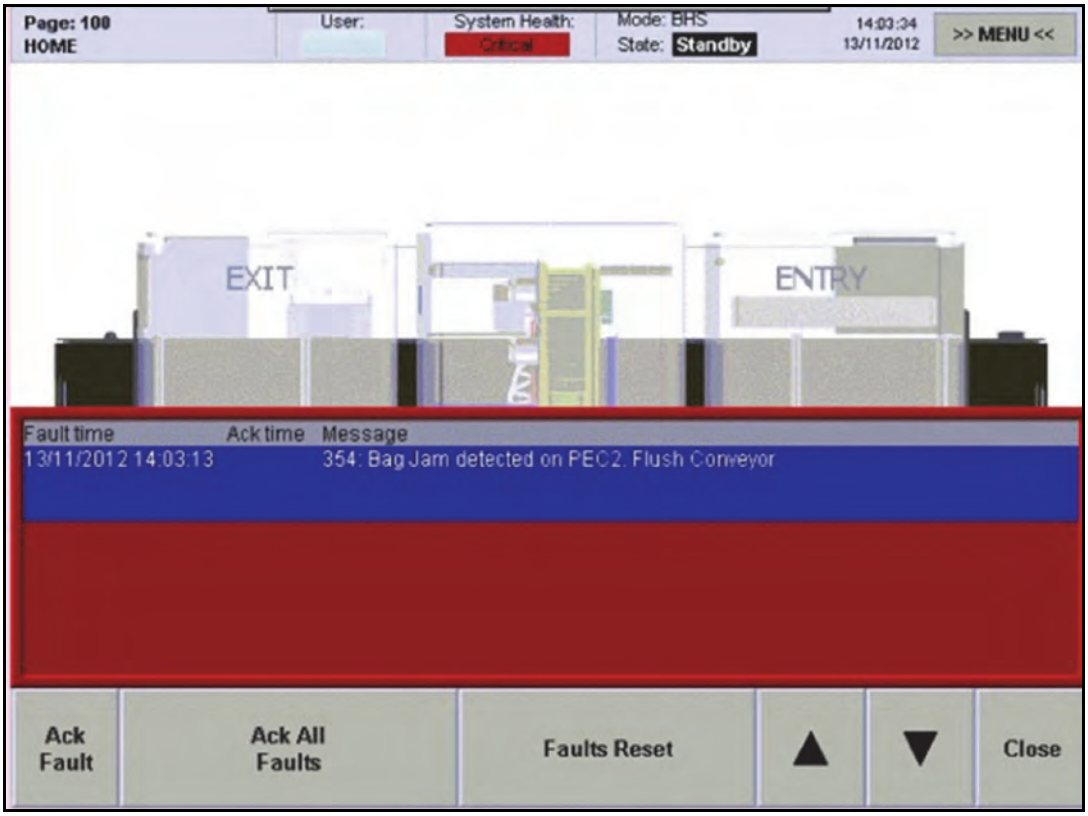



*Figure 18 HMI Fault - Bag Jam Active*

**Note:** The system sounds an audible beep for approximately 10 seconds, indicating the system has gone into Fault/Critical mode.

The HMI Status toolbar also displays the current condition, present fault using the *System Health* and *State* windows - see below:


*Figure 19 Status Toolbar - Bag Jam Fault*

See *Chapter 10 Basic Operations*, *Bag Jam Recovery on page 147*.

### 7.4.4 Messages

The *Messages* page displays non-critical information regarding the system or subsystem details on the HMI display during normal operation of the system.

The *Messages* option is selected from the *HMI Page Navigation Menu* by pressing the *Messages* button on the *Machine Control* toolbar.

See *Messages on page 90*.

# 7.5 System Tests

The Control system is utilized to test and ensure the RTT110 system operates accurately, and efficiently whilst in operation.

The operator simply selects the applicable test using the HMI display and follows the instructions.

## 7.5.1 OTK Daily Test

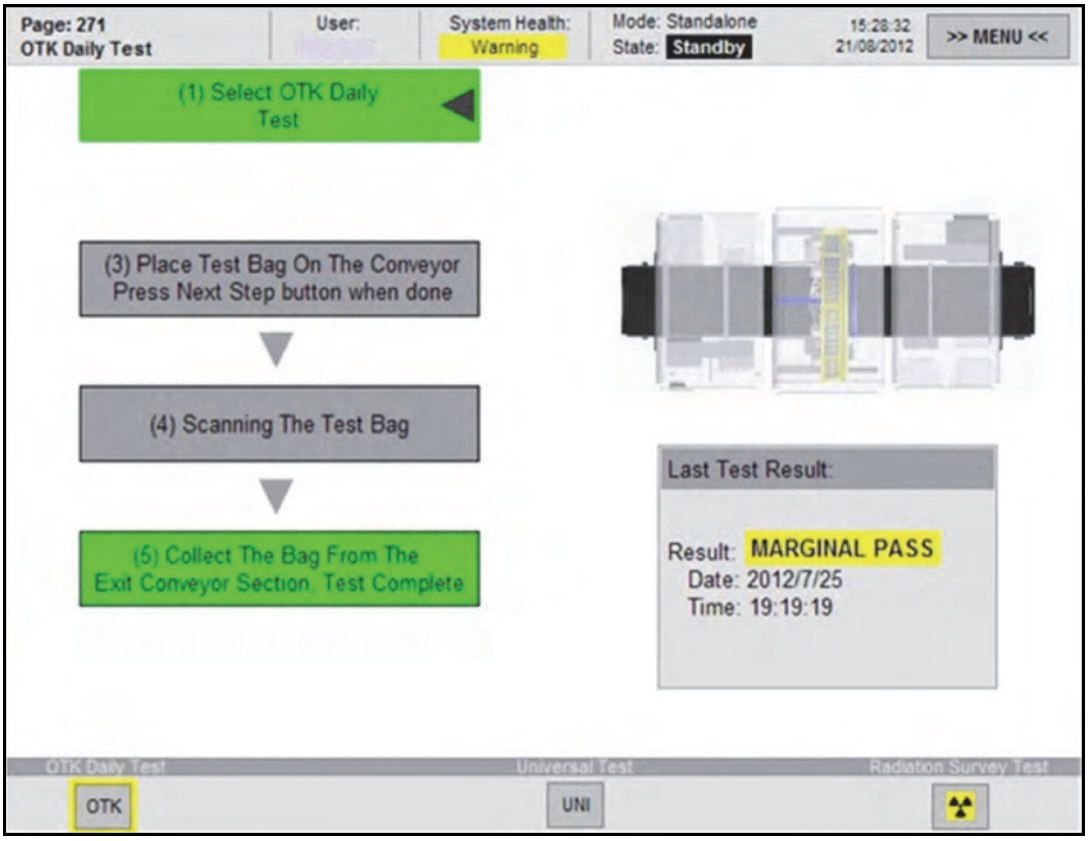



*Figure 20 HMI Menu, Service option, Tests - OTK Daily Test*

The Operational Test Kit (OTK) Daily Test is started from the HMI display, and provides the operator with an automated test, with on screen instructions at each stage.

The OTK Daily Test is available from the *Tests* option.

The *Tests* option is selected from the *HMI Page Navigation Menu*, by pressing the *Tests* button on the *Machine Control* toolbar.

The OTK Daily test will advise on completion if the result of the test is a PASS, MARGINAL PASS, FAIL or ERROR.

**Note:** If the result is FAIL or ERROR, please contact Rapiscan Systems because the system is out of tolerance.

See *Chapter 10 Basic Operations, OTK Daily Test on page 157*.

# 8 Operators Workstation

The following chapter describes the functions and role of the Operators Workstation:

# 8.1 Operators WorkStation - Overview

*Figure 1 Operators WorkStation*

The operator workstation comprises:

- a high specification computer
- with 3D graphics capabilities
- Running Linux RTTVis user interface application
- 24" monitor
- Mouse
- Keyboard

The workstation is used to allow operators to screen baggage and make accept/reject decisions on the bags contents.

- It is the obligation of the Operator and the Operator's Supervisor to ensure the local screening procedure and protocols are understood and followed when using the RTT workstation and RTTVis image viewing software.
- The exact protocol for what bags appear on the workstation and the criteria and procedure for how accept/reject decisions are made will vary depend in on a number of factors which may include:
  - The individual scanner's configuration
  - The local operating procedures and protocols
  - The current threat level

**CAUTION!**

Only trained qualified personnel should operate the RTT110 system.

### 8.1.1 Workstation Role & Operation

- On boot up the workstation will automatically launch the RTTVis Software
- The operator/supervisor will be presented with a login screen which allows them the access the RTTVis bag screening application
- There is no way for operators to access the workstation computer's operating system
- The RTT workstation is only for use with an RTT system or a network of RTT systems
- The RTT system will scan bags, if it detects something that has similar properties to potential threats these will be marked
- It is the operator’s job to resolve any alarms indicated, as well as, typically, determining if there are other potential threats in a bag
- The operator’s decision on any bag will be "Accept" or "Reject", in instances where no decision has been made before a preset period, bags will automatically be rejected
- What happens to "rejected" bags will depend on the screening protocol for individual installations, they may be automatically diverted by a baggage handling system or they may be manually removed from the stream of commerce for further alarm resolution operations. Bags which are accepted would typically travel onto the baggage make-up area and be loaded onto their destination aircraft

## 8.1.2 Operator WorkStation - Configurations

Operator workstations can come as standalone or matrixed. There are a variety of potential configurations for RTT systems and workstations, the configurations which are most common are briefly described below.

### Operators WorkStation - Standalone

Standalone workstations are, most typically, used for Out Of Gauge systems, but will also be used in semi-integrated installations where only a single workstation is used.

Standalone Operator workstations take the images supplied from a single RTT scanner, in instances where the scanner is generating images before the previous images have been accepted or rejected those images will be queued until the operator has finished screening previous bags and is free to view them.

Typically, in standalone operations the Operator Workstation will be close to the RTT scanner, usually within sight of it. The standalone operator will frequently have control of the RTT system's conveyor belt.

## Operators WorkStation - Matrixed

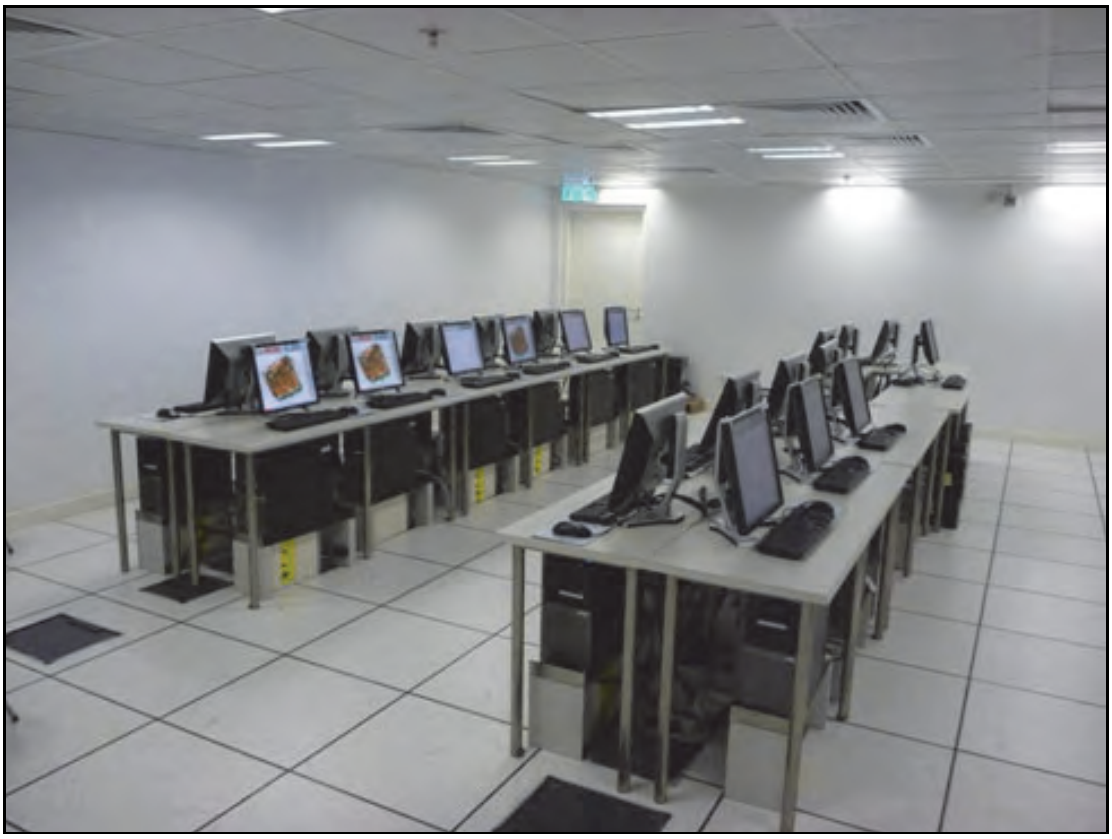


*Figure 2 Typical Matrixed Workstation Screening Room*

In instances where one or more RTT system provides images for more than one workstation, the workstations are described as Matrixed. Matrixed workstations do not typically allow control of the conveyor belt for the RTT scanner or scanners. Often the Matrixed workstations will be remote from the RTT scanner(s), sometimes by distances of hundreds of meters. Bags generated by the network of scanners will be queued and sent to the next available workstation as workstations become free. The RTTVis bag screening application does not change in either standalone or matrixed configurations.

