

CT2211 Aerosol Leak Detection System



Preface

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1 Introduction

The aerosol leak detection system described in this document has been quality control tested and left the manufacturer in pristine condition. To achieve the correct and safe operation of the product, it must be transported, installed, operated, and maintained as described by the manufacturer.

This manual contains all the information required to operate the leak detection system, including basic maintenance and troubleshooting information. Please read the manual carefully before you start work on the leak detection system, as it contains important information that must be followed to guarantee the correct operation of the system and the safety of personnel. The manual is divided into sections, which allows you to rapidly find the information you need.

Cascade Technologies is committed to continuously improving its products and documentation. Every effort will be made to include any sensor modifications by the manufacturer in the documentation. However, it should be noted that this document reflects the supplied sensor as of the revision number and date on the front cover.

Should you require further information or should particular problems arise that are not covered within this user manual, then refer to the Leak Detection System Installation and Service Manual. Additional help can also be requested from Cascade Technical Support (qcl.csc@emerson.com) or Cascade Technologies distribution partners.

1.1 Qualified personnel

These operating instructions have been prepared for technically qualified personnel who have been specially trained or who possess appropriate knowledge in the field of instrumentation and control.

Knowledge of the safety information within this user manual and its technically correct implementation are prerequisites for danger-free installation, commissioning, operation and maintenance of the system. Only qualified persons have the required specific knowledge to correctly interpret the general safety information and warnings given in this user manual and thus apply them to the particular application.

1.2 Safety

During the manufacturing process of the aerosol leak detection system, a rigorous set of safety and quality checks is performed to ensure that the equipment meets and exceeds the safety requirements for the system. In order to maintain the operational performance and safety of the control system, the correct installation, use, and maintenance procedures detailed by the manufacturer must be adhered to.

The aerosol leak detection system uses no ionizing radiation.

⚠ CAUTION

Certain parts of the Leak Detection system carry dangerous voltages. All housings must be closed with covers in place and the sensor head mounted and connected to the air arch before switching on. Death, personal injury, and/or damage to persons and/or property may result if this is not observed.

⚠ CAUTION

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

All lasers used within the leak detection system are of class 1. The emitted laser light is invisible (mid-infrared) and the pulse duration so short that the unprotected eye will not be damaged. The nature of the laser beam path and beam width furthers ensures that it should be impossible to cause any eye damage. The leak detection system has warning labels at appropriate positions according to USA 21 CFR 1040.10.

1.3 Certifications and approvals



All in zone parts comply with the ATEX directive (94/9/EC).

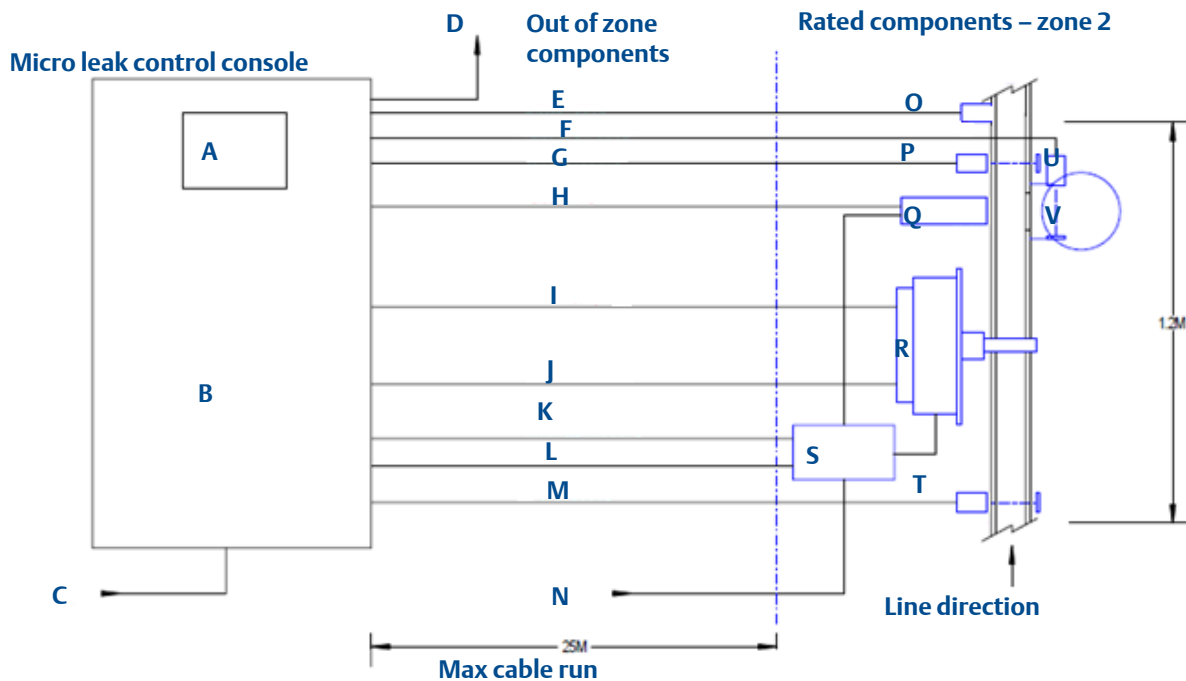


This leak detector complies with USA 21 CFR 1040.10. It is also designed and manufactured under an approved quality management system to ISO 9001:2008.

1.4 System overview

The aerosol leak detector is used on aerosol production lines in conjunction with a control and reject mechanism, to form the aerosol leak detection system, which is used to manage the interaction with the line and the safe removal of faulty cans at high speed. The system consists of a detector, control console (non-ATEX), encoder, optical gates, rejecter (air based reject as standard), reject chute, air preparation equipment, and mounting mechanics. [Figure 1-1](#) and [Figure 1-2](#) below show the schematic of the leak detection system:

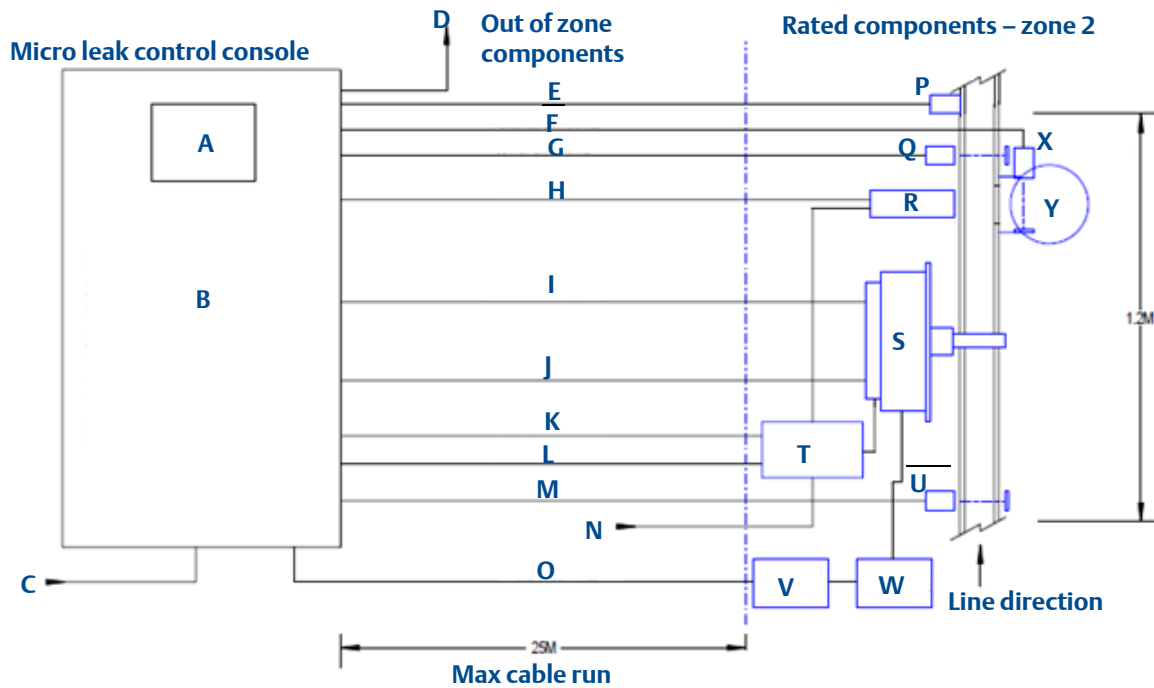
Figure 1-1 Aerosol leak detection system - Venturi configuration



- | | |
|-----------------------------------------------------------------------------|--------------------------------------------------------------------|
| A. HMI | M. Input gate signal |
| B. Leak Detection System ¹ | N. Compressed air supply min 5 BAR, max 10 BAR (customer supplied) |
| C. AC supply voltage 110V/220V AC, 50-60 Hz 13A (customer supplied) | O. Encoder |
| D. Line status signals to customer communications (running, waiting, error) | P. Output gate |
| E. Encoder signal | Q. Reject |
| F. Rejected can signal | R. Micro leak detector |
| G. Output gate signal | S. Air status air control |
| H. Reject signal | T. Input gate |
| I. CT2211 communications (cat5) | U. Rejected can gate |
| J. CT2211 I/O and power | V. Reject bin (customer supplied) |
| K. Mirror cleaning signal | |
| L. Air status signal | |

¹ The leak detection system components are: DC power supplies (+12V & 24V); system controlling PC with Microsoft® Windows operating system; micro leak and control system software; national instruments digital I/O and digital timing card; line driver and opto barrier circuitry; customer line PLC interface; vircuit protection; AC power control; and console thermal management and control.

Figure 1-2 Aerosol leak detection system - blower configuration



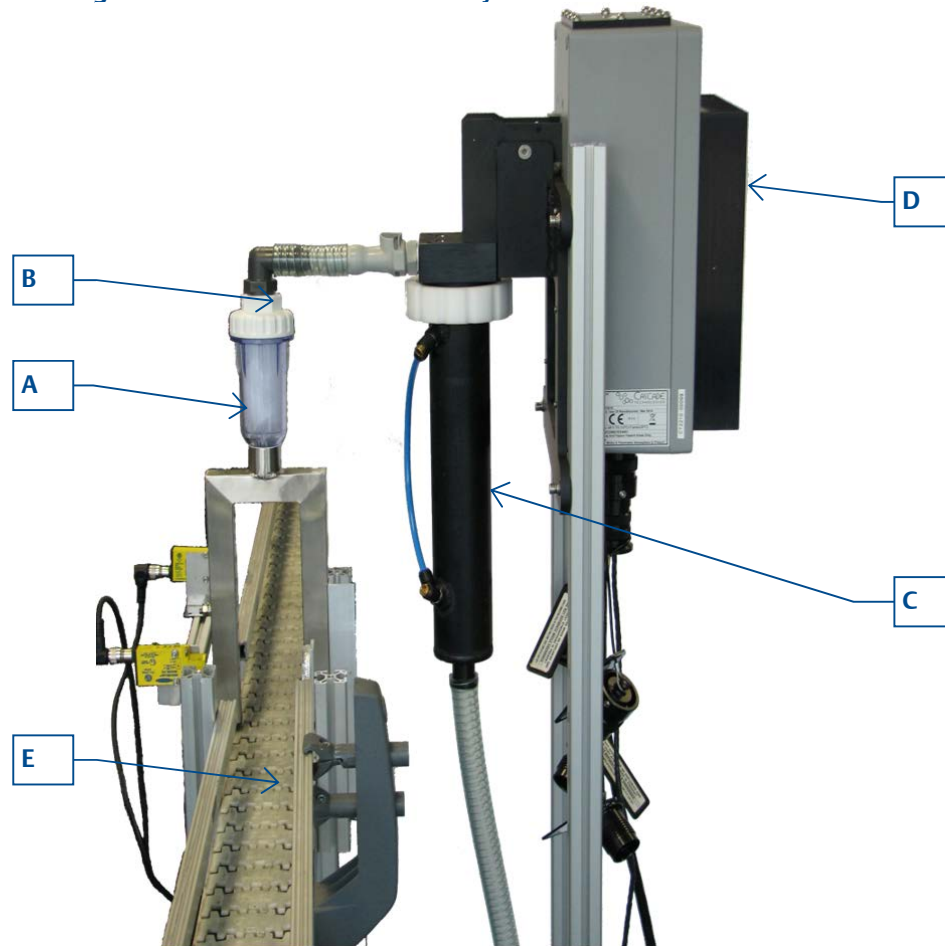
- | | |
|-----------------------------------------------------------------------------|--------------------------------------------------------------------|
| A. HMI | M. Input gate signal |
| B. Leak detection system ² | N. Compressed air supply min 5 BAR, max 10 BAR (customer supplied) |
| C. AC supply voltage 110V/220V AC, 50-60 Hz 13A (customer supplied) | O. Phase controlled power |
| D. Line status signals to customer communications (running, waiting, error) | P. Encoder |
| E. Encoder signal | Q. Output gate |
| F. Rejected can signal | R. Reject. |
| G. Output gate signal | S. Micro Leak detector |
| H. Reject signal | T. Air status air control |
| I. CT2211 communications (cat5) | U. Input gate |
| J. CT2211 I/O and power | V. ATEX zone 2 disconnect switch |
| K. Mirror cleaning signal | W. ATEX zone 2 rated blower |
| L. Air status signal | X. Rejected can gate |
| | Y. Reject bin (customer supplied) |

² The leak detection system components are: DC power supplies (+12V & 24V); system controlling PC with Microsoft® Windows operating system; micro leak and control system software; national instruments digital I/O and digital timing card; line driver and opto barrier circuitry; customer line PLC interface; circuit protection; AC power control; and console thermal management and control.

1.5 Leak detector overview

The leak detector identifies aerosol cans that are leaking propellant as they are carried along a conveyor belt at high speed. The leak detector consists of an air extraction arch, air filter/regulator, sample cell, sensor head and either a Venturi or 3-phase blower.

Figure 1-3 Monitoring aerosol cans for leaks on a conveyor



- A. Air extraction arch – draws the air from around the aerosol can into the sample handling system
- B. Air filter – for the removal of air particles and leaked contents of the aerosol cans
- C. Sample cell – laser light is directed through the air extracted from around the cans and back into the sensor head.
- D. Sensor head – contains the lasers and laser light detector. It is ATEX Category 3 rated for a Zone 2 explosive environment.
- E. Conveyor belt – transporting the aerosol cans

Aerosol cans (not shown) are moving along the conveyor belt.

The control console (not shown) is located outside the explosive environment and is not ATEX rated.

The power supply (not shown) for the sensor is also mounted outside the explosive environment.

The Venturi (not shown) is powered by compressed air and mounted in the exhaust line below the sample cell. It is used to draw air from around the aerosol cans via the air extraction arch.

The 3-phase blower (not shown) is powered from the control cabinet and mounted in the exhaust line below the sample cell. It is used to draw air from around the aerosol cans via the air extraction arch.

The Venturi air status pressure switch (not shown) signals a third party controller if the air pressure drops below that required by the Venturi.

Gas concentrations are measured using mid-infrared optical absorption spectroscopy. The light sources are quantum cascade lasers, which are operated to produce wavelength sweeps that cover the absorption lines of the gases.

The lasers are mounted in the leak detector, and light is directed into the sample cell, where it is partially absorbed by the gas from the stack. The reflected light from the cell is detected by a receiver in the leak detector. The variation in the intensity of the light in the vicinity of the absorption lines is measured, and the concentration is determined using a comprehensive spectral fitting routine.

1.6 Detailed system specification

The following table shows the general characteristics of the leak detection system.

Table 1-1 Leak detection system specifications

Application	Leak detection system
Measurement technique	IR absorption spectroscopy
IR source	Quantum cascade laser
Laser classification	Class1 BS EN 60825-1:2007 Safety of laser products Equipment classification and requirements (identical to IEC 60825-1 2007)
Sensitivity	2×10^{-3} mbar.L ⁻¹
Line speed	Up to 500 cpm
Can dimensions	Up to 350 mm (H) by 80 mm (D)
Response time	20 ms
Temperature range	10 – 30 °C (50 – 86 °F)
Sample gas temperature range	Room temperature
Leak detector humidity range	10 to 95 % relative humidity (non-condensing) at 35 °C (95 °F)
ATEX Approvals (in zone sensor)	Zone 2 Ex II 2G Ex nR II T6 (10 °C ≤ T _{amb} ≤ 30 °C) (50 °F ≤ T _{amb} ≤ 86 °F)
Leak detection system	CE approved
Protection class	IP65
Hazardous area classification	Ex II 3G Ex nR II T6 (10 °C ≤ T _{amb} ≤ 30 °C) (50 °F ≤ T _{amb} ≤ 86 °F)
Analog signal out	n/a
Analog signal in	n/a
Digital signal out	3 X normally closed contact
Digital signal in	10/100 Base T ethernet
Inlet gas port connector	¾ in. BSPT
Exhaust gas port connector	¾ in. BSPT
Power supply	120 VAC 60 Hz/240 VAC 50 Hz 200 W/A
Control console size	1,200 x 600 x 560 mm (H x W x D)
Control console weight	70 kg
Sensor head size	590 x 330 x 330 mm (H x W x D) sensor only
Sensor head weight	20 kg (sensor only)
Installation	On production line
System operating voltage	110 – 240 V AC 50 -60 Hz, specify on order
System power consumption	600 W maximum power requirement
Max factory air consumption	25 L/min approximately on regular usage
Factory compressed air pressure	8-10 bar, clean, dry, and oil free
Line space requirement	1.2 m straight free line (maximum)
Air filter particulate filter	2 um, inline filter/regulator required

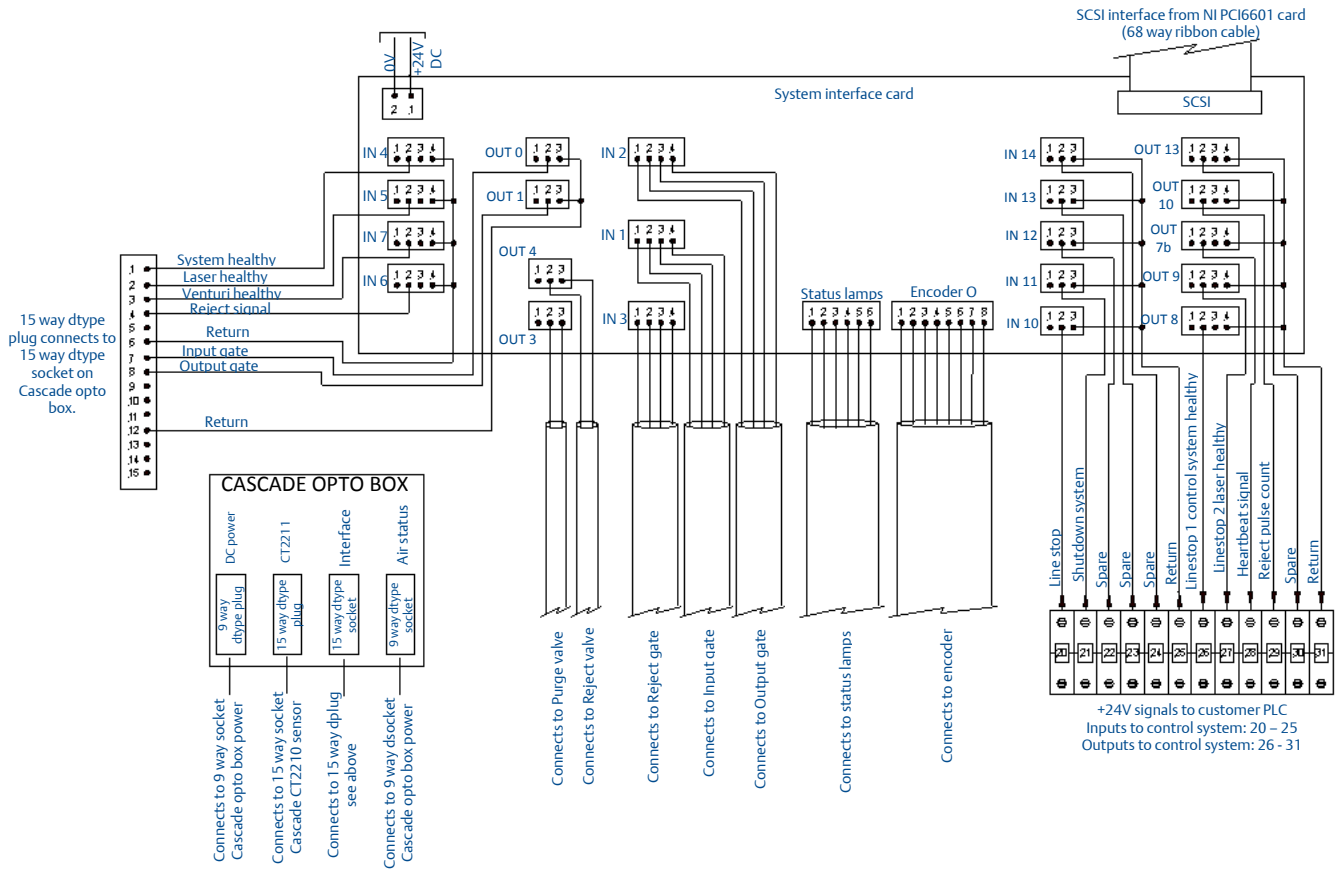
1.7 Operators' system pre startup checklist

	Remove hose from air line.
	Check and bleed air line.
	Check filter condition and color before switching on system.
	Change filter if more than 60% discolored.
	Ensure that there are no cans between the input and output gates.
	Power on system.
	Power on conveyor; do not let cans through.
	Clear any error messages, e.g., encoder.
	Purge air in chamber
	Let cans through to commence normal working activity.