# 9 RTTVis - Workstation Software

This chapter provides an overview of basic RTT110 custom Image analysis software, RTTVis - see below:

# 9.1 RTTVis - Overview

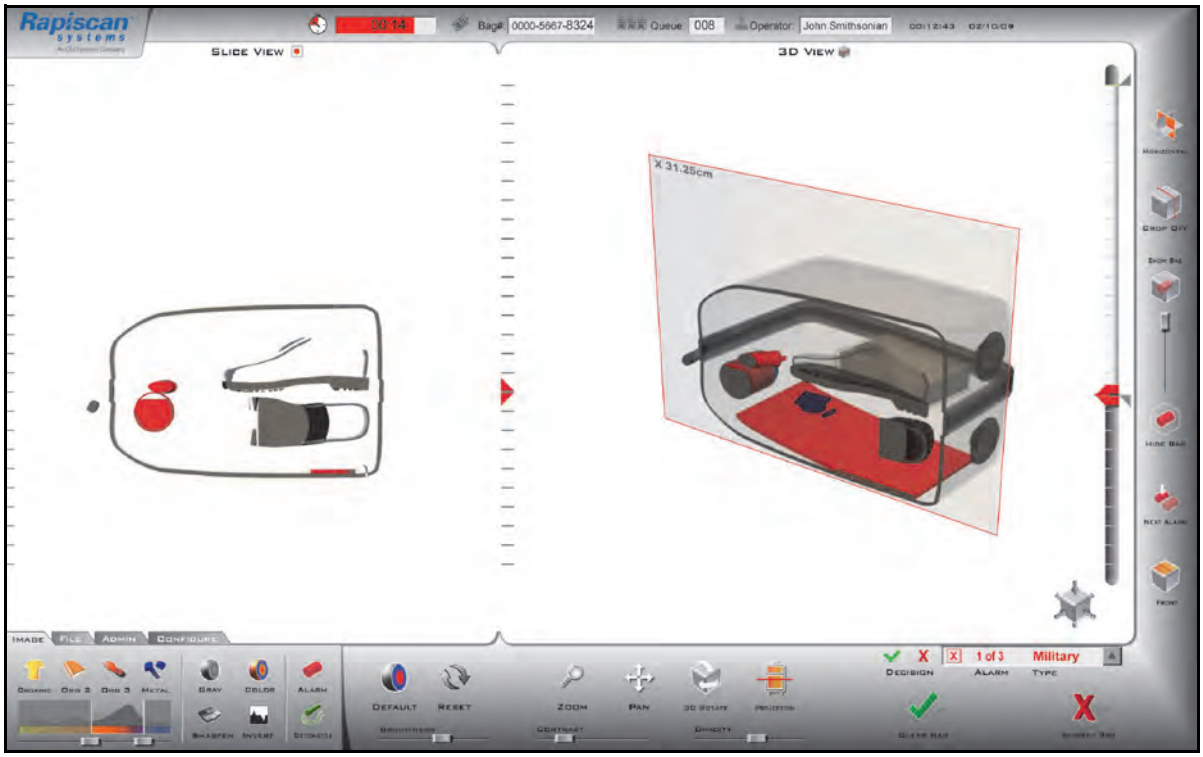



*Figure 1 RTTVis Graphical User Interface - Main Window*

RTTVis is specifically designed software that is displayed in a graphical user interface (GUI) on the workstation monitor, for the purpose of viewing and resolving bag images produced by the RTT110 system.

The RTTVis software provides the operator the following general functions and capability when reviewing bag images;

- displays highlighted suspected threats, for analysis
- an intuitive view window (UI), with correlated volumetric 3D images and 2D section views
- manipulation tools, that aid movement of images
- effects tools, that apply preset values, filters to aid item definition

The main window provides all the controls and views that the user needs to perform baggage screening.

**CAUTION!**

Only trained qualified personnel should operate the RTT110 system.

## 9.1.1 RTTVis UI - General Description

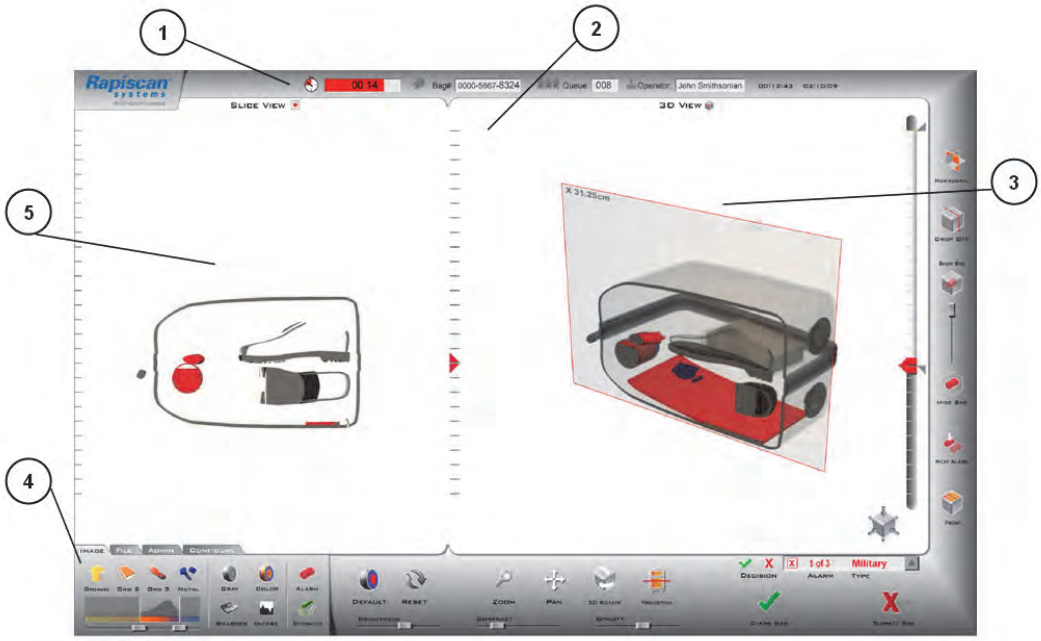



*Figure 2 RTTVis - User Interface (UI), Main View*

RTTVis is a graphical user interface for viewing and resolving bag images produced by the RTT110 system.

The below table contains details of the RTTVis UI displayed in *Figure 2*:

RTTVis UI - Legend:

| Number | Component description |
|---|---|
| **1** | Status Bar |
| **2** | Image View- |
| **3** | Volume View |
| **4** | Control Panel |
| **5** | Slice View |

## 9.1.2 RTTVis User Interface (UI) Components

### Status Bar

The Status Bar is located across the top of the screen. It displays the bag countdown timer, bag id, operator id, and current time and date.

### Image View

The Image view occupies most of the main window. The Image View can display 2D slice, projection, and 3D volume views of the bag. It can be divided to show several of these views at the same time.

*Slice view*

The layout shown above has it split into two windows to display a 2D slice on the left and a 3D volume or projection rendering on the right. There are ruler markings along the edges to help users measure the size of objects. Some functions such as rotation and zoom can be performed through direct manipulation on the Image View.

*Volume view*

The Volume View has a slider control along its right edge for slicing and cropping the image (see UI Detailed Description section).

There is some degree of synchronization between the slice and volume views. The location of the slice within the volume is displayed in the Volume View either as a plane on volume drawings or a line on projection drawings. Changing the slice plane causes the Slice View to display a slice through the new plane, and the slice marker on the Volume or Projection View is updated.

Objects identified by the automatic detection systems as Alarms are marked in two ways. A box is drawn around each of the objects, and the specific parts of the object that alarmed are highlighted to indicate the type of alarm.

### Control Panel

The Control Panel is located along the bottom and one edge of the screen. It has controls for modifying the appearance of the image and resolving the bag. There are also optional sets of controls for doing things like configuring the UI and reviewing bags.

### 9.1.3 RTTVis UI - Control Panel


The RTTVis Control Panel is located in the bottom left corner of the User Interface (UI) and consists of the following options (tabs).

**Image**

The Image tab controls the Image view, how the operator can adjust the display (threshold) to gain further definition of objects on display.

See *Image Tab on page 110*, for further information.

**File**

The File tab allows the user to control, view image files - see *File Tab on page 114*, for further information.

**Admin**

The Admin tab is used for operators to Log In or Out of the RTTVis software and system, see *Admin Tab on page 115*, for further information.

**Configure**

The Configure tab is used to adjust screen set up, UI language etc, see *Configure Tab on page 116*, for further information.

**Note:** Not all tabs, and their relevant functions listed, may be displayed or available to all users.

### 9.1.4 Image Tab


The Image tab, provides the operator the following functionality;

- enables the user to filter, isolate types of material such as metals
- switches highlighting so that alarm objects are redrawn in the color they would have if they were not alarms
- allows the user to limit the image on display, to a density region (thresholding)

The Image tab contains three (3) sections that provide the following controls:

- **Histogram**
  Slider bar & display, on lower left side of the toolbar, see *Histogram on page 111*
- **Histogram Presets**
  Icon buttons to the left & top, see *Histogram Presets on page 111*
- **Image Effects Toolbar**
  Remaining Icons in the middle and to the right of the panel, see *Image Effects Toolbar on page 112*

### Histogram


A graph display that allows the user to observe how density values are distributed in the image. (Density determines the color and transparency of each image pixel.)

This control also allows the user to limit display to a density region (thresholding).

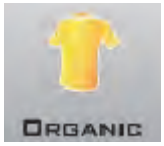
#### Histogram Presets

Sets the Histogram to preset thresholds. There are four of these buttons. Pressing one of the buttons sets the thresholds to limit the density to a particular range. Each button can be assigned a range that will isolate a type of material such as organic, or metals.

The histogram slider bars will move to match the range, as though they had been moved by the user, when a preset button is selected.

**Note:** Works only on 3D image and also available on view slice and projection.

**ORGANIC:**




Purpose: Sets the Histogram to preset threshold, to display light organic materials such as clothing.

**ORG 2**


Purpose: Sets the Histogram to preset threshold, to display medium organic material such as printed material.

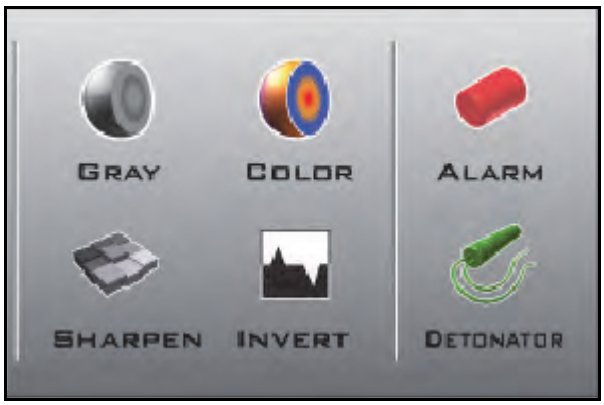
**ORG 3**


Purpose: Sets the Histogram to preset threshold, to display heavier organic material such as shoe soles.

**METAL**


Purpose: Sets the Histogram to preset threshold, to display very dense materials such as metals.

### Image Effects Toolbar




The Image Effects toolbar provides the operator the following functionality;

- provides additional control of the image display - see Image Effect functions table
- enables adjustment to the display (threshold) for the Operator to gain further definition of objects/items on display
- switches on or off certain affects, so original objects composition can be viewed

### Image Effects - functions:

**GRAY Scale:**


Type: Radio Button

Purpose: Applies Gray Scale effect to image in the Image View.
Use: Pressing this button activates the Gray Scale mode, the button border changes to indicate the mode is active. When active, the image is displayed using shades of gray to indicate different densities.

To deactivate Gray Scale mode, press the Color Image button. Works on 2D and 3D.

**COLOR Image:**


Type: Radio Button

Purpose: Applies Color Image effect to image in the Image View.
Use: Pressing this button activates the Color Image mode: the button border changes to indicate the mode is active. When active, the image is displayed using colors to indicate different densities.

To deactivate Color Image mode, press the Gray Scale button. Works on 2D and 3D.

## Image Effects - Modes & functions (continued):

**SHARPEN:**


Type: Toggle Button

Purpose: Changes the sharpness of the Image View image.
Use: Pressing this button applies the sharpening filter to projection image.
Image becomes sharper when the button is pressed, and returns to normal when the button is pressed again.
Works only on the projection image.

**INVERT**:


Type: Toggle Button

Purpose: Applies Invert effect to image in the Image View.
Use: Pressing this button activates the inverse mode: the button border changes to indicate the mode is active, and colors in the image are replaced with their complement. Affects only normal data, not objects with highlighting. Works on Color and Gray scales. Also changes Image View background color.
To deactivate this mode, the user presses the Invert button again. Works on 2D and 3D.

**ALARM:**


Type: Toggle Button

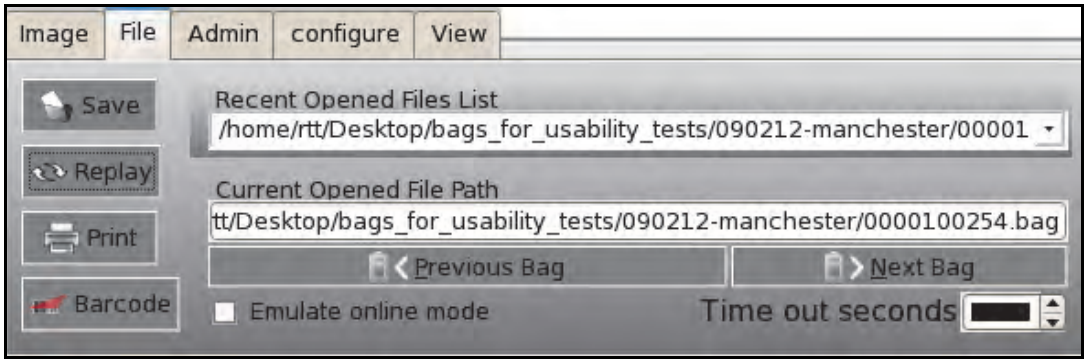
Purpose: Applies alarm highlighting effect.
Use: By default, objects identified as alarms are highlighted in red. Pressing the button once removes the highlighting so that alarm objects are redrawn in the color they would have if they were not alarms. The non-highlighted color is based on the objects' density and the current gray or colorscale. Pressing the button again highlights alarm objects in red.
Alarm highlighting is also restored when the color Default button is pressed. Works on 2D and 3D.

**Detonator:**


Type: Toggle Button

Purpose: Applies detonator highlighting effect.
Use: By default, objects identified as detonators are highlighted in green. Pressing the button once removes the highlighting so that detonator objects are redrawn in the color they would have if they were not detonators. The non-highlighted color is based on the objects' density and the current gray or colorscale. Pressing the button again highlights detonator objects in green.
Detonator highlighting is also restored when the color Default button is pressed. Works on 2D and 3D.