2 System Connection

The diagram below shows the electrical connections of the aerosol leak detection system:

Figure 2-1 Schematic of I/O and external connections
System I/O, External Component Connection and Customer Interface



The air arch is connected to the leak detector using the attached quick fit connector:

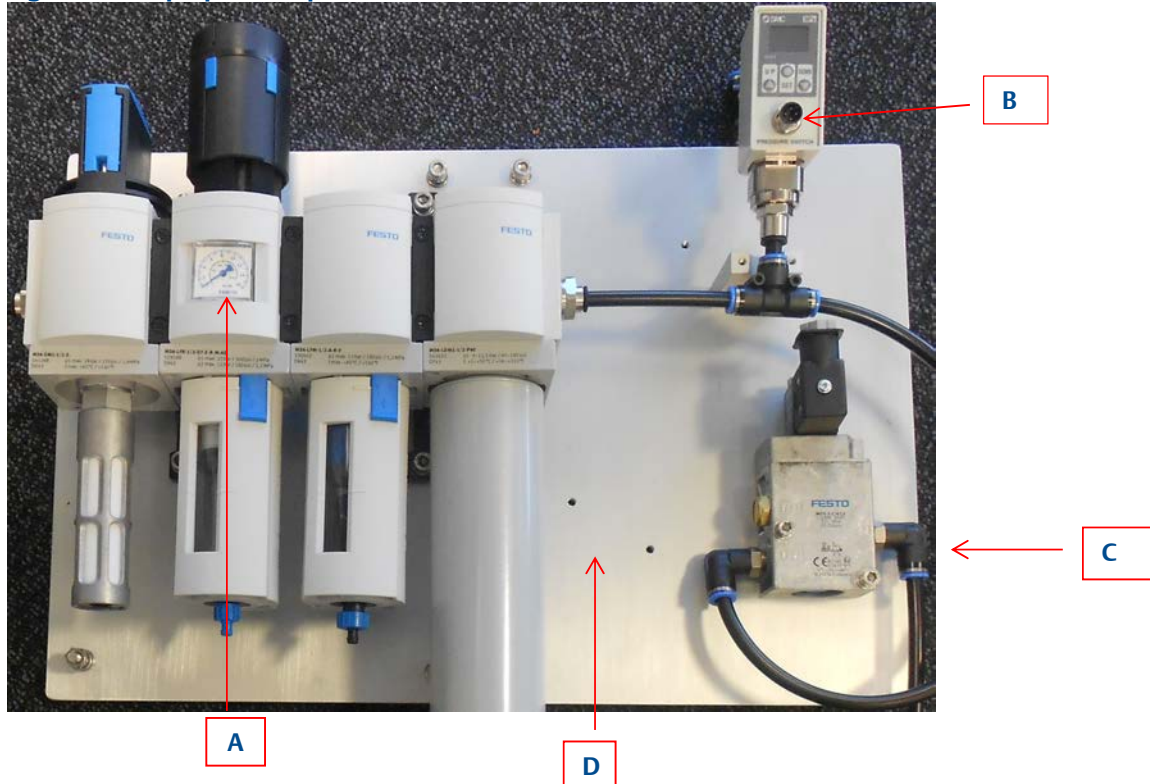
Figure 2-2 Filter assembly and archway quick connector



- A. Filter assembly
- B. Air arch
- C. Leak detector quick fit connector

The filter regulator, pressure switch, and valve shown below are mounted onto the leak detector pedestal stand.

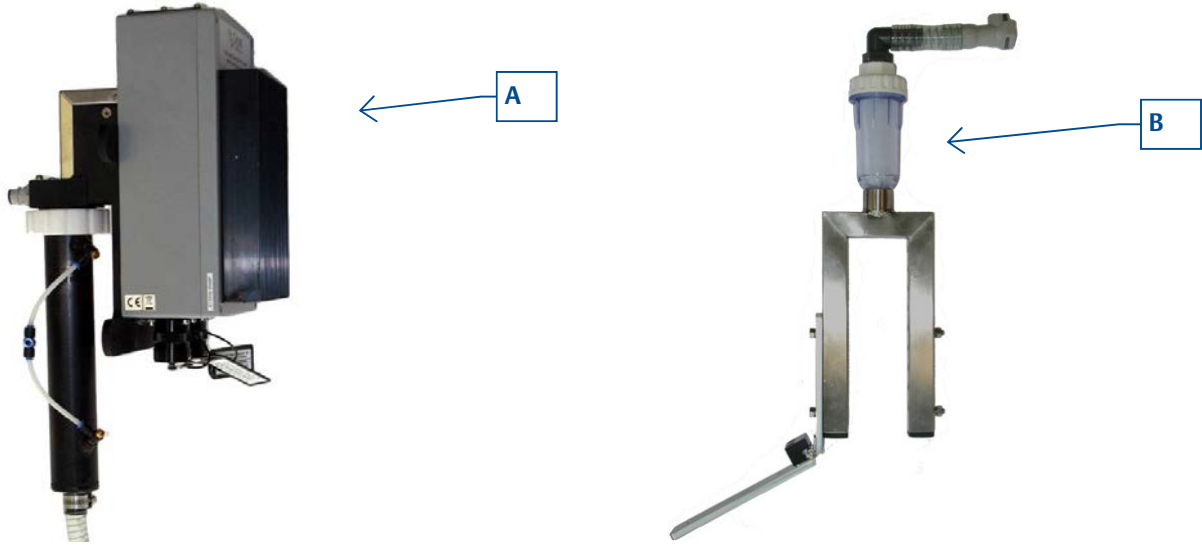
Figure 2-3 Air preparation plate



- A. Filter regulator
- B. Pressure switch
- C. Valve
- D. Water separator

The leak detector is comprised of the following components:

Figure 2-4 Left: Sensor head, Right: Air extraction arch assembly



- A. Sensor head unit
- B. Air extraction arch

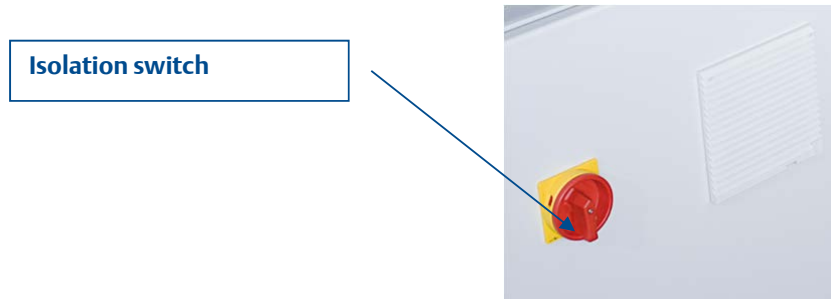
3 System Startup

The aerosol leak detection system must be installed and fully commissioned prior to customer operation.

Ensure that all cables are correctly terminated and the components on the production line are correctly mounted. The control console must also be securely mounted with clear access around. The shutdown signal from the line PLC must be set to not switch the system off otherwise the system will begin to shutdown straight after booting.

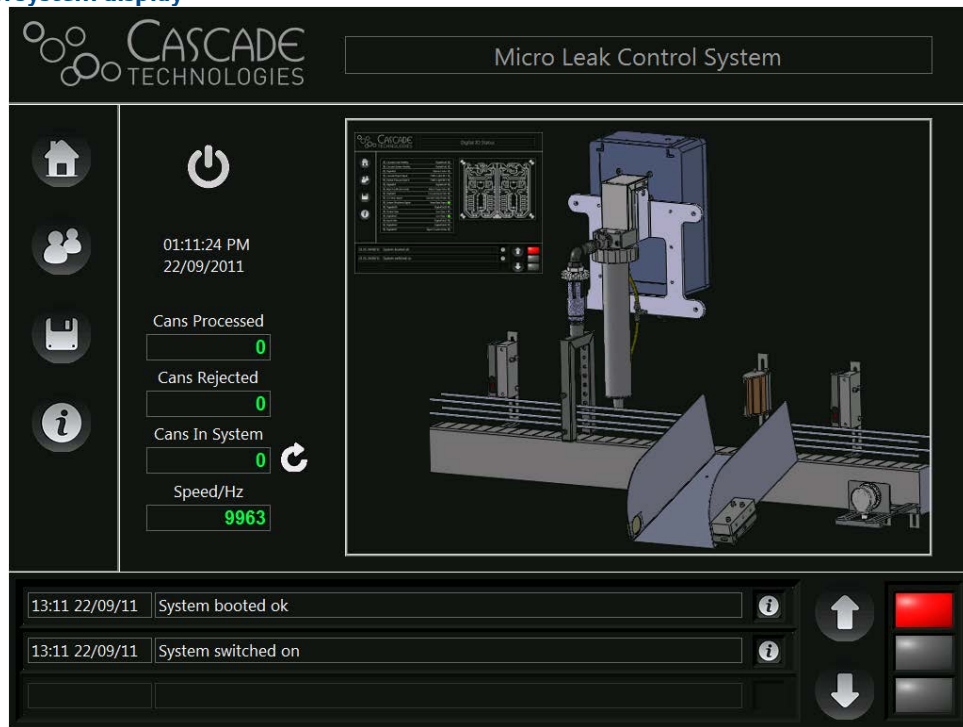
The system is activated by turning the isolation switch (shown below) to the **ON** position. The system must have been off for at least 30 seconds in order to boot correctly.

Figure 3-1 Isolation switch



The Micro Leak Control System initialization takes approximately two minutes after power is applied.

Figure 3-2 Control system display



The message box at the bottom of the screen indicates any errors or warnings detected during the boot sequence. If the system has successfully booted, the traffic light indicator in the bottom right of the screen goes green. For a full explanation of the control system software, see [Section 5](#) of this manual.

4 Shutdown

There are three system shutdown methods:

1. 150 ms signal from the System I/O line to the PLC line
2. Press the control system *Power* button on the **Home** screen.
3. Turn off the *Isolation* switch on the Control System front panel.

CAUTION

Failure to shut down the system using the correct procedure may damage the system. Only use the isolation switch on its own to shut down the system in an emergency as a last resort to remove power from the system.

Once activated, the first two safe shutdown methods follow the same sequence. The screen shows the shutdown of the system and goes blank. Once the screen has gone blank, wait thirty seconds and set the isolation switch to **OFF** to remove power from the console and from the components of the system on the line.

5 Operation

The aerosol leak detection system is designed to run autonomously with minimal user interaction required. The majority of the information on screen is for user information only. Some parts of the software require password access; this is described in the relevant sections.

5.1 Software screens

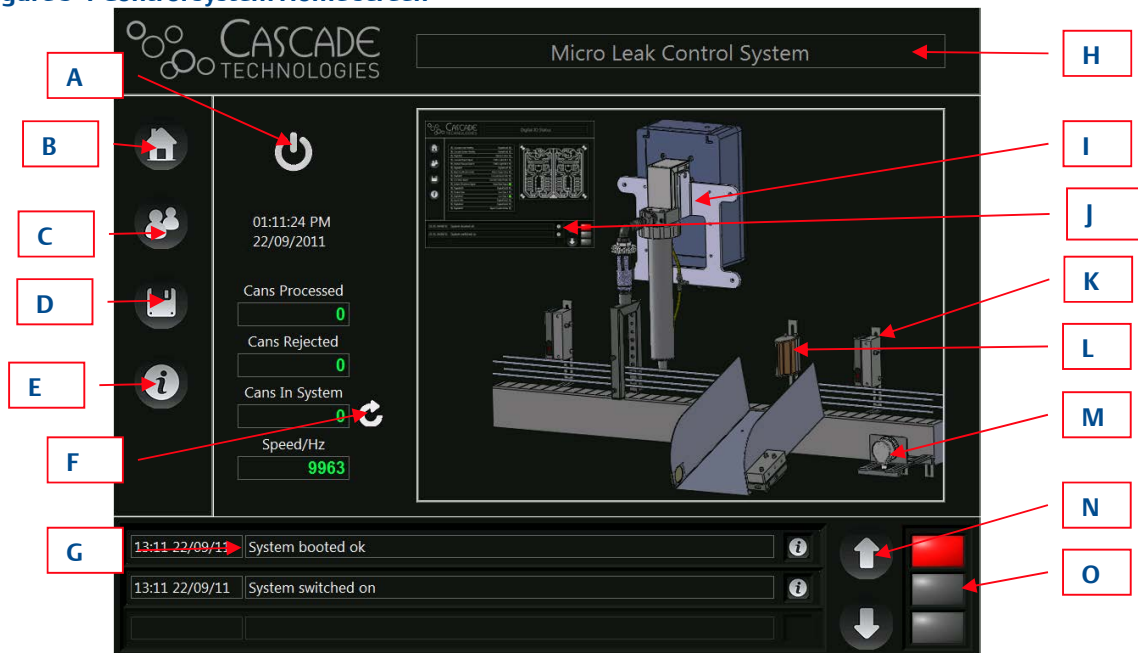
This section describes the elements on each of the different user accessible screens on the control system.

5.1.1 Home screen – aerosol leak detection system

The **Home** screen is the initial screen displayed by the aerosol leak detection system after booting.

Figure 5-1 is the **Home** screen.

Figure 5-1 Control system Home screen



- | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>A. <i>Power button:</i> used to turn the system off safely; generates a prompt to confirm the switch is off.</p> <p>B. <i>Home button:</i> allows navigation back to this screen from any screen.</p> <p>C. <i>User login button:</i> changes the central section of the screen to the User Login screen.</p> <p>D. <i>Programs page button:</i> changes the central section of the screen to the Programs page.</p> <p>E. <i>Error status page button:</i> changes the error status</p> | <p>H. <i>Title bar:</i> displays the title of the current page.</p> <p>I. <i>Main Screen button:</i> changes the center section of the screen to the main control page for the leak detector</p> <p>J. <i>IO Status Page button</i> changes the center section of the screen to the IO Status page.</p> <p>L. <i>Optical Gates Page button:</i> changes the center section of the screen to the Optical Gates page.</p> <p>M. <i>Rejector Page button:</i> changes the center section of the screen to the Rejector page.</p> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

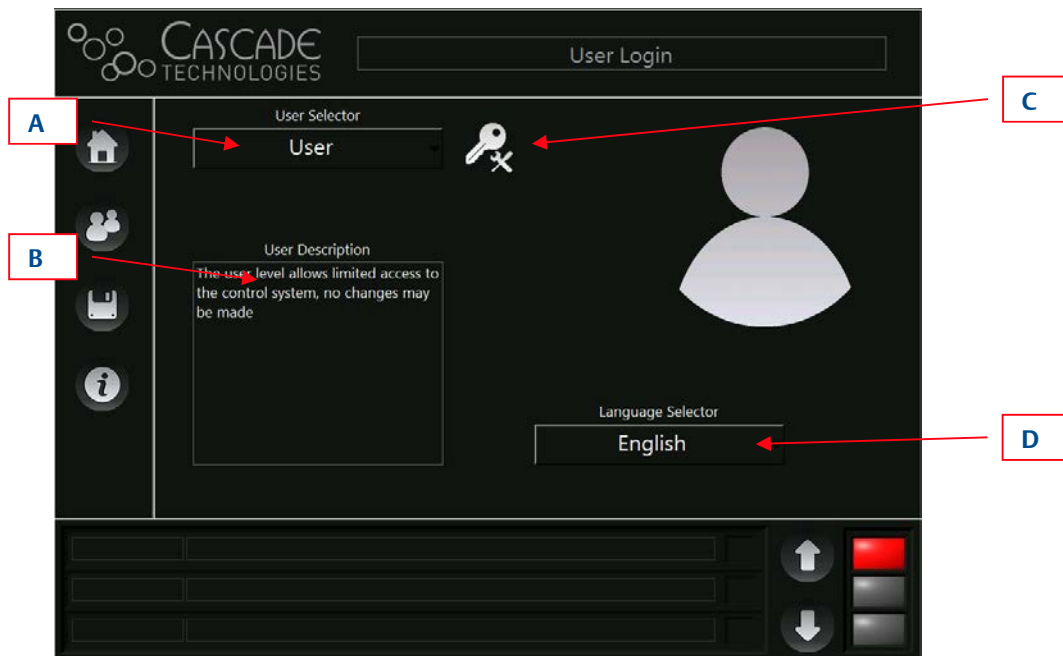
- F. **Reset can buffer button:** resets the cans in the can buffer to 0.
- G. **Message box:** displays messages, warnings, and errors for the control system.
- N. **Message box arrows:** used to scroll up and down through the messages in the message box.
- O. **Error status indicator:** shows the current error status of the control system.

5.1.2 User Login screen

The operation of the aerosol leak detection system requires that some functionality is restricted to authorized users only. The different user login options are available through the **User Login** screen which is shown in

Figure 5-2 below.

Figure 5-2 User login screen



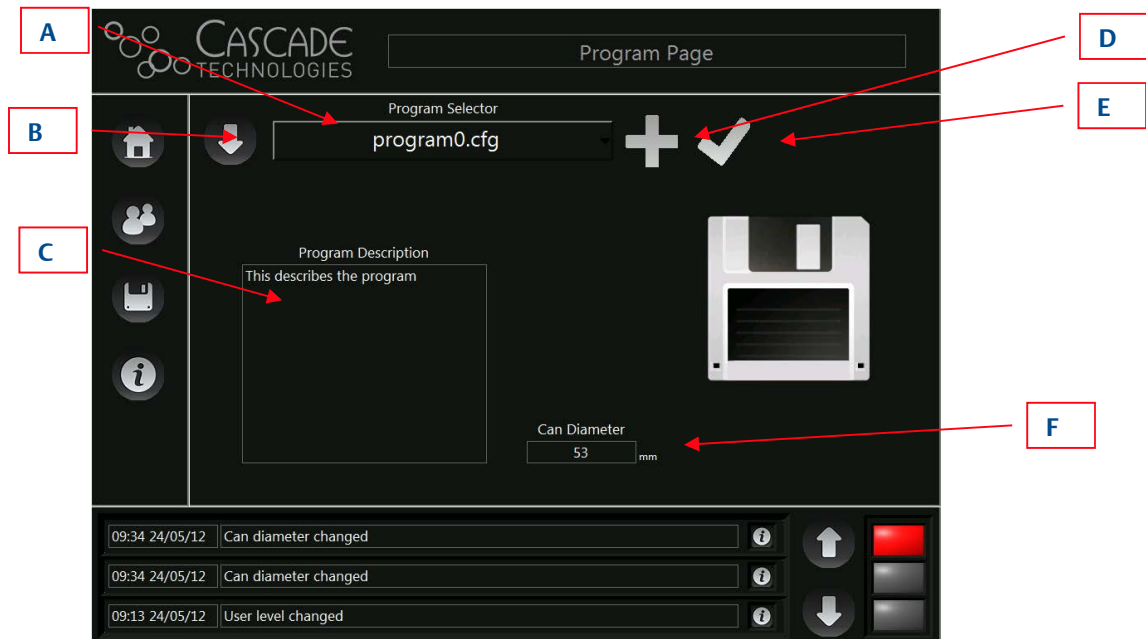
- A. **User Selector:** allows the operator to select and log in to the different user levels of the control system.
- B. **User Description:** describes the access options available to the currently logged in user level.
- C. **Password change button:** prompts the user to change the current password (not available for all access levels).
- D. **Language Selector:** allows the user to change the language used for display purposes. The default language of the system is not changed.

5.1.3 Program Page

The programs used by the control system store the parameters required by the control system that are variable between different can diameters and products.

See [Section 5.4: Control system programs](#) for a description of the creation and use of programs. [Figure 5-3](#) below shows the **Program Page**:

Figure 5-3 Program Page screen

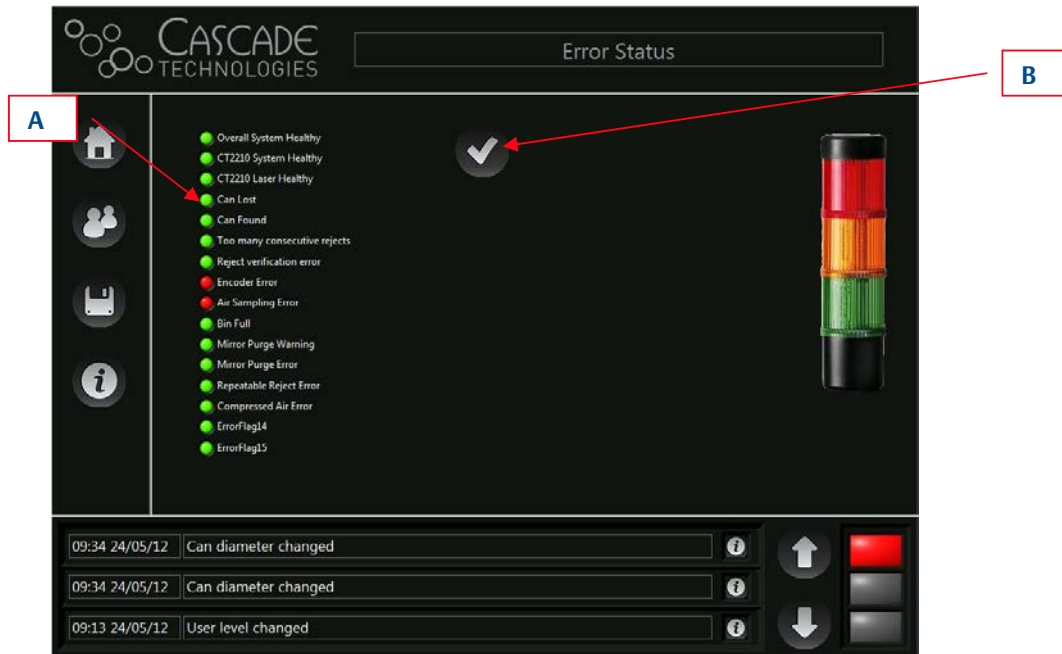


- A. **Program Selector:** this allows the operator to select from all the programs stored on the control system.
- B. **Config backup:** this allows the operator to create a backup of the configuration file on an external USB drive.
- C. **Program Description:** this describes the program and when it should be used. This information is entered by the user during the program creation process.
- D. **Add program button:** allows the user to add a new program using the current programs parameters as a starting point.
- E. **Save changes button:** allows the user to save any changes made to the program, this button is only shown when there are changes to be saved.
- F. **Can Diameter:** the diameter of the container to be used with this program.