### 9.1.5 File Tab



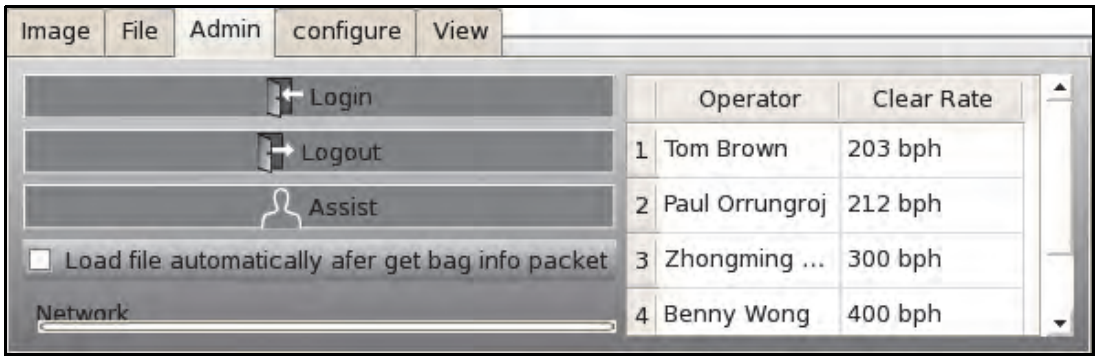

The File tab provides the operator the following functionality;

- provides access to archived images
- enables images to be replayed for additional analysis, demonstration
- and to print images

**File Tab - commands**

| Button / text | Function description |
|---|---|
| Save: | Select to Save file. (*configurable) |
| Replay: | Opens the Replay browser that lists available images. |
| Print: | Print current file. |
| Barcode: | Informs RTTVis to use a bar-code scan. Look up the bag in the database and display the bag. |
| Recent Opened Files List: | The file path of the previous files that have been opened - a history list.<br>Selecting a file from the list displays the image. |
| Current Opened File Path: | The file path of the Current file open. |
| Previous Bag: | Select to navigate backward, for the previous bag image. |
| Next Bag: | Select to navigate forward, for the Next bag image. |
| Emulate Online Mode: | Test function only. |
| Time out Seconds: | Duration, period of time allowed to analyze image/file. |

### 9.1.6 Admin Tab



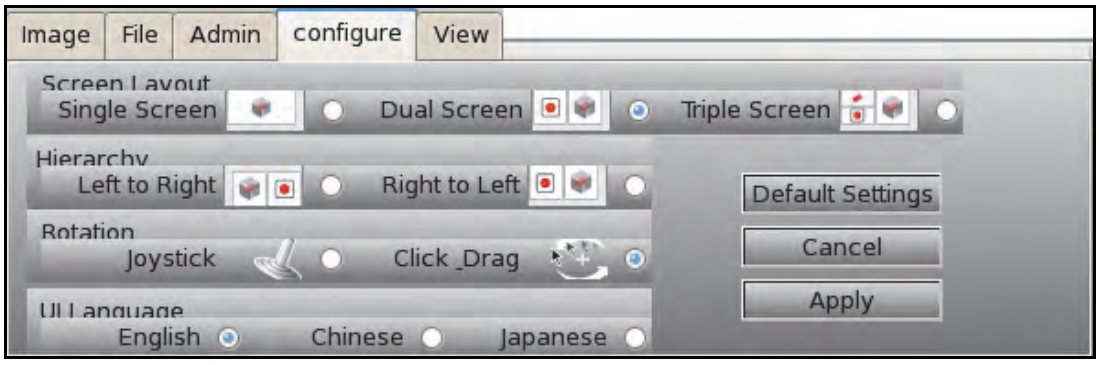

The Admin tab provides the operator the following functionality;

- enables operators to log in and out

#### Admin Tab - commands

| Button / text | Function description |
|---|---|
| Login | Select to Login into the RTTVis software. |
| Logout | Select to Logout of the RTTVis software. |
| Assist | Select to request assistance. (*configurable) |
| Network | Network File path. (*configurable) |

## 9.1.7 Configure Tab




The Configure tab provides the operator the following functionality, usually only applicable at set-up stage;

- Screen configuration, single or multiple
- Image View configuration, Slice & Volume view to the left or right

### Configure Tab - commands

| Button / text | Function description |
|---|---|
| **Screen Layout** | |
| Single Screen | Select for Single screen viewing configuration. |
| Dual Screen | Select for Dual (2) screen viewing configuration. |
| Triple Screen | Select for triple (3) screen viewing configuration. |
| **Hierarchy** | Controls, flips UI Image view layout. |
| Left to Right | Slice view to left. (*configurable) |
| Right to Left | Slice view to right. (*configurable) |
| **Rotation** | |
| Joystick | User holds button down to rotate, zoom or pan in correlation to pointer position. |
| Click Drag | Click and drag = provides rotate, zoom or pan. |
| **UI Language** | |
| English | Selects English, as UI language. (*configurable) |
| Chinese | Selects Chinese, as UI language. (*configurable) |
| Japanese | Selects Japanese, as UI language. (*configurable) |
| **Default Settings** | If selected, returns all configuration setting to default selection. |
| **Cancel** | Select to Cancel you selection. |
| **Apply** | Select to confirm and set the configuration settings applied. |

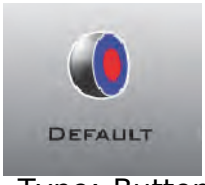
## 9.1.8 Image View Toolbar


The Image View toolbar provides the operator the following functionality;

- provides adjustment to the display, such as brightness, contrast and opacity
- provides movement options and manipulation of the image view
- Image view reset - see Image View buttons for separate definition

**Image View toolbar, buttons:**

**Default Color:**




Type: Button

Purpose: Restores default colors
Use: Returns drawing to the default color scheme. Undoes the effect of the Histogram, Histogram Preset, Alarm and Detonator buttons.
Works on 2D and 3D.

**Reset**


Type: Button

Purpose: Restores Image View to default
Use: Returns all Image View drawings to the default appearance. Has the affect of the Default Color button described above, and also restores Volume View to full bag in isometric orientation. Undoes the effect of rotation, zoom, pan, crop, grow/shrink. Does not affect alarm decisions.
Works on 2D and 3D.

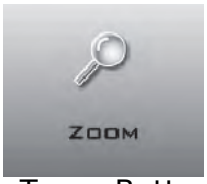
**Brightness**


Type: Slider

Purpose: Changes the brightness of the Image View image
Use: Image becomes darker as the user moves the bar toward the left, and lighter as the user moves the bar toward the right.
Works only on 3D image. (Also works on slice, projection).

**Image View buttons, (continued):**

**Zoom**




Type: Button

Purpose: Sets Zoom interaction mode.
Use: Pressing the button activates Zoom mode. In Zoom mode, dragging on the Slice or Volume View with the left mouse button enlarges or reduces the image in scale depending on direction of drag. Zoom mode is provided as an alternative to using right button drag or the scroll wheel.
To deactivate Zoom mode, the user presses the Zoom button again, or presses Rotate or Pan button to activate a different mode. Works on 2D and 3D.

**Pan**


Type: Button

Purpose: Sets Pan interaction mode.
Use: Pressing this button activates Pan mode. In Pan mode, dragging on the Slice or Volume View with the left mouse button moves the image in the same direction as the drag. Pan mode is provided as an alternative to using middle button drag.
To deactivate Pan mode, the user presses the Pan button again, or presses Rotate or Zoom button to activate a different mode. Works on 2D and 3D.

**Contrast**


Type: Slider

Purpose: Changes the contrast of the Image View image.
Use: Image contrast is reduced (colors more towards medium shades) as the user moves the bar toward the left, and increased (colors more towards brighter and darker shades) as the user moves the bar toward the right. Works only on 3D image.

**Image View buttons, (continued):**

3D Rotate


Type: Button

Purpose: Puts volume rendering into the *Volume View.*
Use: The Volume View can display projection or volume renderings. This button sets the view to display a volume rendering of the image.

Projection


Type: Button

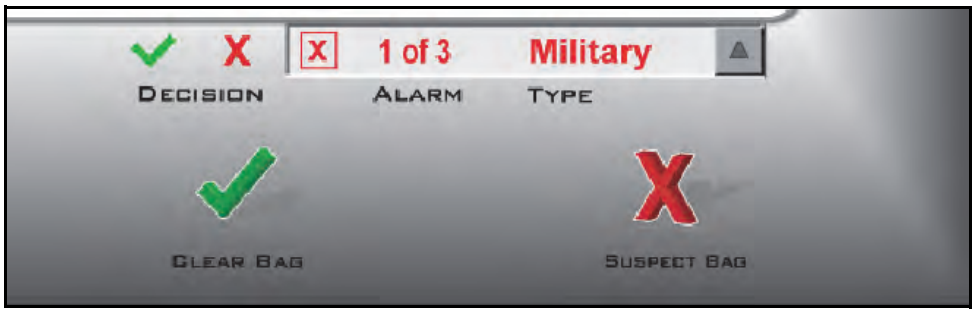
Purpose: Puts projection image into the *Volume View.*
Use: The Volume View can display projection or volume renderings. This button sets the view to display projection images.

Opacity


Type: Slider

Purpose: Changes the opacity of the Image View image.
Use: Image becomes more transparent as the user moves the bar toward the left, and more opaque as the user moves the bar toward the right.
This control has a greater effect on lower density areas to help reveal higher density interior objects, (lower density areas such as air become transparent more rapidly than higher density areas as the slider moves towards Transparent). Works only on 3D image.

## 9.1.9 Alarm Decision Toolbar




The Alarm Decision Toolbar provides the operator the following functionality;

- provides a text list of all threats
- provides controls for making per threat - Alarm decision
- provides controls for making global decision - Bag decision

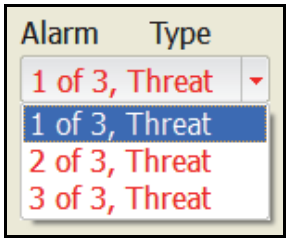
**Alarm Decision toolbar, buttons:**

**Alarm Decision**

Type: Buttons

Purpose: Enter Alarm Decision
Use: Pressing one of the buttons sets a decision on the current Alarm.

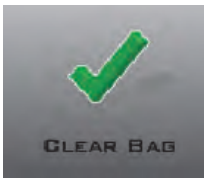
**Alarm List**




Type: Pull-down menu

Purpose: Display Alarm List
Use: Displays the Alarms found in the Bag. For each Alarm the list shows type, mass and decision status. Clicking on an Alarm changes the Volume View to display the alarm, performing the same action as cycling to the alarm with the Next Alarm button.

**Bag Decision:**




**Clear Bag**


**Suspect Bag**

Type: Buttons

Purpose: Enter Alarm Decision
Use: Pressing one of the buttons sets a decision for the Bag. The display is cleared and RTTVis is ready for the next Bag.

## 9.1.10 Static Controls Toolbar

The Static Controls Toolbar provides the operator the following functionality;

- custom 3D Volume view cropping - see Grow/Shrink button
- provides navigation between threats, and between full bag and isolated threat views

**Static Control - buttons**

**Grow / Shrink**

**Type:** Slider

Purpose: Grow and shrink 3D volume cropping
Use: The Grow/Shrink slider expands or contracts cropping on the 3D volume. Pulling the slider up shrinks the visible volume by cropping inward from every side. Pulling the slider down expands the visible volume by moving the cropping planes outward on every side. Growing stops when the full volume is reached.

When showing the full bag (see Show/Hide Bag), the slider handle starts at the bottom (full bag). Moving it up shrinks the visible volume until it is flat in the shortest axis. When showing an isolated Alarm, the slider handle starts at the top (Alarm view). Moving it down expands to the full bag.

Works only on 3D image.

**Hide Bag**

**Type:** Toggle Button

Purpose: Switch from Alarm view to full Bag
Use: When a bag image is first opened, the full bag is displayed. Pressing the button switches the Volume View to display an isolated view of the current Alarm. The volume is cropped to the alarm sub volume and the view is zoomed in.

Works only on 3D image.

**Next Alarm**

**Type:** Button

Purpose: Display the next alarm
Use: Changes the Volume View to display the next alarm. Works only when the Volume View is displaying an isolated Alarm (see Show/Hide Bag).

Works only on 3D image.

# 10 Basic Operations

This chapter provides an overview of the basic operating procedures & processes for RTT110 system:

# 10.1 Operating the RTT110

The following chapter describes in detail the necessary daily operations operators will be required to complete to operate the RTT110 system.

**CAUTION!**

Only trained qualified personnel should operate the RTT110 system.

## 10.1.1 Pre Operational Checks

Before powering on the RTT110, make a complete visual inspection of the unit to check the following:

- Verify that all panels on the scanner are closed and locked
- Verify all lead curtains are in place and intact
- Verify all emergency switches are in the released position
- Verify that there are no objects in the inspection tunnel
- Know how to use the RTT110 Human Machine Interface (HMI)

## 10.2 RTT110, Switching ON & OFF

The following operations are necessary to switch the RTT110 system On and Off for normal operation.

**Pre-Requisites:**

The following pre-requisites are listed below and must be followed before switching the RTT110 scanner On or Off;

- Review, and comply with *Pre Operational Checks on page 124*
- Ensure that the power supply is connected and switched on
- Ensure the HMI key switch must be in the Off position - turned to the left

## 10.2.1 Start Up

**CAUTION!**

Only trained qualified personnel should operate the RTT110 system.

### RTT110 - Start up Steps

1. Ensure Main Circuit Breaker (MCB) is in the On position.


*Figure 1 RTT110 - Main Circuit Breaker (MCB) and Mains Isolator switch location*

2. Turn the *Mains Isolator* switch to the On position.
3. Turn the key switch, located to the right of the HMI to the On position, by rotating clockwise (to the right).

4. Press the push button next to the HMI to start the HMI and control system. The button will be backlit green, indicating that the system is powering up.