5.1.4 Error Status screen

This screen displays the current state of the control system. It allows the user to reset any errors once they have cleared. All error signals must be acknowledged by pressing the reset errors button. **Figure 5-4** below shows the **Error Status** screen:

Figure 5-4 Error Status screen

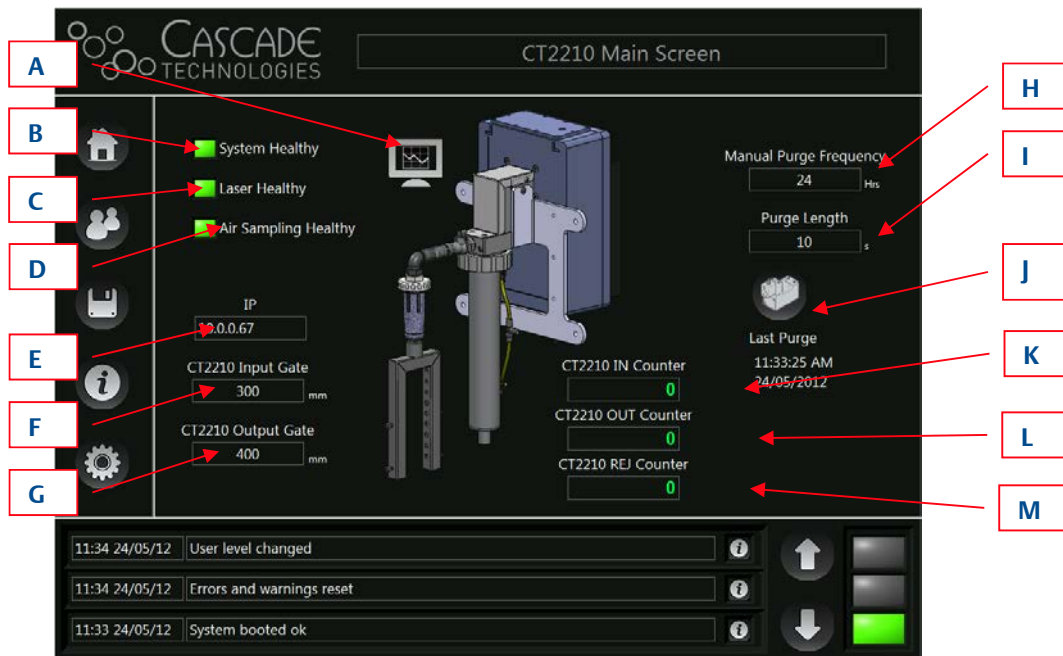


- A. **Error Status:** shows the status of all the configured error checks. For all status flags, green is OK, orange is warning, and red is error.
- B. **Reset errors button:** is used to reset the errors in the control system. If an error persists then it cannot be reset and will still appear as red or orange on the Error Status list.

5.1.5 CT2211 Main Screen

All of the control system parameters relating to the leak detector are displayed on this page. For all sensor related issues see the Leak Detector manual supplied separately. **Figure 5-5** below shows the **Main Screen**.

Figure 5-5 CT2211 Main Screen

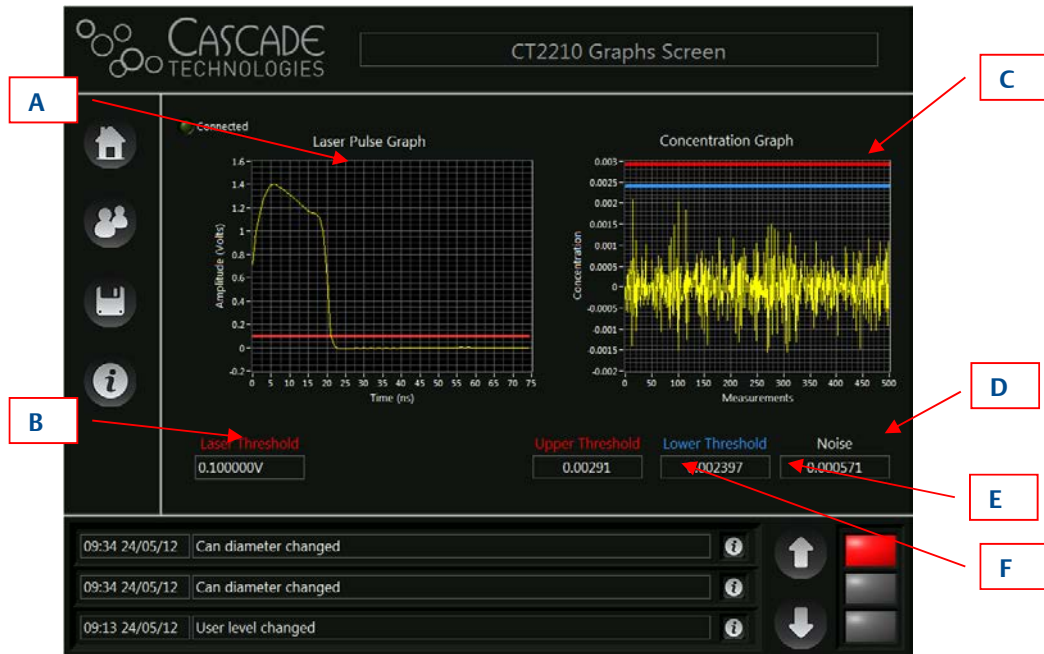


- A. **Graphs page Button:** navigates to the leak detector Graphs page.
- B. **System Healthy indicator:** displays the health status of the leak detector.
- C. **Laser Healthy indicator:** displays the health status of the laser used in the leak detector.
- D. **Venturi Healthy indicator:** displays the health status of the air supply to the Venturi.
- E. **IP address Indicator:** displays the IP address of the leak detector connected to the control system.
- F. **Input Gate position:** is the position relative to the main input gate of the control system of the input gate to the leak detector, which is typically located close to the air archway used to sample gas into the leak detector from the conveyor.
- G. **Output Gate position:** is the position relative to the main input gate of the control system of the output gate from the leak detector, which is typically located after the air archway used to sample gas into the leak detector from the conveyor.
- H. **Purge Frequency:** is the time duration (in hours) between the required mirror purge cleaning function. After this time durationn the system goes into warning for two hours before going into an error state if the cleaning purge is not performed.
- I. **Purge Length:** is the time (in seconds) that the mirror cleaning purge is activated for.
- J. **Mirror purge button:** activates the purge function, which should not be carried out when there are cans in the system as the mirror purge function disrupts the normal operation of the leak detector during the purge duration.
- K. **CT2211 IN Counter:** provides a running count of cans entering the detection zone since last reset.
- L. **CT2211 OUT Counter:** provides a running count of cans exiting the detection zone since last reset.
- M. **CT2211 REJ Counter:** provides a running count of cans rejected since last reset.

5.1.6 CT2211 Graphs Screen

This optional screen allows you to view the laser pulse data and the concentration data from the leak detector. The data is read from the sensor at a frequency of approximately 1Hz. The leak detector runs in real time; however, the data displayed on the graphs is not displayed in real time and is for diagnostic purposes only. **Figure 5-6** below shows the **CT2211 Graphs Screen**.

Figure 5-6 CT2211 Graphs Screen

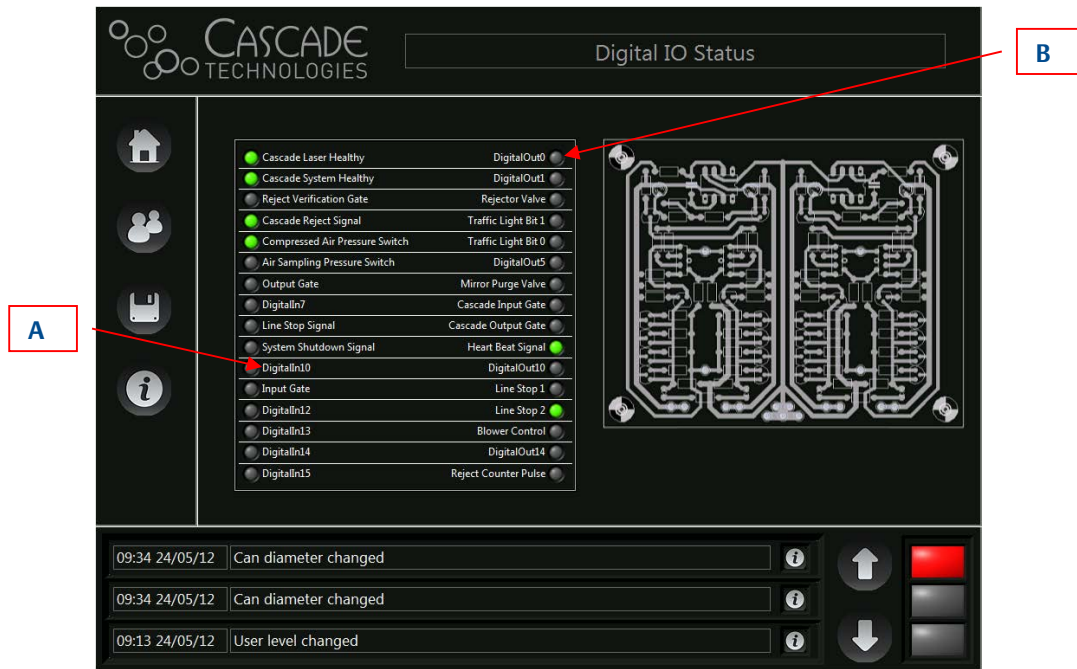


- A. **Laser Pulse Graph:** displays a laser pulse from the last second of running.
- B. **Laser Threshold:** is the voltage that the laser pulse must be above to ensure the laser healthy status signal is OK.
- C. **Concentration Graph:** is the output from the concentration calculations on the Leak Detector. A rejected can will show as a spike on this graph above the thresholds.
- D. **Noise:** shows the overall noise level of the concentration data. The lower the number the better.
- E. **Lower Threshold:** in order to reject a can using the lower threshold the leak detector must see at least two consecutive concentrations above this threshold.
- F. **Upper Threshold:** in order to reject a can using the upper threshold the leak detector must see at least a single concentration above this threshold.