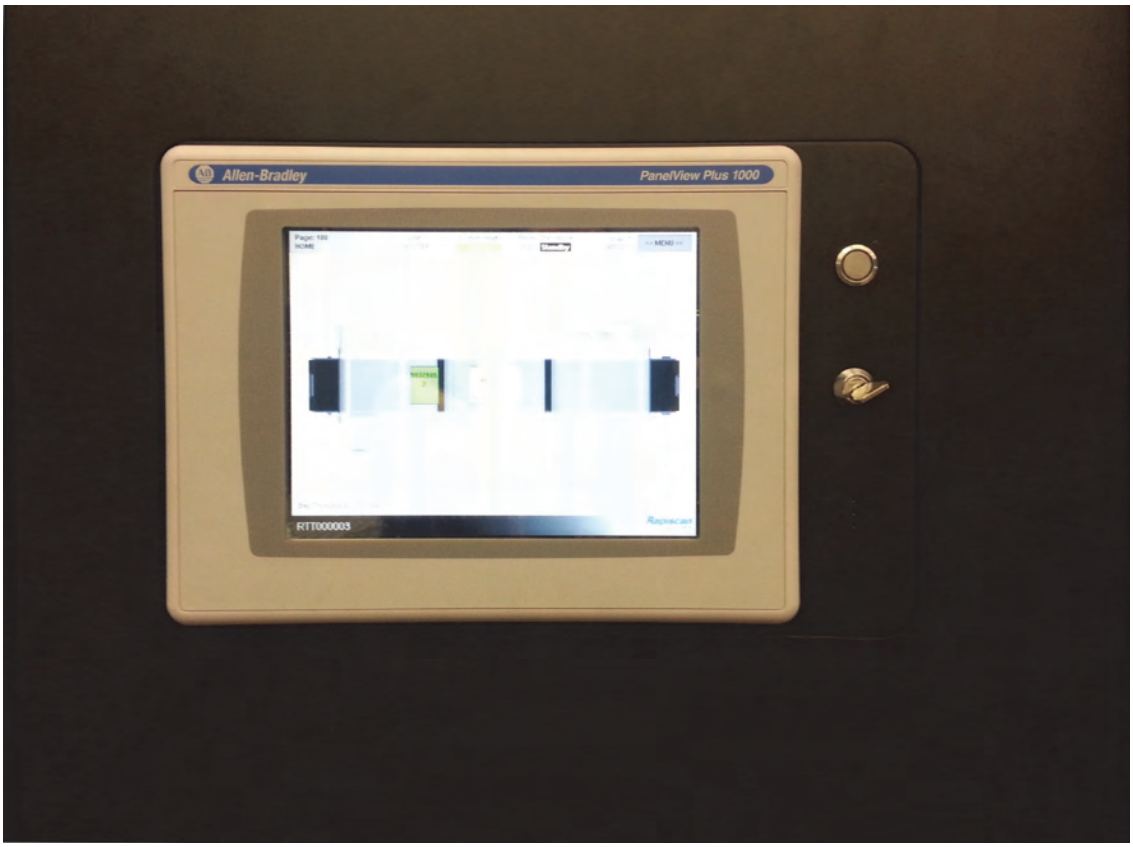



*Figure 2 HMI, Key Switch & Start button*

The Start up page appears.

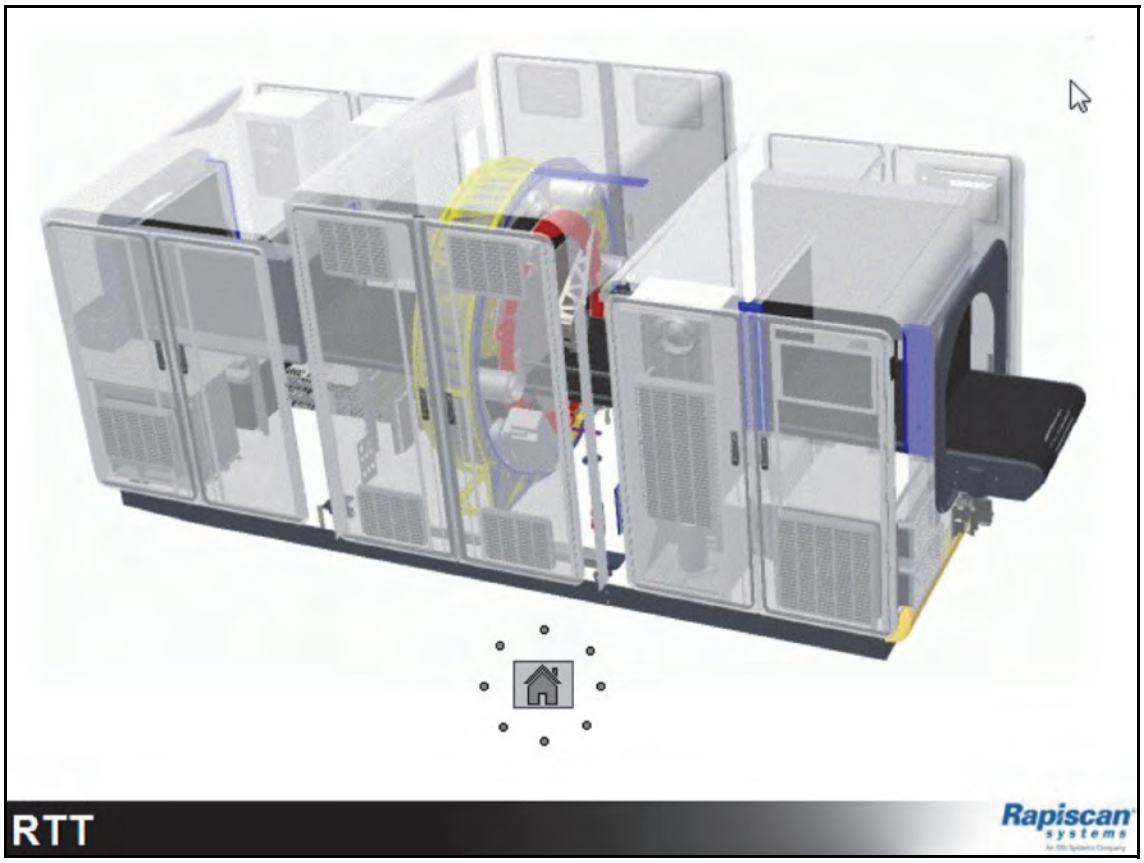



*Figure 3 HMI, Start up page*

5. Select the *Home* button.
   The *Home* page appears.

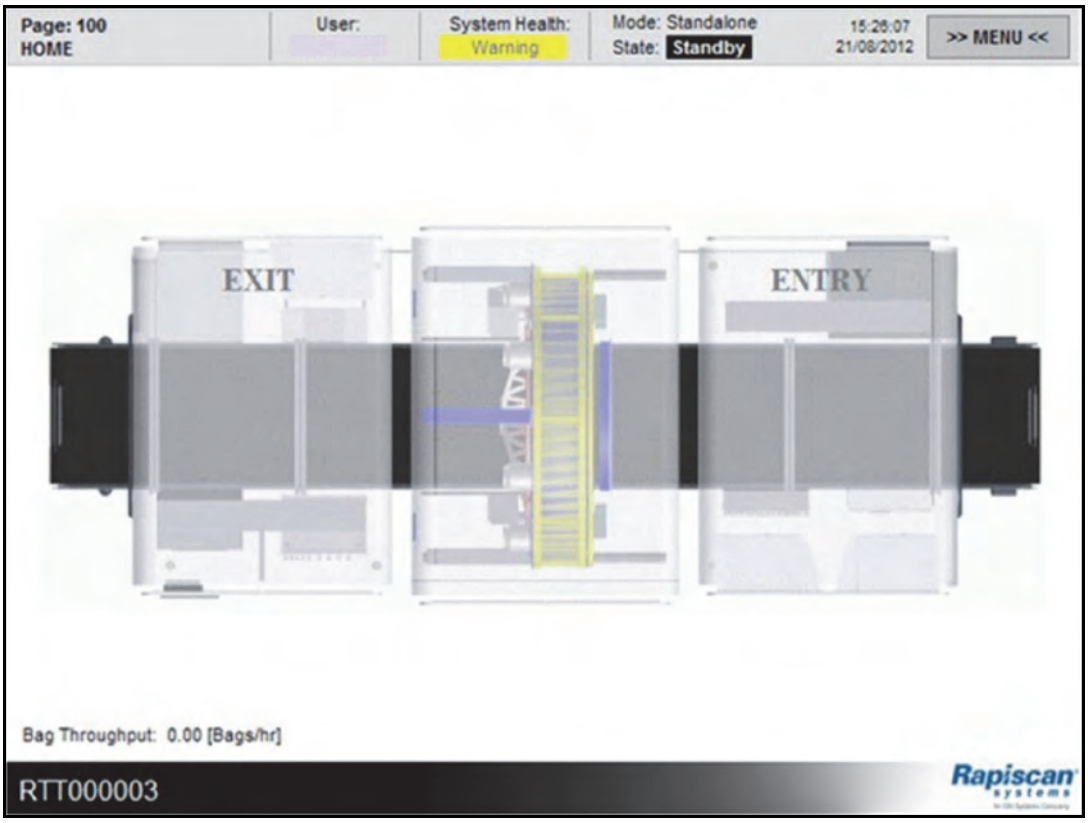



*Figure 4 HMI, Home page*

6. Wait while the HMI completes its start up process. Whilst the HMI and control system starts up the Status bar will indicate with the following:

   State: *Power Off*

   Once the initial start up process for the control system and HMI has completed the Status bar displays:

   State: *Standby*

7. Press the push button next to the HMI again to reset the scanner safety circuit and interlocks. Ensure none of the E-stop buttons are Active (depressed). The *Health Status* on the *Status* toolbar should not be showing as *Critical/E-Stop* - see example below.


See *Mode, State and System Health on page 69*.

**Start up - Standby Mode**

8. Login to the HMI, see *HMI Log in - Steps: on page 136*.

   **Note:** When *Logging In*, ensure your user profile will provide you with sufficient level of access to see the HMI *Machine Control* toolbar.

   The Start up page appears.

9. Select the *Home* button.
   The *Home* page appears.

10. Press the *MENU* button.
    The *Page Navigation Menu* appears.

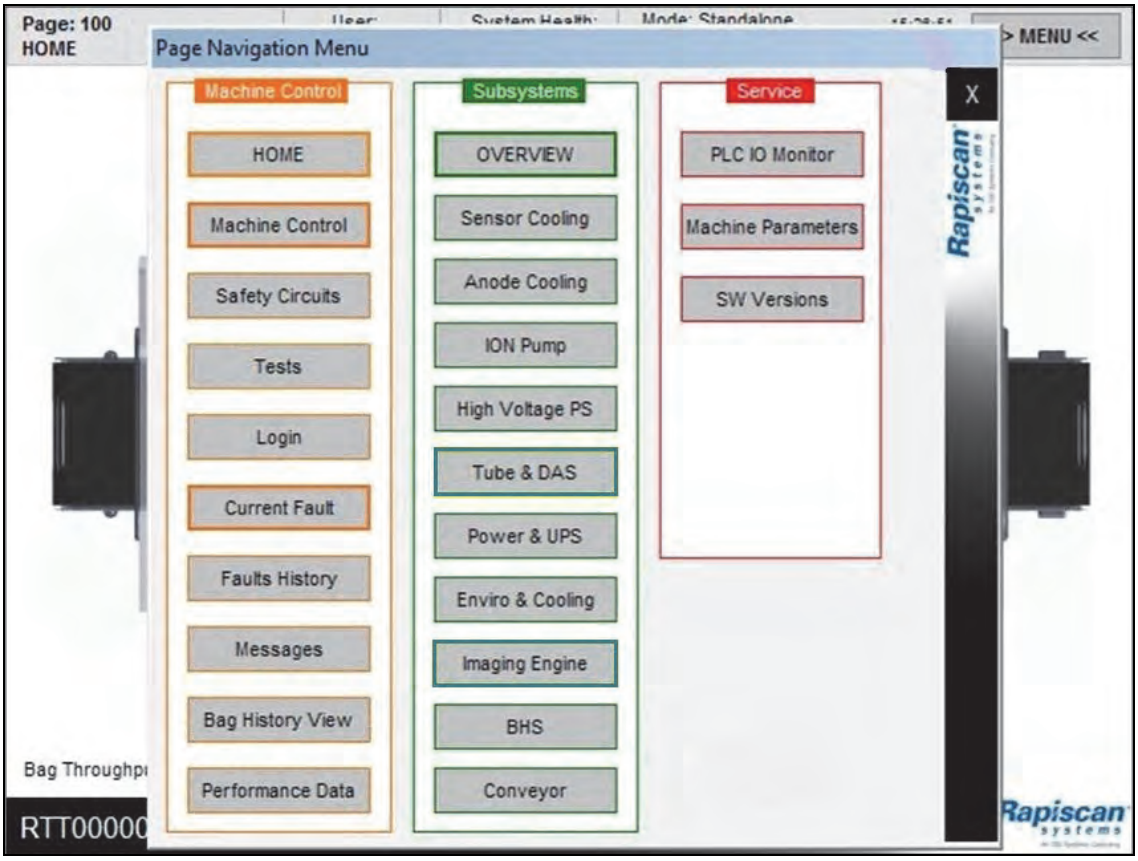



*Figure 5 HMI, Page Navigation Menu*

11. Load the *Machine Control* page, by selecting the *Machine Control* button from the *Machine Control* toolbar.

    The *Machine Control* page appears.