5.1.7 Digital IO Status screen

This page allows the operator to see in real time the state of any of the digital IO lines to the control system. For some signals that are rapidly changing, the signal change on screen may be too quick to observe. **Figure 5-7** below shows the **Digital IO Status** screen:

Figure 5-7 Digital IO Status screen



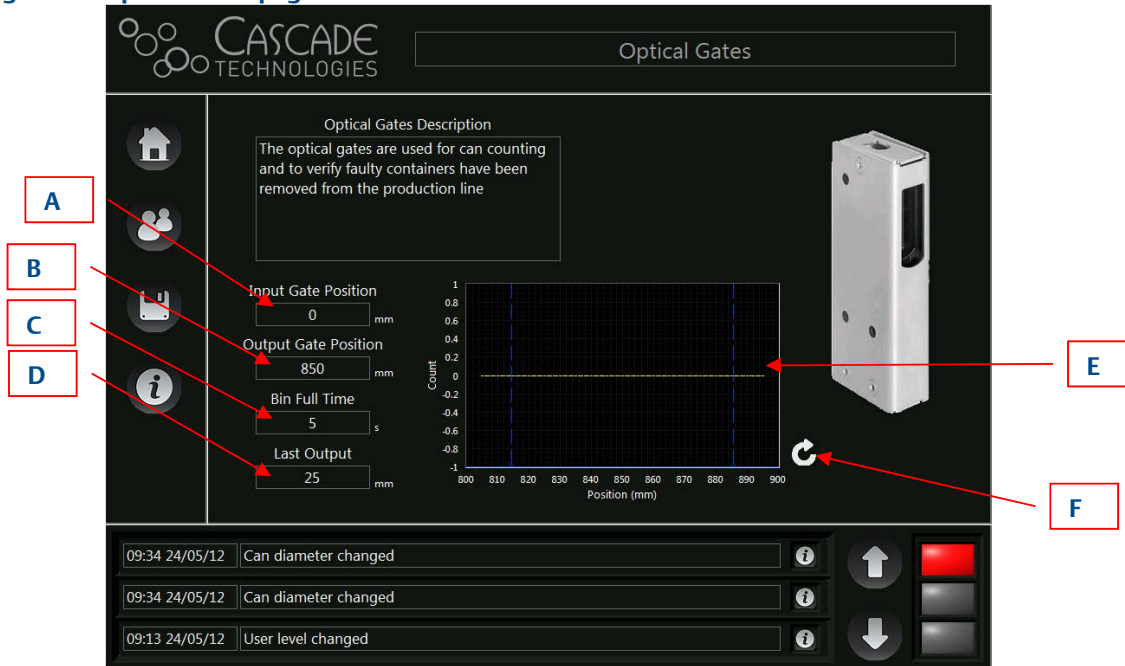
- A. Digital inputs: displays the current status of the digital inputs to the control system. Green is active, and grey is inactive.
- B. Digital outputs: displays the current status of the digital outputs from the control system. Green is active, and grey is inactive.

5.1.8 Optical Gates screen

The **Optical Gates** screen allows the user to see the output gate position and the bin full time for the control system.

Figure 5-8 below shows the **Optical Gates** screen:

Figure 5-8 Optical Gates page

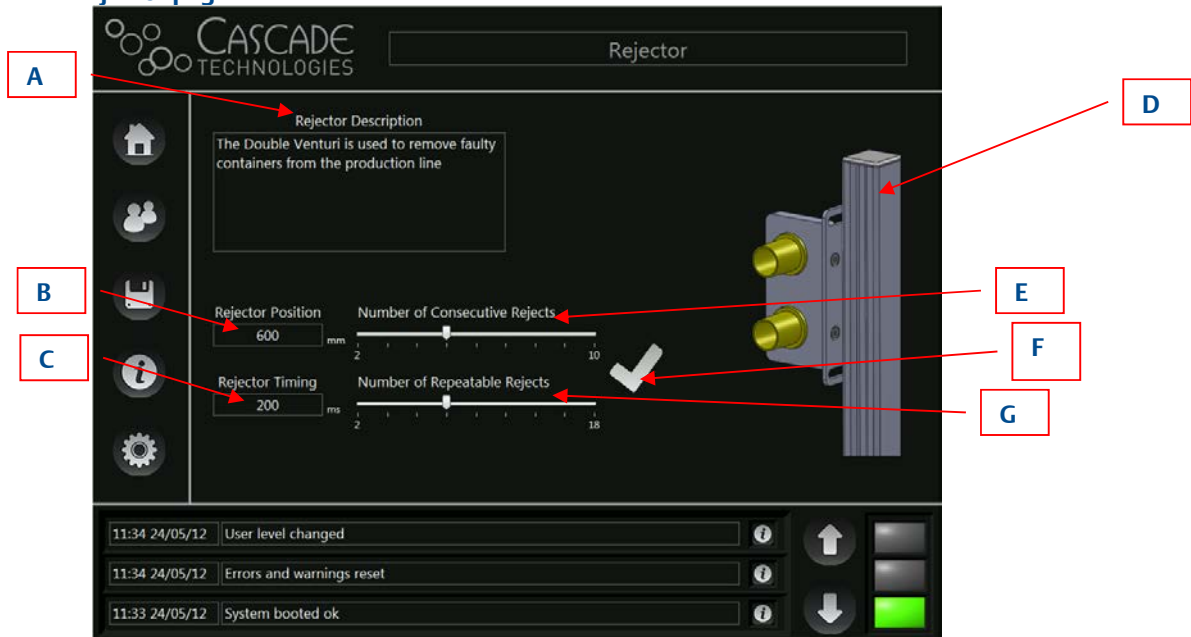


- A. **Input Gate Position:** displays the position in mm of the input gate of the system. This is always 0.
- B. **Output Gate Position:** displays the position in mm of the output gate of the system relative to the input gate.
- C. **Bin Full Time:** is the time in seconds that the reject verification gate must be blocked for the bin full error to be displayed.
- D. **Last Output:** monitors the canister position as it exits the leak detection system.
- E. **Position Summary Chart:** summarizes any deviations in the expected can position when exiting the leak detection system.
- F. **Position Summary Chart Reset:** clears the Position summary chart.

5.1.9 Rejector screen

The rejector is used by the control system to remove faulty containers from the production line. There are a number of different options for the rejector. This manual assumes that the default air rejector is being used. **Figure 5-9** below shows the **Rejector** screen:

Figure 5-9 Rejector page



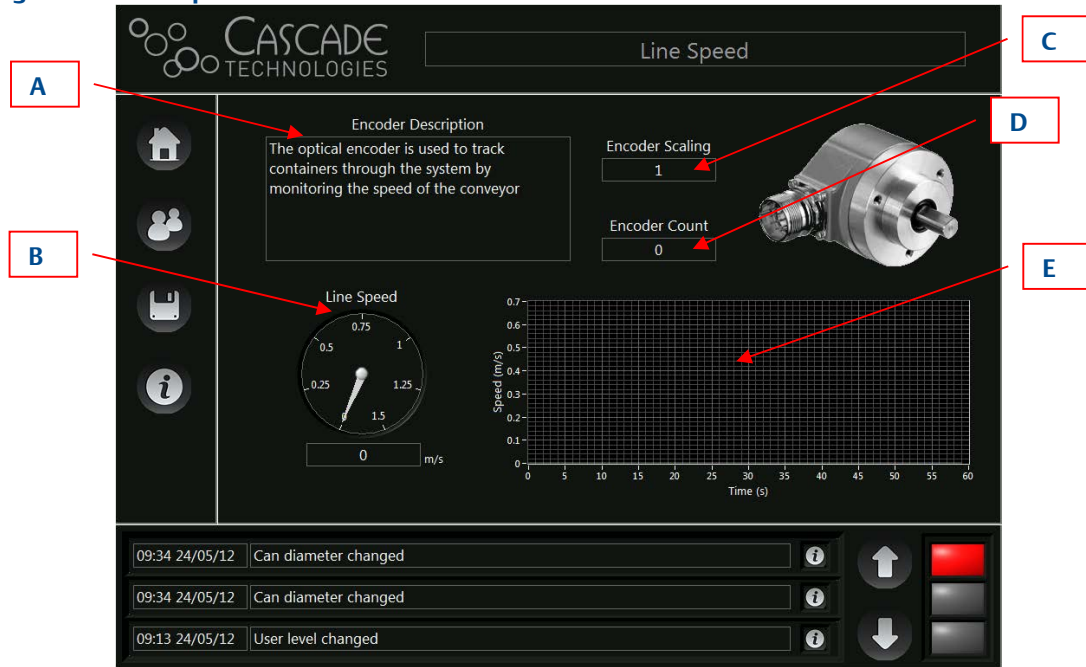
- A. **Rejector Description:** describes the rejector in use.
- B. **Rejector Position:** is the position relative to the main input gate of the rejector.
- C. **Rejector Timing:** is the length of time the rejector is active for each faulty container.
- D. **Rejector Type:** shows a picture of the particular rejector in use.
- E. **Number of Consecutive Rejects:** is the number of consecutive canister rejects required to trigger the *Too many consecutive rejects* alarm.
- F. **Check mark:** is to apply changes made to Number of Consecutive Rejects and Number of Repeatable Rejects to the configuration file. If the changes are not stored, they will be reset to the previously stored values on system reboot.
- G. **Number of Repeatable Rejects:** is the number of canister rejects per 100 canisters required to trigger the *Repeatable Reject Error* alarm.

5.1.10 Line Speed screen

This page shows the line speed of the conveyor.

Figure 5-10 below shows the Line Speed screen.

Figure 5-10 Line Speed screen



- A. Encoder Description: describes the use of the encoder.
- B. Line Speed: is the one second average of the line speed.
- C. Encoder Scaling: is the ratio of pulses of the encoder to mm of travel on the production line. It is used to convert the encoder count from pulses to distance.
- D. Encoder Count: is the total number of pulses on the encoder since the control system was last switched on.
- E. Line speed graph: shows the speed of the production line for the last sixty seconds.

5.2 Errors

There are a number of errors that the control system monitors for that may occur during the normal operation of the system. If the error status indicator in the bottom right hand side of the screen or if the traffic light indicators change from green then the control system has detected an error. Most errors are easily reset from the **Error Status** screen of the control system. The errors that are active show as red lights on the **Error Status** screen. The following errors are detectable by the control system:

5.2.1 Overall system healthy

The *overall system healthy* error checks the system parameters on boot. If this error occurs, there will be an explanation of the reason in the message box at the bottom of the screen. The most likely reason for this error is an incorrect parameter in a configuration file or missing configuration file. These files can be reinstalled with the assistance of Cascade Technologies Ltd.

5.2.2 Leak detector (CT2211) system healthy

The leak detector provides the control system with a healthy status signal. If this signal becomes too low, it will trigger this error. See **Section 7: Troubleshooting and Diagnostics** for more information on this error.

5.2.3 Leak detector (CT2211) laser healthy

The leak detector provides the control system with a healthy status signal for the laser pulse. If this signal becomes too low, it triggers this error. See **Section 7: Troubleshooting and Diagnostics** for more information on this error.