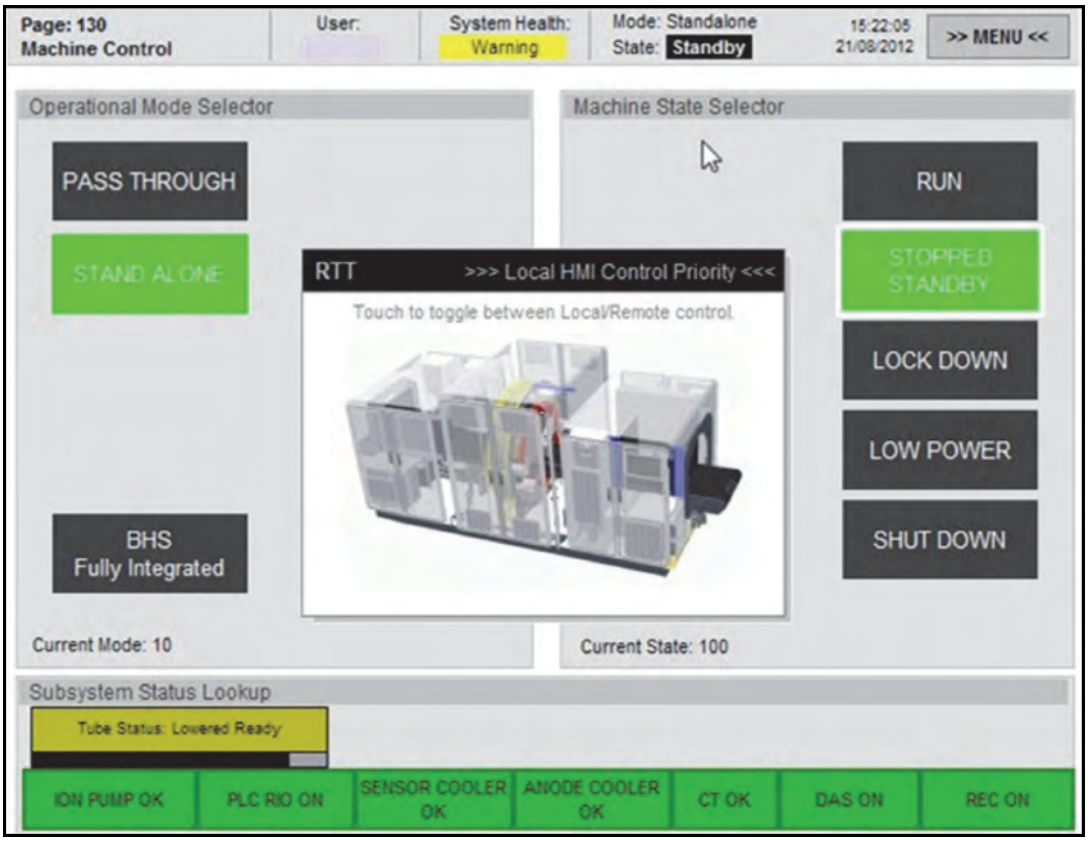



*Figure 6 HMI, Machine Control toolbar, Machine Control page*

12. Select the *RUN* button under the field heading *Machine State Selector* on the *Machine Control* page, the x-ray scanner's State changes and the HMI Status bar displays:

    State: *Start Up*

    The RTT110 will now start up, as the control system gradually introduces power to various subsystems, including at this stage heating the x-ray generator to normal operating temperature - when this completes the remaining on board computers are supplied power and started.

13. When the system start up is completed, the system State changes and the HMI Status bar displays:

    State: *Standby*

14. Now the RTT110 system has completed the Start Up and is ready to accept bags for scanning - once an applicable RUN/Scanning State is set.

    **Note:** It is possible with the time delay, whilst the scanners subsystems start up the HMI can 'time out' (anything over approximately 5 minutes) and the control system will log off the current operator automatically.

    **Note:** A HMI login will be required before setting the scanner into a Run state (bag scanning).

15. Select *RUN* from the *Machine Control* page, to start the x-ray scanner in a scanning operation.

## 10.2.2 Shut Down

**CAUTION!**

Only trained qualified personnel should operate the RTT110 system.

### RTT110 - Shut Down Steps

1. Login to the HMI, see *HMI Log in - Steps: on page 136*.

   **Note:** Ensure when *Logging In* your user profile will provide you with sufficient level of access to see the HMI *Machine Control* toolbar.

2. Load the *Machine Control* page, by selecting the HMI display *HOME* button to access the *Page Navigation Menu*, then select the *Machine Control* button from the *Machine Control* toolbar.
   The *Machine Control* page appears.

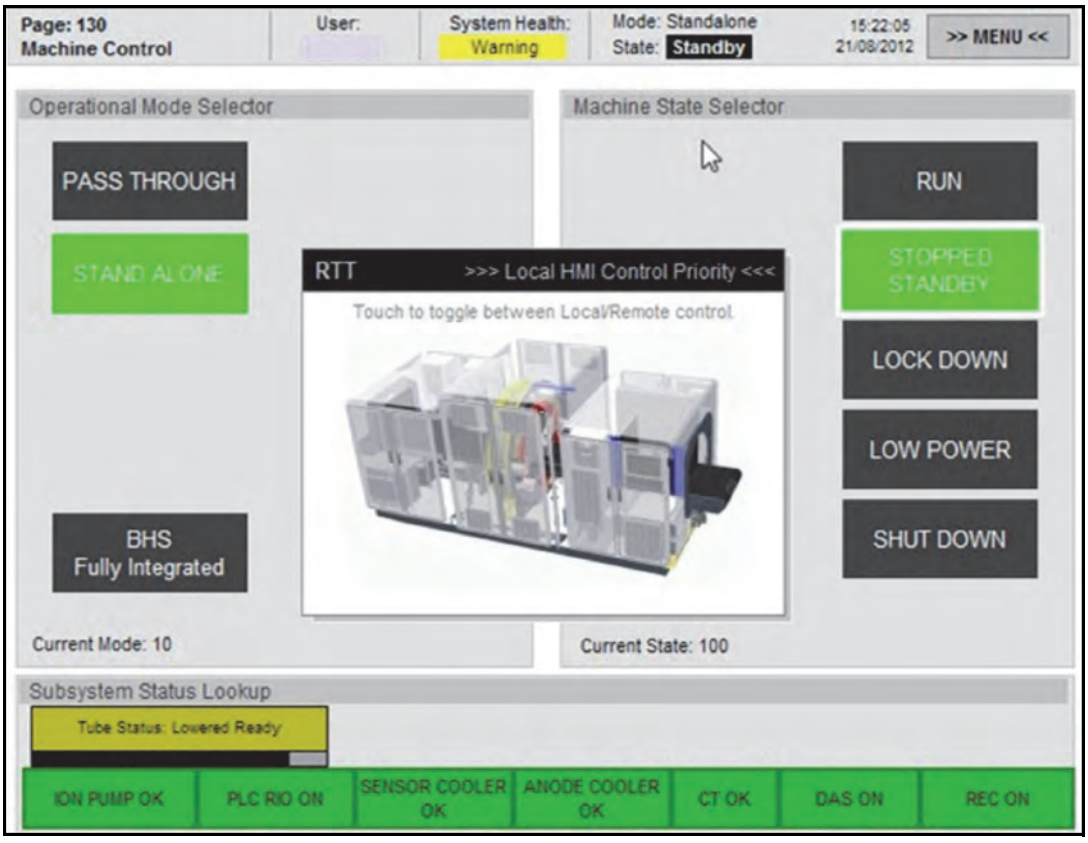



*Figure 7 HMI, Machine Control toolbar, Machine Control page*

3. Select and press the *SHUT DOWN* button, under the field heading *Machine State Selector* on the *Machine Control* page.
4. Allow a period of time, while the system shuts down, including the HMI display.

5. Turn the key switch, located to the right of the HMI to the Off position, by rotating fully anti-clockwise (to the left).

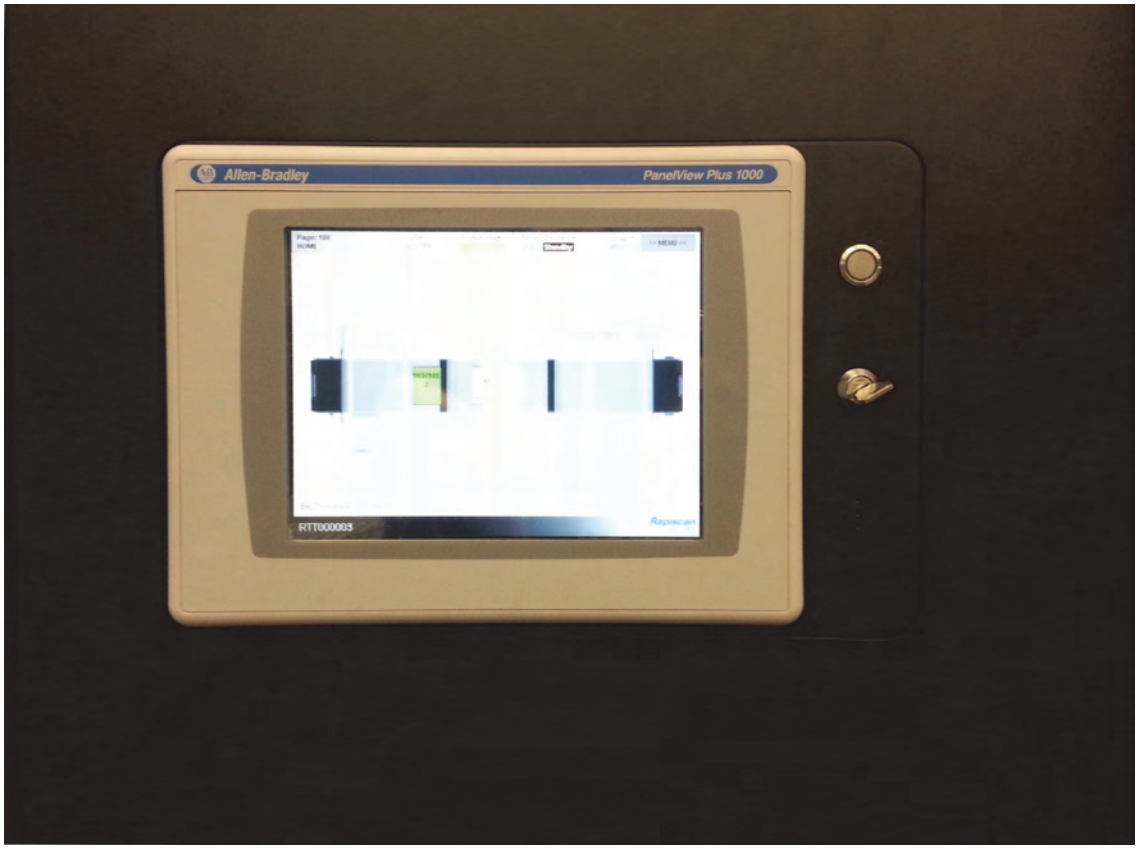



*Figure 8 HMI, Key switch & start button*

6. The RTT110 system is completely shut down (off).

### 10.2.3 HMI - Logging In/Out

Before an Operator can control the system, access to the RTT Control system must be granted. This is achieved by *Logging In* to a pre-configured User Account stored in the Matrix Network server using the HMI touch screen.

**Pre-requisites:**

The following pre-requisites are listed below and must be followed;

- Review, and comply with *Pre Operational Checks on page 124*
- The RTT110 system is operational

**Note:** Various levels of User Access can be configured, to offer specific User accounts, which in turn enables different levels of users to access the system, which have different system responsibilities/roles, for example a basic User or a Supervisor.

For further information see *User Level & Access on page 68*.

## Logging In

### HMI Log in - Steps:

1. From the HMI *Page Navigation Menu* select the *Login* button from the *Machine Control* toolbar.
2. The *Login* page appears, displaying the following fields; *Current Login* and *New Login* - see below:

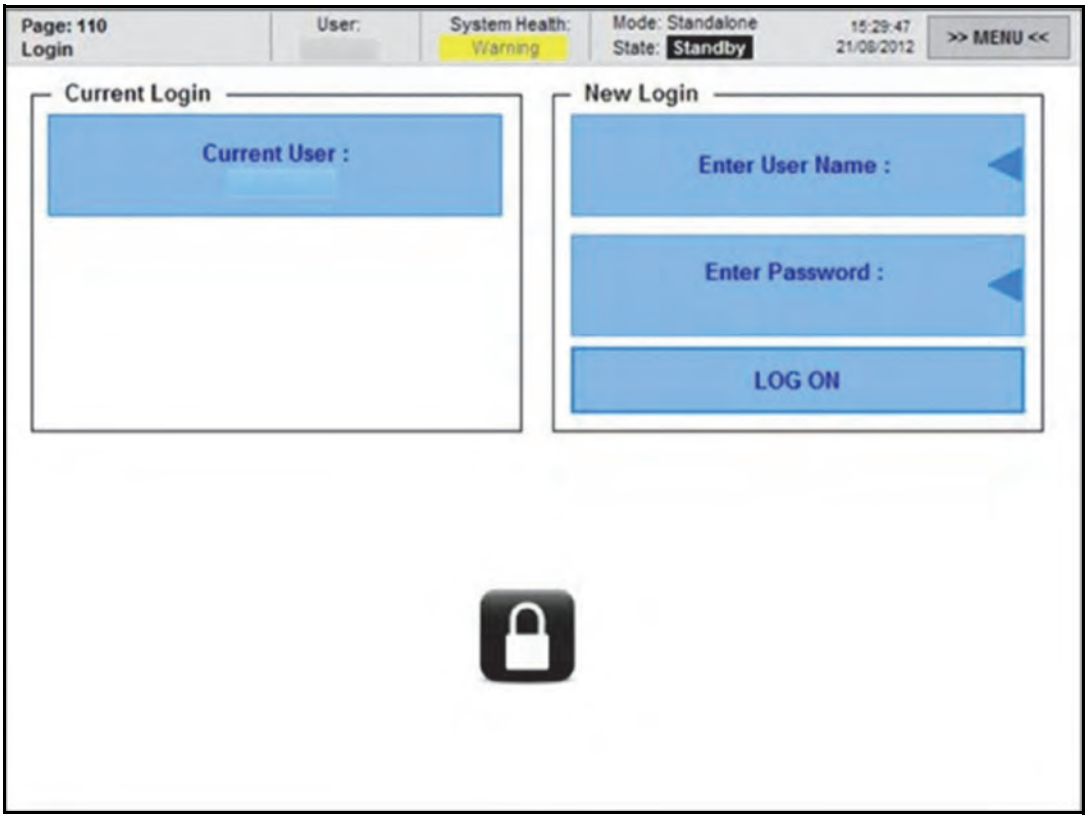



*Figure 9 HMI, Machine Control toolbar, Login page*

**Note:** The above *Login* page indicates no person (user) is logged on to the HMI, as both the *Current User* and *User Access Level* display.

3. To Log in, press the *Enter User Name:* button below the *New Login field.*
4. The *Enter User Name:* page appears containing an on screen keyboard.
5. Using the on screen keyboard, type a *User Name* and then select *Enter* to complete entering the User Name details.
6. Select the *Enter Password:* button below the *New Login* field.
7. The *Enter Password:* page appears containing an on screen keyboard.
8. Using the on screen keyboard, type the associated password for the above *User Name* and then select *Enter* to complete entering the password.