5.2.4 Can lost

The cans in the system are tracked using a combination of optical gates and a line encoder. This allows the control system to predict when a particular container should reach the output gate of the system (assuming it is not rejected). If a can does not trigger the output gate in a set window, then this error is triggered. The following are the most likely reasons for this error:

- The output gate is positioned incorrectly.
- Cans are slipping on the production line.
- Someone has removed a can from the line inside the system.
- A can in the system has fallen.
- The height of the gate output is wrong, causing the gate not to trigger when cans go through.
- The output gate is not working or disconnected.

In order to reset this error all the cans in the system must be removed, and the can buffer must be reset using the *can buffer reset* button on the **Home** screen.

5.2.5 Can found

The cans in the system are tracked using a combination of optical gates and a line encoder. This allows the control system to predict when a particular container should reach the output gate of the system (assuming it is not rejected). If there is a trigger on the output gate that falls outside of the expected window, this error is triggered. The following are the most likely reasons for this error:

- The output gate is positioned incorrectly.
- Cans are slipping on the production line.
- Someone has added a can after the input gate and before the output gate.

5.2.6 Too many consecutive rejects

If a number of cans above a configurable threshold are rejected in a row, this error is triggered. In order to reset this error, a good can must be put through the system. This error may be used as a potential indication of a production fault.

5.2.7 Reject verification

When the rejector removes a can from the line, the reject verification gate expects to see a trigger within a set time after the rejector is activated. If the reject verification gate does not see this trigger, the *reject verification* error is triggered. There are a number of reasons this may occur:

- A can has been unsuccessfully rejected.
- The reject verification gate is disconnected or not working.
- The trigger is taking too long to activate.

5.2.8 Encoder error

The correct operation of the encoder is vital for the control system to function. There is a range of line speeds that the encoder expects to see (from 0m/s to 1.5m/s). If the speed of the line is outside of this range, the error will be triggered. The error is also triggered if the encoder sees that the line is running and the line stop input signal is low, meaning that the control system expects the line to be stopped.

5.2.9 Air sampling healthy

The Cascade pressure switch is used to monitor the air supply to the system. If the air supply is interrupted, the pressure switch will activate this error.

5.2.10 Bin full

As the number of cans removed from the line increases, the reject bin begins to fill. The reject verification gate is used to detect when the bin is overflowing and trigger the *bin full* error.

5.2.11 Mirror purge warning

The leak detector requires a mirror purge cleaning at regular intervals to maintain the performance of the sensor. The control system has a timer that is used to ensure that this cleaning purge is performed. Once the timer reaches 0, the warning light is activated for two hours to remind the user to operate the purge.

5.2.12 Mirror purge error

The leak detector requires a mirror purge cleaning at regular intervals to maintain the performance of the sensor. The control system has a timer that is used to ensure that this cleaning purge is performed. Once the mirror purge warning has been active for two hours, the *mirror purge* error is triggered, forcing you to purge the mirrors before the system continues.

In addition to the errors listed above that the control system can detect, there is a hardware watch dog on the system. If the system crashes, the watch dog will cause the system to become unhealthy, and the production line PLC can read the output from this watch dog to ensure that the system remains healthy.

In order to reset any of the errors above, press the *Reset errors* button on the **Error Status** page. This clears any errors that are no longer affecting the system. If any errors persist, the error status indicator will not turn green, and the reason for the continued error should be investigated.

5.2.13 Repeatabe reject error

The *repeatabe reject* error reports when the number of rejects per hundred canisters exceeds a configurable threshold. This threshold is set on the **Rejector** screen and can be saved to the configuration file. This error may be used as an indication of a production fault.

5.2.14 Compressed air error

The *compressed air* error reports when insufficient pressure on the Venturi/reject/purge air is detected. Insufficient air pressure results in decreased performance of the CT2211 aerosol leak detection system.

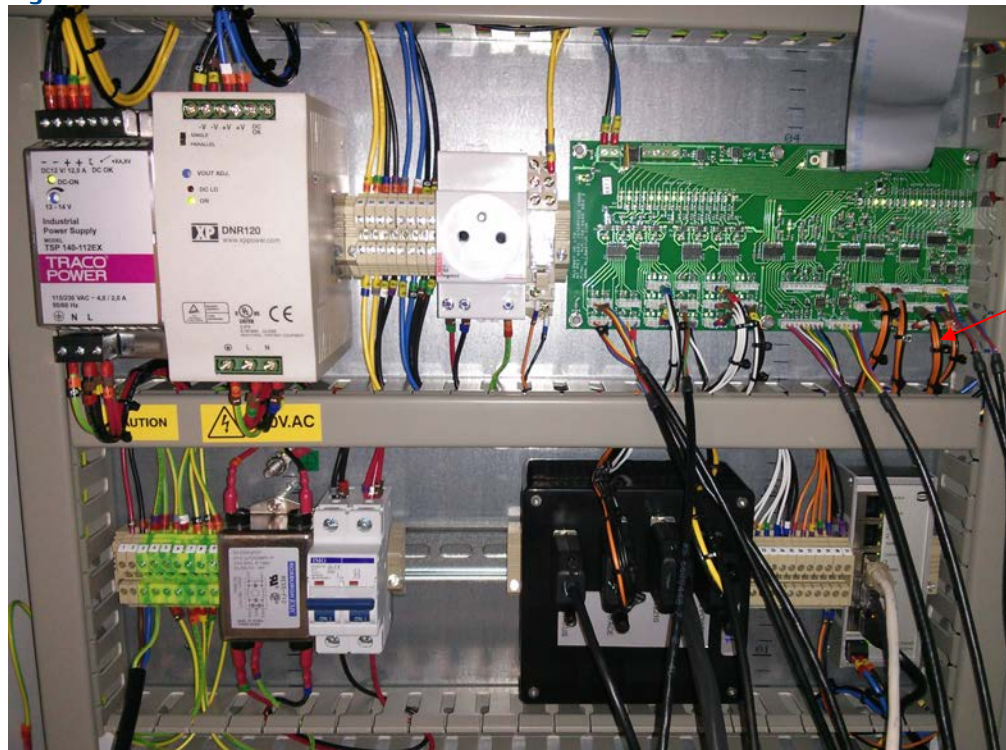
5.2.15 Error flags 14/15

These error flags are currently unassigned.

5.3 Line PLC communication

The aerosol leak detection system communicates to the line PLC via digital IO lines. The input and output lines to the control system are 24 VDC. The connections from the control system to the line PLC are made inside the console as shown below:

Figure 5-11 PLC connections



PLC connections

Table 5-1 IO lines

Terminal number :	Line description	System input/output	See Section number :
20	Linestop	Input	5.3.1
21	Shutdown system	Input	5.3.2
22	Spare	Input	N/A
23	Spare	Input	N/A
24	Spare	Input	N/A
25	Return	Input	N/A
26	Linestop 1	Output	5.3.3
27	Linestop 2	Output	5.3.3
28	Heartbeat Signal	Output	5.3.4
29	Reject Pulse Count	Output	5.3.5
30	Not Available	Output	N/A
31	Return	Output	N/A

Inputs to Control System : Terminals 20 – 24 (+24V), Return Terminal 25 (0V)

Outputs From Control System : Terminals 26 – 30 (+24V), Return Terminal 31 (0V)

The wiring numbers for each of the input and output lines can be found in the system wiring diagram.

Each of the individual IO lines is described below:

5.3.1 Linestop (in)

A positive Linestop voltage input signal from the conveyer to the Control System indicates the conveyer is working within its operational parameters. A 0.0V signals the line is stopped.

5.3.2 System shutdown signal (in)

The system shutdown signal allows the control system to be deactivated remotely. If the signal is high, the control system continues to function. If the signal is low, the control system switches off.

5.3.3 Linestop 1 and linestop 2 (out)

The control system provides two output signals to stop the production line if there are errors on the system. The two outputs can be configured to trigger for different errors. If the linestop signals are high, the system is healthy; if either or both of the linestop signals are low, the production line should be stopped.

5.3.4 Heartbeat signal (out)

The heartbeat signal is the hardware watchdog output. If the signal is high, then the system is running normally. If the signal is low, the watchdog has detected an error, and the system should be reset.

5.3.5 Reject counter pulse (out)

For each can removed from the production line by the rejector, a 100ms counter pulse is sent on this output line. This allows the line PLC to know how many cans have been rejected by the control system.

5.4 Control system programs

The aerosol leak detection system loads parameters from a number of different sources. One of those sources is the program file. The parameters loaded from the program file are:

1. Output gate position
2. Cascade input gate position
3. Cascade output gate position
4. Rejector position
5. Can diameter
6. Bin full time
7. Maximum consecutive rejects – line stoppable
8. Maximum repeatable rejects – line stoppable

⚠ CAUTION

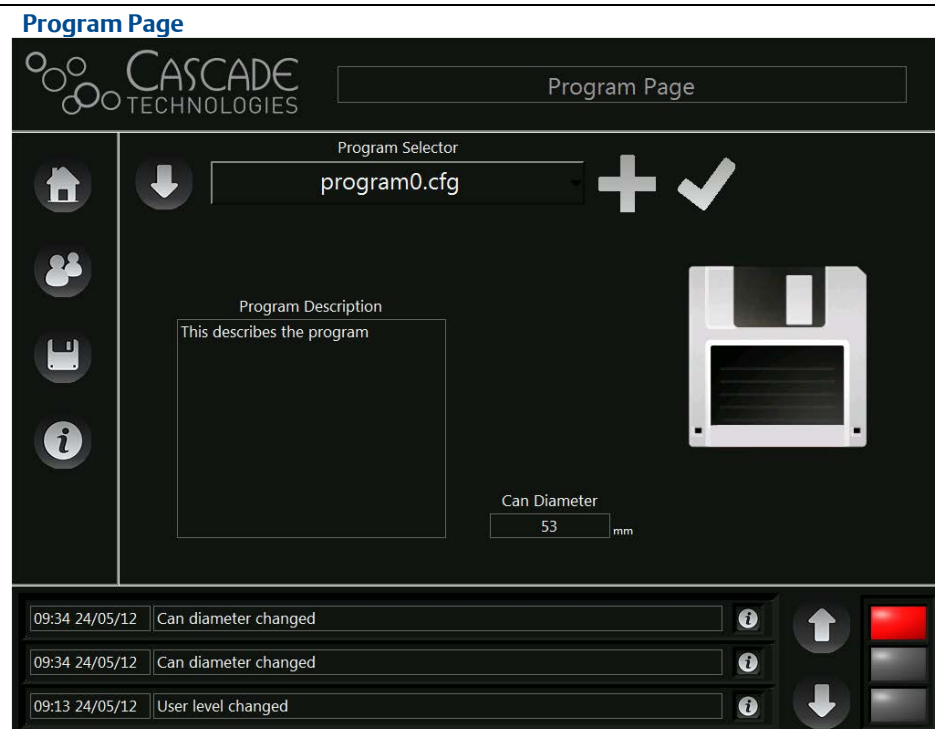
Use of an incorrect program may lead to degraded performance of the control system, and the wrong cans may be rejected.

Use the **Program Page | Program Selector** to change or load a Control System program. A login security level of Power User or higher is required for an operator to save changes to the program.