9. With both the User Name and Password entered, select the *LOG ON* button to complete the *Logging In* operation.

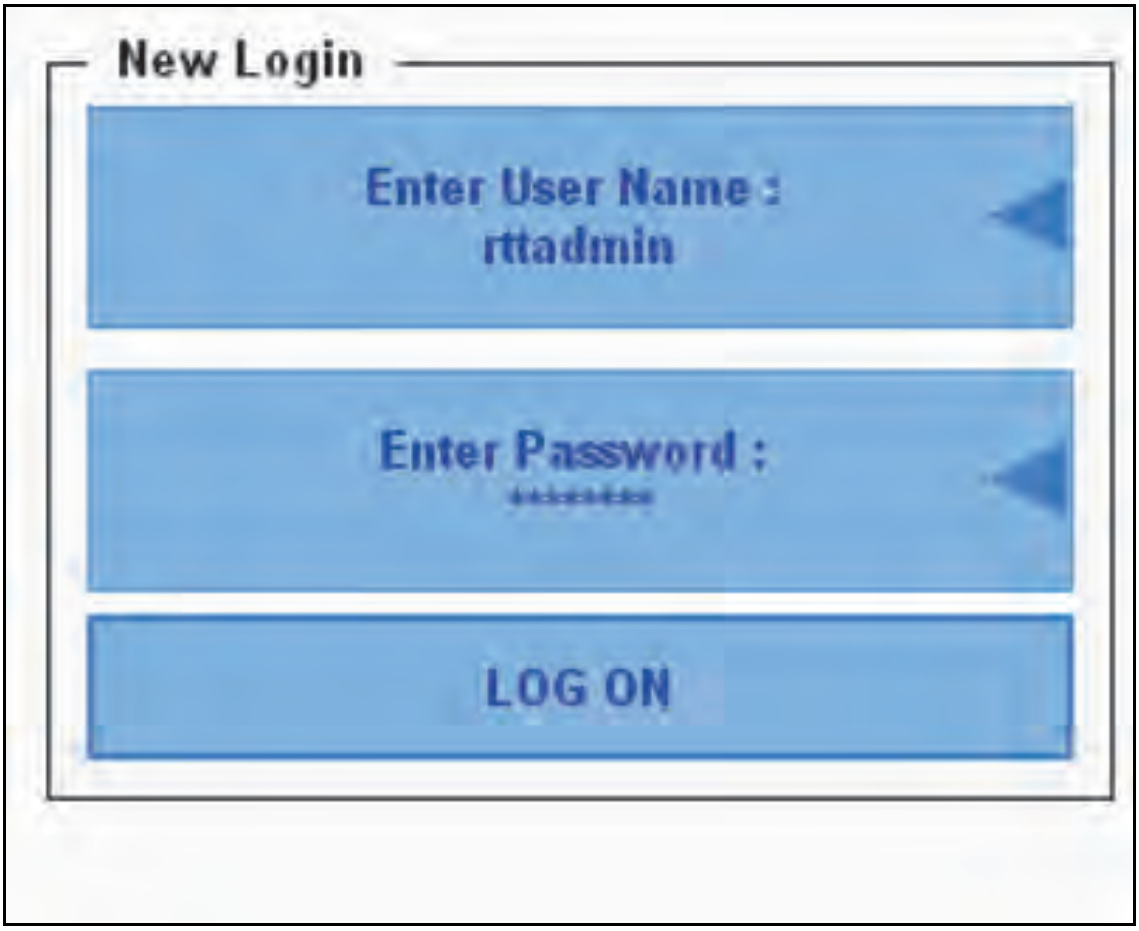



*Figure 10 New Login page*

10. The *Current Login* page appears displaying, and confirming details of the *Current Login* (the person connected and in control of the HMI) - see below:

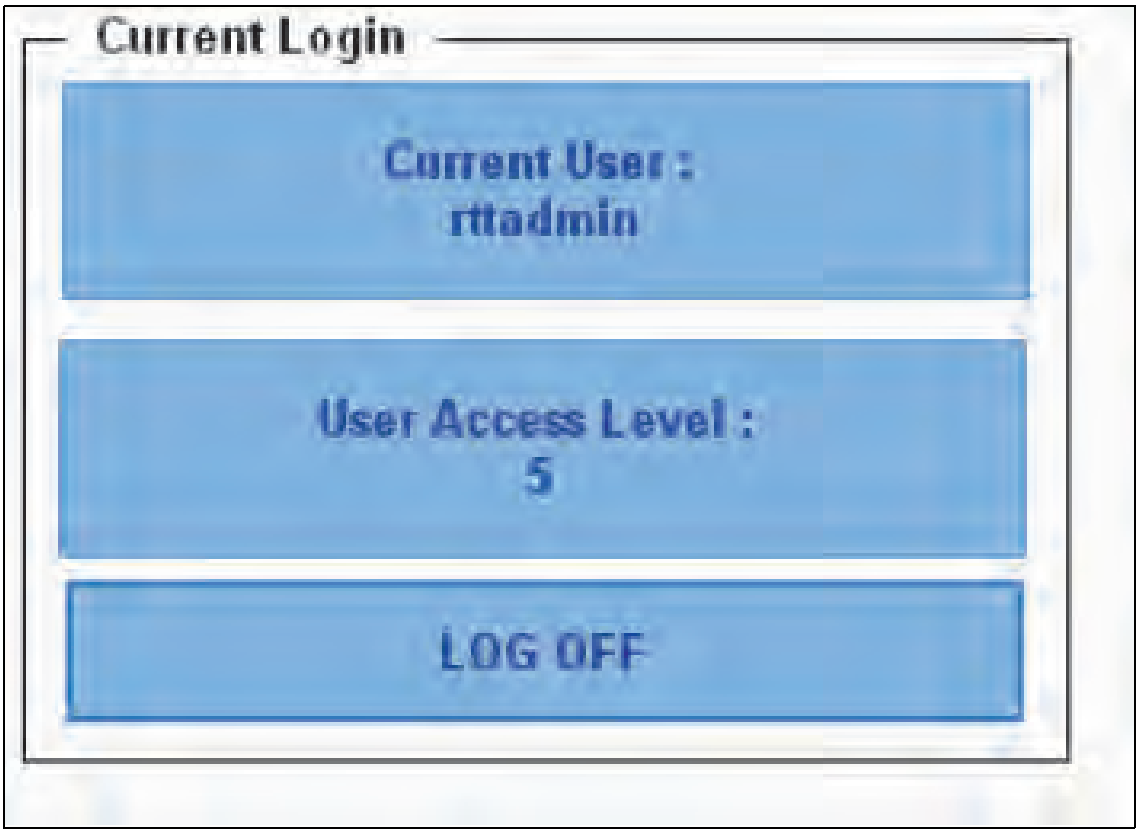



*Figure 11 Current Login page*

11. Select *Menu* to close the *Login* page and return to the *HMI Page Navigation Menu*.

## Logging Out

### HMI Logging Out - Steps:

1. From the HMI *Menu* page, select the *Login* button from the *Machine Control* toolbar.

   The *Login* page appears.

   Select the *LOG OUT* button, from the *Login* page.
   The current operator will be Logged Out immediately.

# 10.3 Operator Workstation - Switching ON & OFF

The following operations are necessary to switch the Operators workstation On and Off for normal operation.

**Note:** The following instructions are written assuming the rest of the RTT110 system is already online and ready (in Standby mode).

## 10.3.1 Start Up

**Pre-Requisites:**

The following pre-requisites are listed below and must be followed;

- A RTT110 EDS must be operational (on)
- Ensure the Workstation's power and network cables are connected and routed/stored safely

**Operators Workstation - Switching ON Steps**

1. Select, and press the Workstation power button, and allow to start up automatically.
2. When the Workstation has completed the start up process the RTTVis *Log on* page will display automatically.

   See *Operator Workstation - Log in (RTTVis) on page 142* for further details.

## 10.3.2 Shut Down

### Operators Workstation - Logging Out

1. See *Operator Workstation - Logging Out (RTTVis) in 10-143*, for further details.

### Operators Workstation Shut Down - Steps

2. Locate and press the Workstation power On/Off button, press but do not HOLD constantly to shut down the workstation completely.

   See *RTTVis - Logging In/Out on page 142* for further details.

## 10.3.3 RTTVis - Logging In/Out

### Logging In

#### Operators Workstation - Start up

1. See *Operators Workstation - Switching ON Steps on page 140*, for further details.

#### Operator Workstation - Log in (RTTVis)

1. With the Operators Workstation started, the RTTVis software automatically starts.
2. Select from the *RTTVis Control* panel the *Admin* tab, and select the *Login* button - see below:

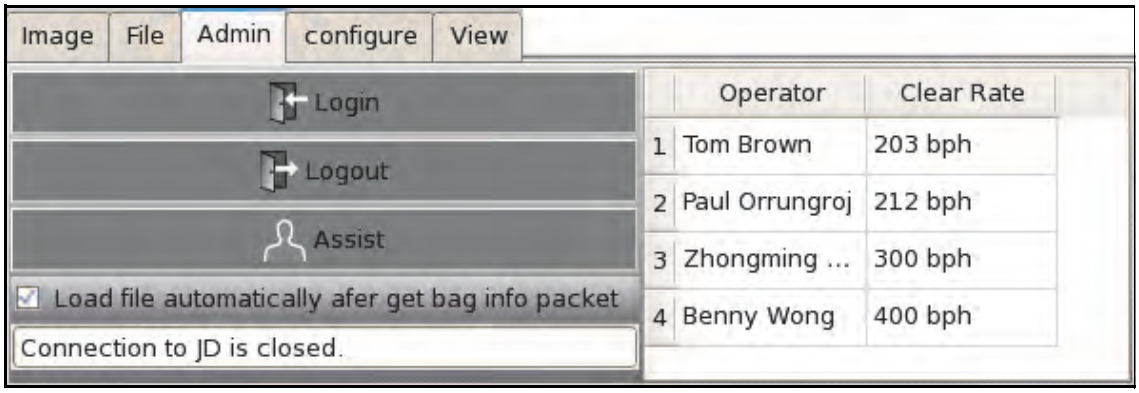



*Figure 12 RTTVis, Workstation Software - Control panel, Login & Logout buttons*

3. The *Operator Login* page appears - see below:


*Figure 13 RTTVis, Workstation Software - Operator Login page*

4. Enter the following information into the RTTVis *Operator Login* page;

| Heading / Field | Field Description |
|---|---|
| Operator ID: | Operator personnel ID number |
| Password: | Operator password (associated with relevant Operator ID). |

5. Select *OK* to enter and complete the *Operator Login* page.
6. You can confirm your *Log in* is successful by checking the last line of the *Admin* tab, the following options could be displayed:

   User Logged in = successful log on

   Incorrect user credentials supplied = confirm correct Log in details supplied

## Logging Out

### Operator Workstation - Logging Out (RTTVis)

1. Select from the *RTTVis Control* panel the *Admin* tab, and select the *Logout* button - see below:

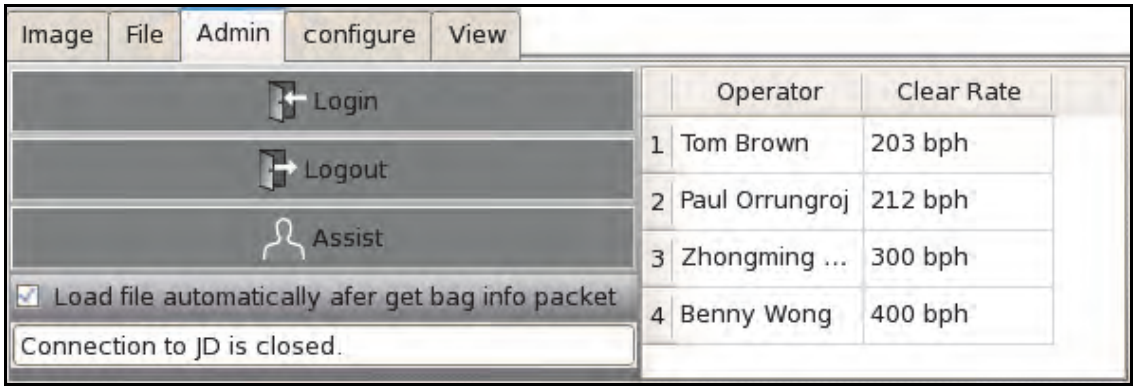



*Figure 14 RTTVis, Workstation Software - Control panel, Login & Logout buttons*

2. The RTTVis Workstation software completes the request, and logs the operator off.
3. The Workstation is disconnected from the RTT110 scanner.

See *Operator Workstation - Log in (RTTVis) on page 142*.

# 10.4 Baggage - Loading & Feeding

The RTT110 can be operated in standalone mode, with bags inserted manually or automatically whilst connected to a powered conveyor, or as an integrated system, with bags automatically inserted by the BHS.

### RTT110 Baggage Limitations

| Baggage Dimensions [1] | Limitation |
|---|---|
| Minimum - Bag Dimensions | *Millimetres (Inches)* |
| Length: | 200 (7.87) |
| Width: | 100 (3.94) |
| Height: | 20 (1.97) |
| Minimum - Bag Weight | *Kg (lb)* |
| Mass: | 5 (11.023) |
| Maximum - Bag Dimensions | *Millimetres (Inches)* |
| Length: | 2500 (98.43) |
| Width: | 1000 (39.37) |
| Height: | 410 (17.13) with a width of 1000 (39.37) or 600 (23.62) with a width of 765 (30.12) |
| Maximum - Bag Weight | *Kg (lb)* |
| Mass: | 50 (110.23) |
| Gap Between Bags | *Millimetres (Inches)* |
| (Minimum): | 200 (7.87) |

1. *Bag sizes/weight are nominal and should be accurate for virtually all standard hold baggage. However, reliable transport cannot be guaranteed for exceptional packages with unusual characteristics. Examples include: extremely large items that are extremely light, extremely slippery items, wheeled items or round items. Such items may encounter problems with any conveyor system and may need to be placed in trays or totes to allow effective transport though the scanner.**

   **Rapiscan Systems will discuss effective solutions with customers that have an unusual prevalence of non standard bags and exceptional packages.*

**Note:** Any bags that are too long will be flushed without being scanned.

## 10.4.1 Manual - Loading / Feeding

Manually loading is possible with the RTT110 system and involves the operator simply checking, preparing and placing the baggage that requires security scanning, into the infeed line of the scanners.

The below list provides guidelines that should be followed when loading baggage. When manually feeding and loading bags ensure the following:

- Confirm baggage does not exceed limits, refer to the *Baggage Limitations table*
- Remove or secure loose straps
- Centre the bag on the infeed conveyor or ramp, (depending on local configuration)
- Ensure wheels/feet are uppermost and forwards
- Ensure handles are not extended
- Ensure when loading multiple bags that there is a gap, a minimum of 0.15 metre / 6 inches provided between each bag

**CAUTION!**

Careful lifting heavy baggage, ensure all Health & Safety protocols are followed when lifting and carrying objects.

Only trained qualified personnel should operate the RTT110 system.

## 10.4.2 Automatic - Loading/Feeding

Where systems are integrated into a Baggage Handling System (BHS), loading/feeding will be the responsibility of the BHS.

No operator interaction will be required except if a bag jam occurs.

## 10.4.3 Bag Jams

If the baggage becomes trapped, or collects at the entrance to the RTT110 system or even possibly inside, preventing the flow of bags through the scanner it is known as a Bag Jam - a fault.

**CAUTION!**

Do not insert any items or part of your body into the inspection tunnel while x-rays are on.

Turn off all system power before reaching inside the tunnel to clear jammed items.

Only trained qualified personnel should operate the RTT110 system.

If a Bag jam fault appears, the operator will be advised through the Control system specifically the Human Machine Interface display.

See *Bag Jam Fault in 7-95*.

See also *Bag Jam Recovery on page 147*.

# 10.5 Recovery Procedures

The following section, items explain the operation and procedure of how to recover from specific conditions that can appear during normal operation.

## 10.5.1 Bag Jam Recovery

### Acknowledging Fault

1. Select the *Ack Fault* button in the *Fault* pop up window, if this clears the bag jam fault, the system returns to normal baggage scanning operation.

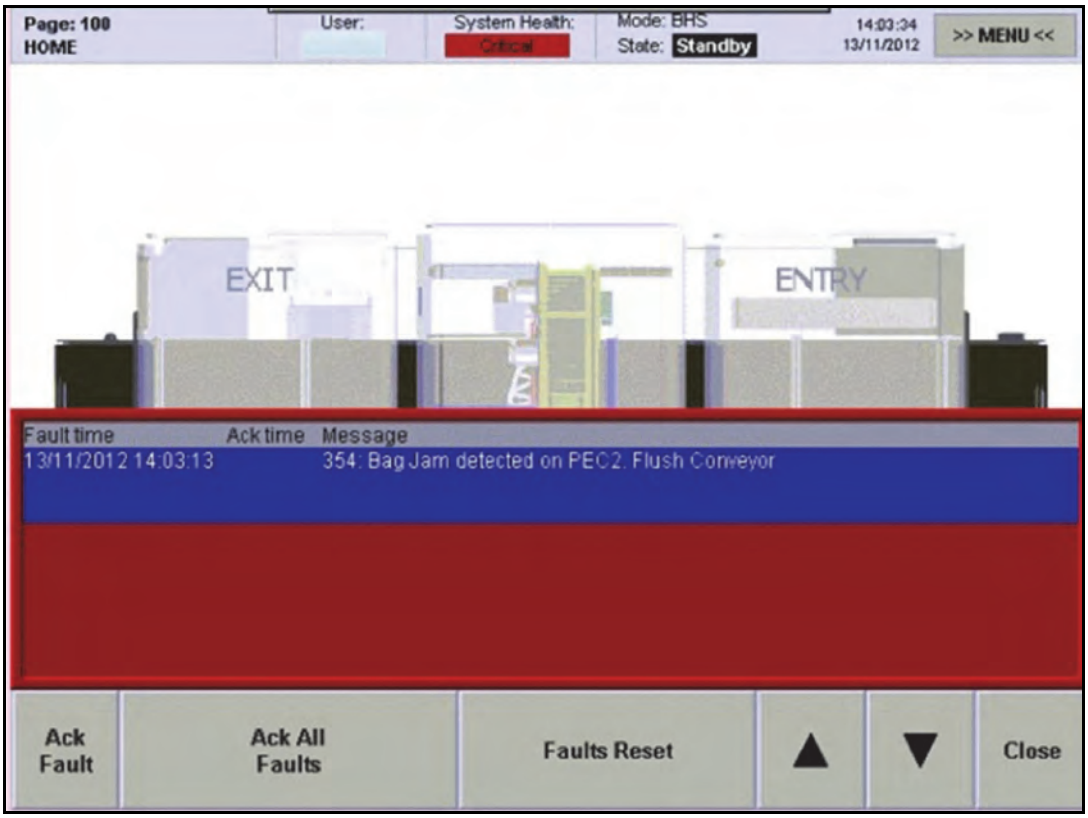



*Figure 15 Bag Jam Fault - Acknowledging Fault*

2. If the *Ack Fault* button does not clear the bag jam fault, continue with the following instructions.

### Bag Jam - Unblocking

If minor jam - this can usually be cleared manually by simply lifting the cases free, and re-positioning on track.

If a major jam - for example, further inside the RTT110 scanner, the conveyor will have to be operated, possibly reversed in direction to extract the jammed bags.

3. Refer to the *Current Fault* page to obtain information about the bag jam location.
4. Press the push button next to the HMI to reset the fault.
5. Select the *Menu* button.
   The *Page Navigation Menu* appears.
6. Select the *Conveyor* button from the *Subsystems* toolbar.
   The *Conveyor* page appears - see below:

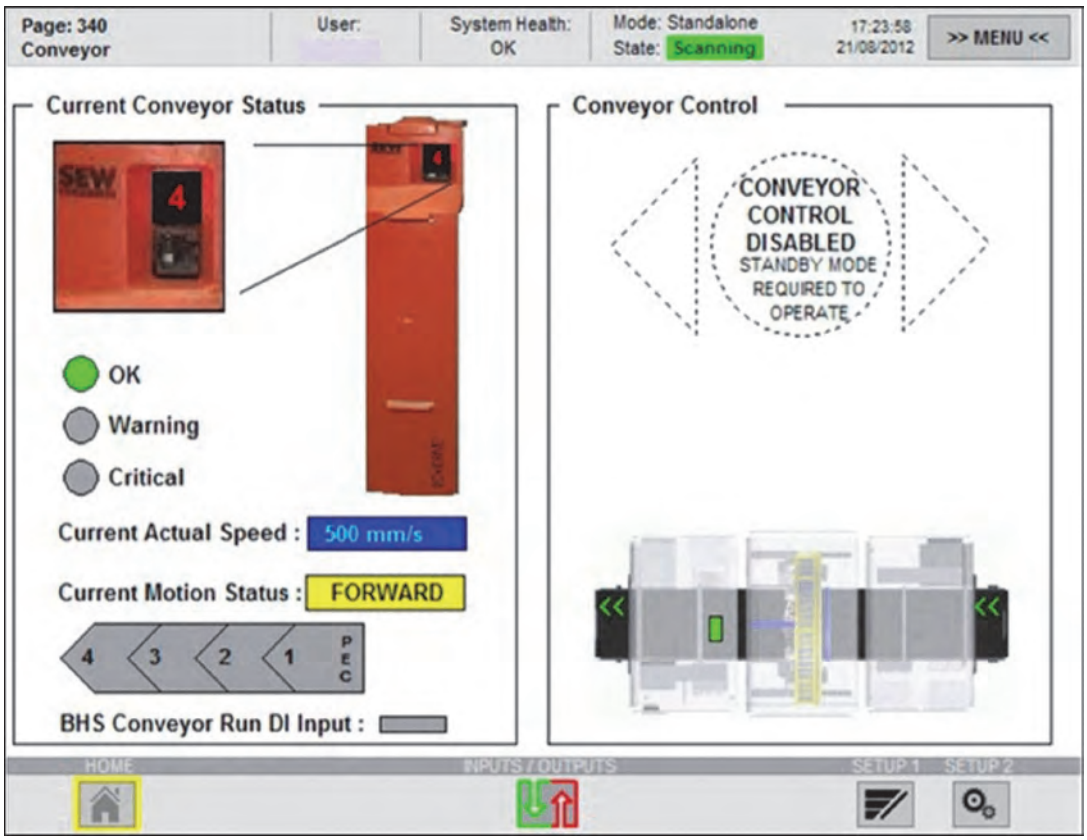



*Figure 16 HMI, Subsystems toolbar, Conveyor page*

7. Using the following Conveyor commands from the *Conveyor* page, the conveyor can be moved in the required direction manually.

| | |
|---|---|
| **Reverse:** | Operates the conveyor in a reverse direction, moving baggage towards the Entry section. |
| **Forward:** | Operates the conveyor in the normal direction towards the Exit section. |
| **Flush Conveyor:** | Operates the conveyor for a set distance, the length of the conveyor, in the normal direction towards the Exit section and then stops automatically - flushing the conveyor. |

8. When the conveyor is clear, select the *Menu* button to clear the *Conveyor* page and return to the *Page Navigation Menu*.

**Re-starting**

9. From the *Page Navigation Menu*, select the *Machine Control* button from the *Machine Control* toolbar.

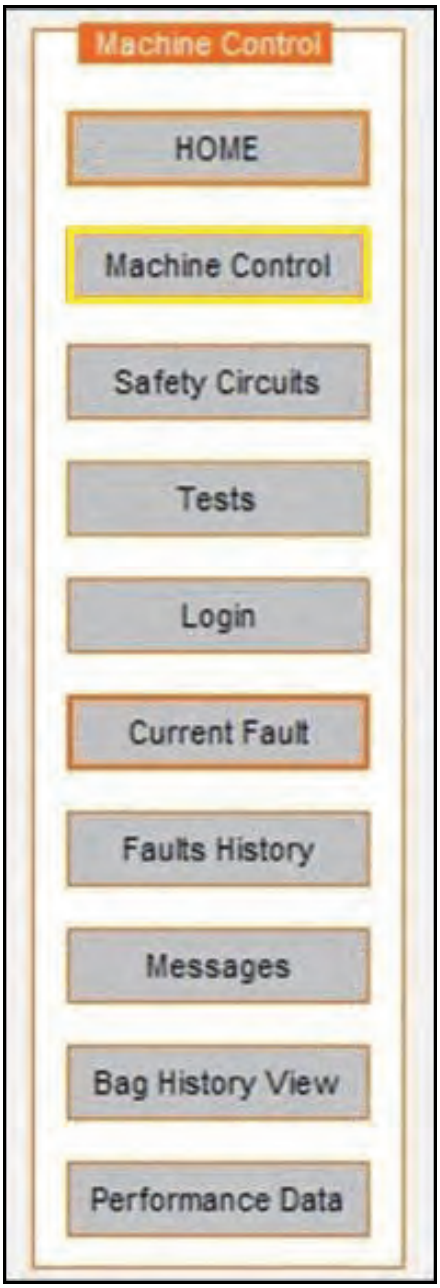



*Figure 17 HMI Page Navigation Menu, Machine Control toolbar*

The *Machine Control* page appears.