The *save changes* button applies the changes to the currently loaded program.

The **Program Description** provides detailed information about the currently loaded Control System program.

Figure 5-12



The different programs allow the user to customize the operation of the control system for different can types and diameters. The program can also be backed up by selecting the down arrow to the left of the Program Selector as seen in **Figure 5-12 Program Page**.

5.4.1 Add programs

If you have a Power user or higher security level, you can add extra programs (up to a maximum of twenty-five). To add a program, press the *Add programs* button on the **Program Page**. **Figure 5-13** below shows the **Add programs** screen. There is a description of the program on the **Add programs** screen that helps inform you about your selection.

Figure 5-13 Add programs screen

The screenshot shows a dark-themed interface for adding a program. On the left, there is a 'Program Name' field containing 'program5.cfg' and a larger 'Program Description' box containing the text 'This is the program description'. On the right, there are several input fields for parameters: 'Output Gate Position' (1000), 'Cascade Input Gate Position' (400), 'Cascade Output Gate Position' (700), 'Rejector Position' (800), 'Can Diameter' (53), and 'Bin Full Time' (3). At the bottom, there are two buttons: 'Save' and 'Cancel'.

The values on the right of the **Add Programs** screen come from the currently loaded program. You can enter the program description with the on screen keyboard, which loads when the **Program Description** box is touched.

The other parameters on the right hand of the screen can be edited in the main control system. When you have finished making your changes, press the *Save* button.

6 Maintenance

The aerosol leak detection system is inherently reliable, reducing the requirement for routine maintenance. This section provides information on the schedule of maintenance to be performed by the user in order to ensure the reliable performance of the system.

⚠ WARNING

For all maintenance inside of the control console, the system must be powered off using the shutdown procedure detailed earlier. There are potentially dangerous voltages inside the console.

6.1 Schedule

The maintenance activities and their related frequencies are shown below:

6.1.1 Daily

These are the activities that should be performed once per day:

- Perform an air purge of the leak detector's mirrors.
- Verify the leak detection performance of the sensor by passing a leaking can through the sensor (or equivalent test technique).

6.1.2 Weekly

These are the activities that should be performed once per week:

- Inspect and clean the optical gates and reflectors.
- Check the pressure settings on the filter/regulators.
- Inspect the rejector and ensure it is operating correctly.
- Inspect the encoder to ensure the coupling to the line is solid.

6.1.3 Monthly

These are the activities that should be performed once per month:

- Inspect and clean the air arch filter.
- Verify that the compressed air supply to the leak detector is within the levels specified in **Section 1.6: Detailed system specification**.

This represents an advanced operation of the leak detector and should only be performed by suitably trained personnel.

In order to ensure that the aerosol leak detection system is reliable over the long term, an annual service is recommended. This service should be carried out by a Cascade engineer or a Cascade-trained service engineer.

6.2 Analysis system

The leak detector system is inherently tolerant to high levels of contamination without a reduction in performance. The comprehensive filtering undertaken within the air arch ensures that there should be no need to clean any part of the leak detector within the lifetime of the product.

6.3 Venturi

The Venturi should require no maintenance other than periodic exterior cleaning to remove surface dust.

6.4 Replacement parts

The following parts are available from Cascade as replacement parts for the leak detection system:

Table 6-1 Aerosol leak detection system replacement parts list

Part description	Zone	Part number	User replaceable?
Touchscreen		P-5000-0578	Yes
Control PC and software (DAC and controls)		P-5000-0579	No
I/O board		P-5000-0580	Yes
Fan module		P-5000-0581	Yes
Optical gate	Zone 2	P-5000-0328a	Yes
Optical reflector	Zone 2	P-5000-0328b	Yes
Encoder	Zone 2	P-5000-0327	Yes
Sample flow filters	Zone 2	M-1000-1840	Yes
Sample flow filter housing	Zone 2	P-5000-0060	Yes
Venturi	Zone 2	P-5000-0117	Yes
Pressure switch	Zone 2	P-5000-0615	Yes
Power supply 12 V	Zone 2	P-5000-0331	Yes
Power supply 24 V	Zone 2	P-5000-0392	Yes
Leak generator valve	Zone 2	P-5000-0587	Yes
Filter/regulator	Zone 2	P-5000-0560	Yes
Solenoid valve	Zone 2	P-5000-0329	Yes
Blower	Zone 2	P-5000-0389	Yes
Differential pressure switch	Zone 2	P-5000-0588	Yes
40 micron filter	Zone 2	P-5000-0589	Yes
0.01 micron filter	Zone 2	P-5000-0590	Yes
Lens cleaning tissue (Pack of 5)		P-5000-0613	Yes
Fully assembled pneumatic plate	Zone 2	M-3000-0609	Yes
Carbon filter sleeves (enclosure purge)	Zone 2	P-5000-0680	Yes
Precision optical cleaner		P-5000-0681	Yes

7 Troubleshooting and Diagnostics

The aerosol leak detection system is designed to run unattended and to recover from system issues where possible. This chapter is designed to assist you in the identification and solution of potential problems. If in doubt, contact Cascade Technologies Ltd for clarification on solutions before continuing.

7.1 Warning and error messages

There are a number of warning and error messages that the system can generate, which will be displayed in the message box at the bottom of the screen.

Table 7-1 Possible problems and solutions

Problem	Symptom	Possible causes	Solutions
Plots are not updated on the leak detection system Graphs screen.	The laser pulse graph and concentration graph are not displayed or do not update on the leak detector Graphs screen.	<ul style="list-style-type: none"> The network connection is not established. The leak detection system network cable must be connected to the network switch in the control console, and the network cable to the PC must be installed into the same switch. The leak detection system is not powered. See the leak detection systems manual for trouble shooting. 	<ul style="list-style-type: none"> Ensure that the indicator lights are flashing on the network switch for both cables. See Figure 7-1. Check the LED on the 12V PSU in the control console. See Figure 7-2.
Cannot update system settings	It is not possible to change any of the parameters, such as output gate position.	<ul style="list-style-type: none"> You are logged in as <i>User</i>. In order to make changes to the settings, you must be logged in as <i>Power User</i> or above. The touch screen is not working. 	<ul style="list-style-type: none"> Log in as a <i>Power User</i> or above. Contact the factory.
System does not boot up when powered	The control system does not power on.	<ul style="list-style-type: none"> The isolation switch on the front of the control system is set to OFF. The circuit breaker on the inside of the control system is tripped. The system was not powered off for long enough. The isolation switch must be off for a minimum of thirty seconds prior to booting the system. 	<ul style="list-style-type: none"> Turn the isolation switch to the ON position. Set the circuit breaker to the ON position. See Figure 7-3. Turn the system off. Wait thirty seconds, and then turn the system back on.

Figure 7-1 Network status

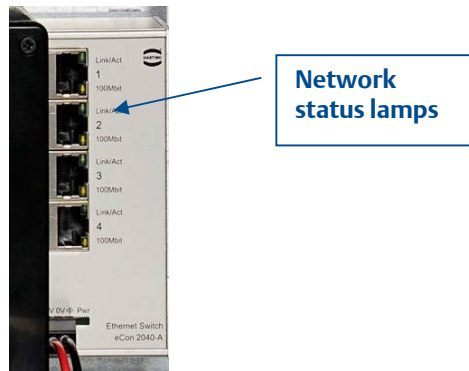


Figure 7-2 12V PSU status

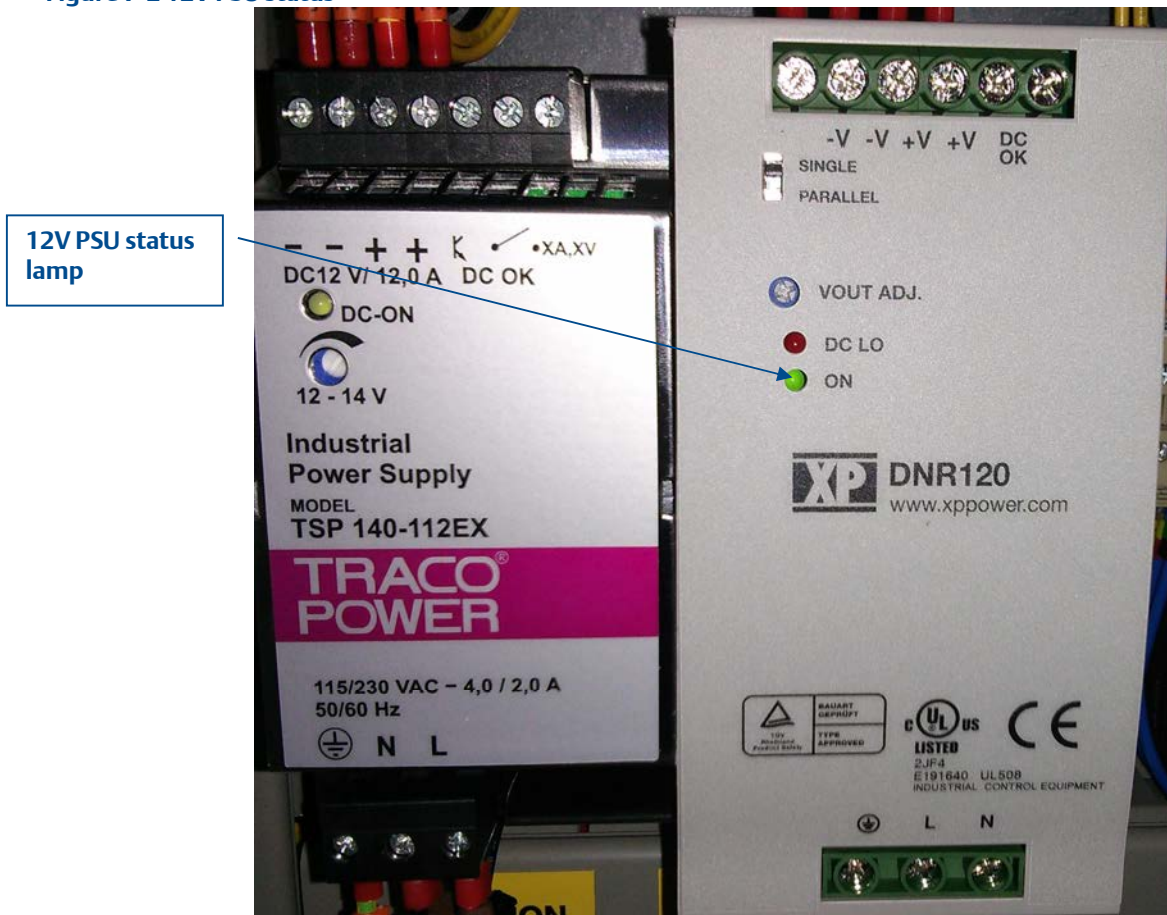


Figure 7-3 Circuit breaker



Circuit breaker

EmersonProcess.com/GasAnalysis



AnalyticExpert.com



youtube.com/user/RosemountAnalytical



twitter.com/Rosemount_News



facebook.com/Rosemount

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