10. Select the *Run* button.
    The system will run and the button will change from *Run* to *Running*.

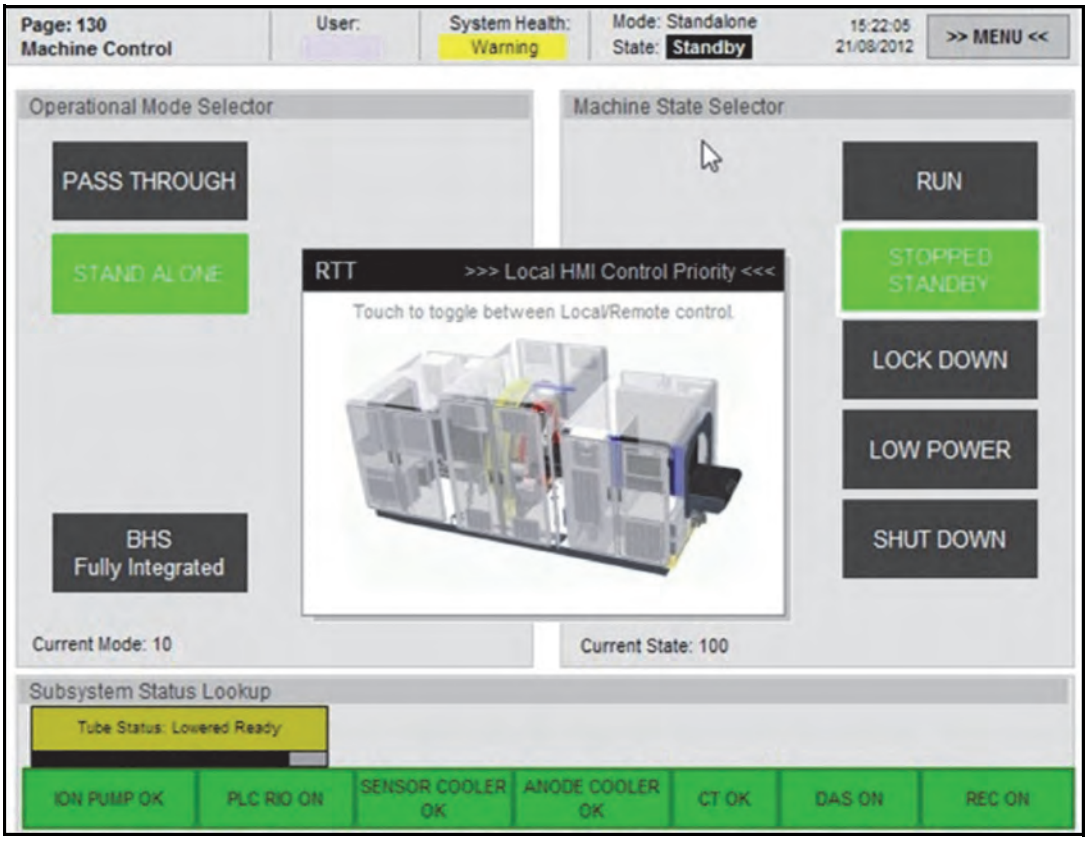



*Figure 18 HMI, Machine Control toolbar, Machine Control page*

## 10.5.2 E-stop Recovery

### Acknowledging Fault

1. Select the *Ack Fault* button in the *Fault* pop up window.

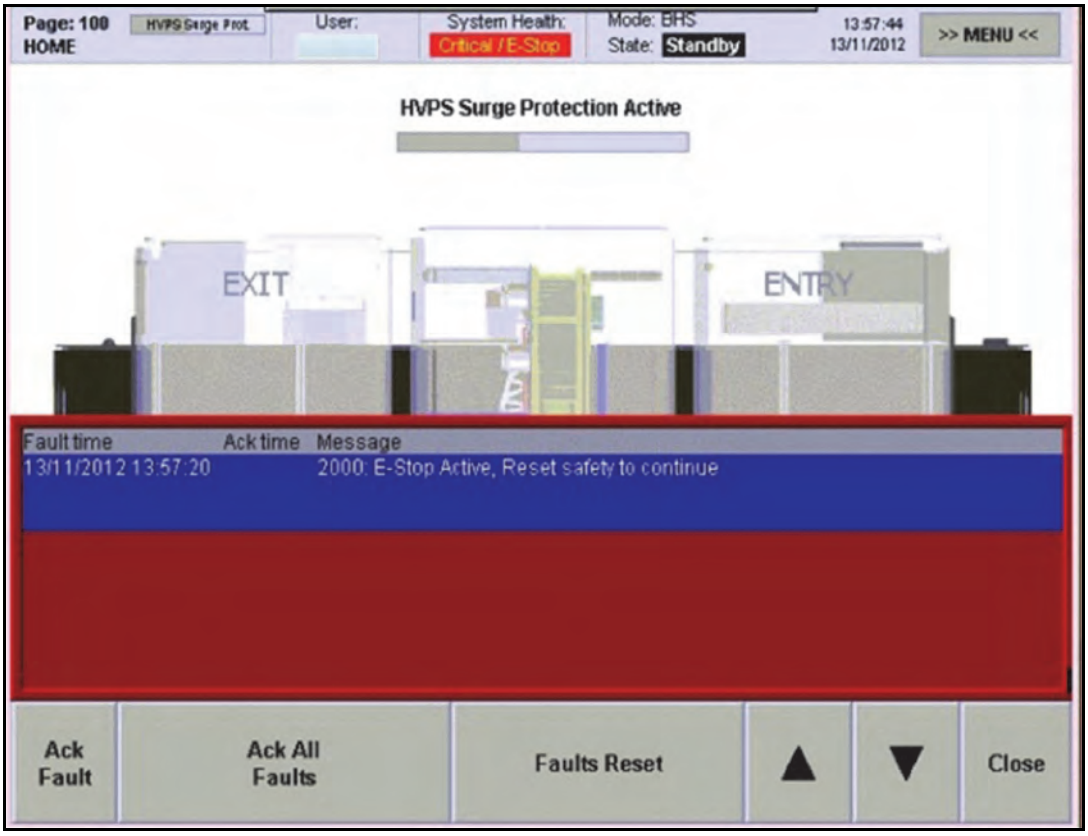



*Figure 19 Fault pop up window - displays E-stop Fault details*

2. If the *Ack Fault* button does not clear the E-stop fault, continue with the following instructions.
3. Determine from the *E-stop Fault* pop up window which E-stop has been activated. (Details will be listed in the pop up window which E-stop switch has been pressed).

### Resetting the E-stop Fault

Resetting is a 2 stage process. The first part identifying and physically resetting the E-stop switch and the second stage resetting the Control Systems *Safety Circuit*.

**Note:** Ensure your HMI Log On will provide sufficient access level to see all the HMI menus.

4. Select the *Menu* button.
   The *Page Navigation Menu* (GUI) should appear.
5. Select the *Safety Circuits* button from the *Machine Control* toolbar.
   The *Safety Circuit* page appears - see below:

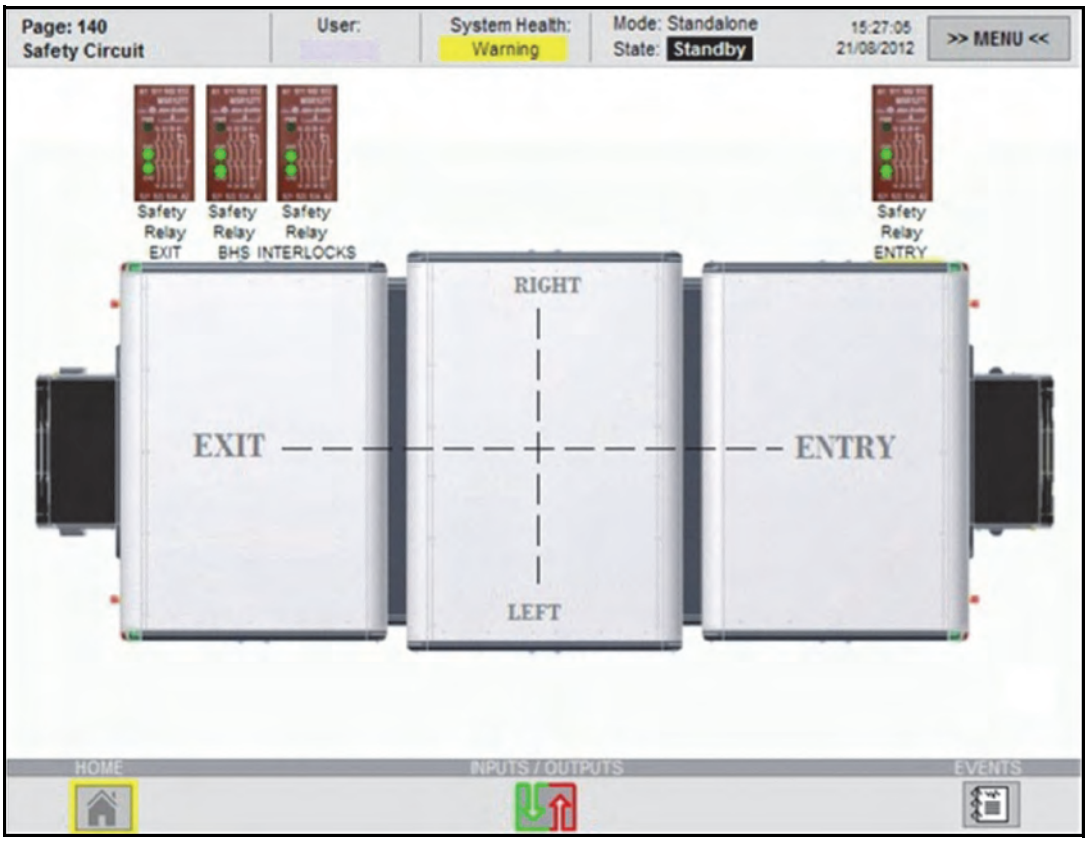



*Figure 20 HMI Machine Control toolbar, Safety Circuit page*

**Note:** Various levels of User Access can be configured, to offer specific User accounts, which in turn enables different levels of users to access the system, which have different system responsibilities/ roles, for example a basic User or a Supervisor.

For further information see *User Level & Access on page 68*.

6. The *Safety Circuit* page will display which circuit the E-stop activation is on, to assist resetting:

| | |
|---|---|
| All | Green Lights<br>Safety Circuits (3) - good, operating correctly |
| Safety Relay 1: | Red lights on:<br>Entry Section safety circuit activated, check E-stop mechanical switches, reset |
| Safety Relay 2: | Red lights on:<br>Exit Section safety circuit activated, check E-stop mechanical switches, reset |
| Safety Relay 3: | Red lights on:<br>Interlock(s) safety circuit activated, check centre section internal lead doors interlock switches and reset |
| Safety Relay 4: | Red lights on:<br>BHS E-stop safety circuit activated, check E-stop mechanical switches, reset |

7. Locate the depressed E-stop switch on the scanner section and physically twist anti-clockwise and pull the red button out to reset.

### Safety Circuit Reset

8. To reset the Safety Circuit, press the button next to the HMI display, above the RTT Control system key switch - see below:

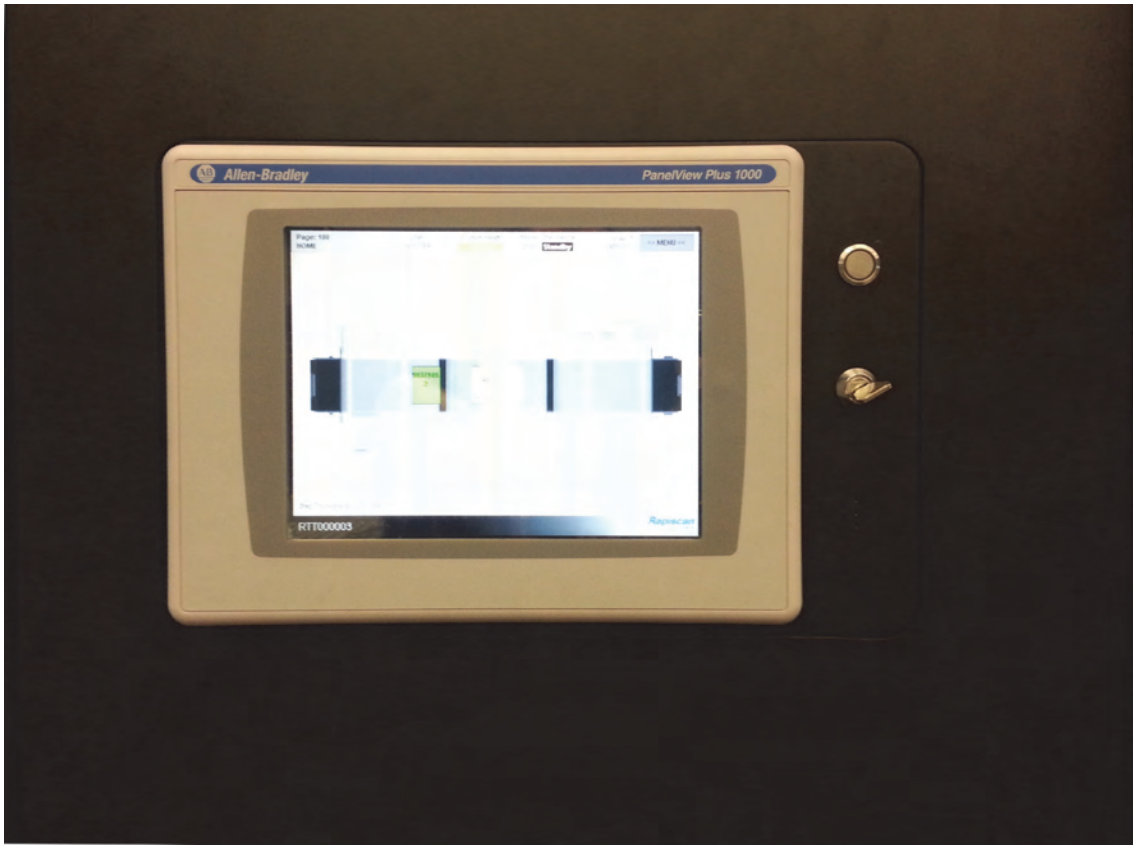



*Figure 21 HMI Display, Key switch and reset button*

The *Safety Circuit* page will confirm reset.

The display will refresh and all Safety circuits that had red lights displayed, will display as green lights indicating normal operating circuit.

9. Return to the *Menu* page, select the *Menu* button on the *Safety Circuit* page.

### Re-starting

10. From the *Page Navigation Menu*, select the *Machine Control* button from the *Machine Control* toolbar.
11. The *Machine Control* page appears.
12. Select the *Run* button.
    The system will start and return to normal operation.

# 10.6 System Test Procedures

The following procedures are used to test and ensure that the RTT110 is operating in an accurate, efficient and safe operation.

**Pre-Requisites:**

Ensure the following is complied with before starting any system tests;

- Ensure the RTT110 is on (but not in operation scanning bags)
- An operator is currently Logged In at the HMI

### 10.6.1 OTK Daily Test

The Operational Test Kit (OTK) Daily test is designed to test *System Health* and ensure that the RTT110 system is working sufficiently to perform it's function of security screening safely.

It is recommended that the OTK test is completed every day when the system is started at the beginning of the working day. However, local operating protocols may be in place that define more or less frequent OTK testing.

**Note:** If the OTK test result is FAIL or ERROR the system is out of tolerance, operating incorrectly and should not be used. Please contact Rapiscan Systems immediately.

**CAUTION!**

Any failure to comply with instructions issued as a result of OTK testing can result in the improper operation of the RTT110 and a risk of security breaches.

Only trained qualified personnel should operate the RTT110 system.

### HMI - Starting OTK Daily Test

**WARNING!**

If the OTK test result is either *ERROR* or *FAIL*, the RTT110 being tested must not be used.

Rapiscan Systems must be contacted immediately.

1. Select the *Tests* option from the *HMI Menu* page, by pressing the *Tests* button on the *Service* toolbar.
2. The *OTK Daily Test* page appears - see below.


*Figure 22 System Test - OTK Daily Test page, starting*

3. The operator selects the *Select OTK Daily Test (1)* button to start the automated process and continues following the on screen instructions.
4. Place the test kit onto the conveyor in the orientation (direction) according to the markings on the case.
5. At the HMI, proceed to the next step, select *Run* and wait for the test to complete.
6. Once scanned and passed through, remove the test kit from the conveyor.
7. Select and press the *OTK Test Complete (6)* button.

### OTK Daily Test - Result

8. The OTK Daily test will advise on completion if the result of the test is a PASS, MARGINAL PASS, FAIL or ERROR in the Red high lighted area, under the *Latest Test Results* field.

**CAUTION!**

Do not operate or use the RTT110 if the OTK Daily Test Fails - contact *Rapiscan Systems* see *Service Departments in 1-24*.

Only trained qualified personnel should operate the RTT110 system.

**WARNING!**

If the OTK test result is either *ERROR* or *FAIL*, the RTT110 being tested must not be used.

Rapiscan Systems must be contacted immediately.

All information, illustrations and specifications contained within this manual are based on the latest production information available at the time of publication

The right is reserved to make changes at any time without notice.

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RAPISCAN RTT™110

Rapiscan® systems

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