

4650-PM

USER GUIDE

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LANGUAGE: ENGLISH

 Model 4650-PM Particulate Monitor



LAND[®]
AMETEK[®]



QUALITY CUSTOMER SOLUTIONS

Health and Safety Information



Read all of the instructions in this booklet - including all the **WARNINGS** and **CAUTIONS** - *before* using this product. If there is any instruction which you do not understand, **DO NOT USE THE PRODUCT**.

Safety Signs

WARNING
 Indicates a potentially hazardous situation which, if not avoided, could result in death or personal injury.

CAUTION
 Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to the user or users, or result in damage to the product or to property.

NOTE
 Indicates a potentially hazardous situation which, if not avoided, could result in damage or loss of data.

Signs and Symbols used on equipment and Documentation



Caution, risk of electric shock.



Caution, attention to possibility of risk of damage to the product, process or surroundings. Refer to instruction manual.



Caution, hot surface.



Protective Conductor Terminal.



Observe precautions for handling electrostatic discharge sensitive devices.

Equipment Operation

Use of this instrument in a manner not specified by LAND may be hazardous. Read **and understand** the user documentation supplied **before** installing and operating the equipment.

The safety of any system incorporating this equipment is the responsibility of the assembler.

Protective Clothing, Face and Eye Protection

It is possible that this equipment is to be installed on, or near to, machinery or equipment operating at high temperatures and high pressures. Suitable protective clothing, along with face and eye protection must be worn. Refer to the health and safety guidelines for the machinery/equipment before installing this product. If in doubt, contact LAND.



Wear Protective Gloves



Wear Protective Clothing



Wear Eye Protection



Wear Ear Protection



Wear Safety Boots



Wear Face Protection

Electrical Power Supply

Before working on the electrical connections, all of the electrical power lines to the equipment must be isolated. All the electrical cables and signal cables must be connected exactly as indicated in these operating instructions. If in doubt, contact LAND.

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For further details on all AMETEK Land offices, distributors and representatives, please visit our website.

Storage

The instrument should be stored in its packaging, in a dry sheltered area.

The maximum storage temperature is 10 °C (18 °F) higher than the maximum operating temperature.

The minimum storage temperature is 10 °C (18 °F) lower than the minimum operating temperature.

Refer to the Technical Specification for details of the operating temperature limits.

Unpacking

Check all packages for external signs of damage. Check the contents against the packing note.

Lifting Instructions

Where items are too heavy to be lifted manually, use suitably rated lifting equipment. Refer to the Technical Specification for weights. All lifting should be carried out in accordance with local and national regulations.

Return of Damaged Goods

IMPORTANT If any item has been damaged in transit, this should be reported to the carrier and to the supplier immediately. Damage caused in transit is the responsibility of the carrier not the supplier.

DO NOT RETURN a damaged instrument to the sender as the carrier will not then consider a claim. Save the packing with the damaged article for inspection by the carrier.

Return of Goods for Repair

If you need to return goods for repair please contact our Customer Service Department for details of the correct returns procedure.

Any item returned to LAND should be adequately packaged to prevent damage during transit.

You must include a written report of the problem together with your own name and contact information, address, telephone number, email address etc.

Design and Manufacturing Standards

The Quality Management System of Land Instruments International is approved to BS EN ISO 9001 for the design, manufacture and on-site servicing of combustion, environmental monitoring and non-contact temperature measuring instrumentation.

Registered ISO9001 Management System approvals apply in the USA.

UK Calibration Laboratory: UKAS 0034.

USA Calibration Laboratory: ANAB Accredited ISO/IEC 17025.

National Accreditation Board for Testing and Calibration Laboratories approvals apply in India.

Operation of radio transmitters, telephones or other electrical/electronic devices in close proximity to the equipment while the enclosure doors of the instrument or its peripherals are open, may cause interference and possible failure where the radiated emissions exceed the EMC directive.

The protection provided by this product may be invalidated if alterations or additions are made to the structural, electrical, mechanical, pneumatic, software or firmware components of this system. Such changes may also invalidate the standard terms of warranty.

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1

INTRODUCTION



1 Introduction

1.1 Purpose of this manual

This manual contains all the information necessary for correct installation and commissioning of the instrument. The procedures given in this manual must only be carried out by suitable trained and qualified personnel.

1.2 Disclaimer

AMETEK Land will not be liable for any injury or damage caused by incorrect installation, set-up, operation or maintenance resulting from a failure to follow the procedures given in this manual.

1.3 Product Safety

AMETEK Land is an EN ISO 9001 accredited design and manufacturing organisation, and within the limits specified in this manual, manufactures instruments which conform to the essential health and safety requirements of the following European Union directives:

Low Voltage Directive (73/23/EEC)

EMC Directive (89/336/EEC)

In particular, the following harmonised standards have been applied:

IEC61010-1:2001

EN61326:2005

All due care has been taken in the design and manufacture of the equipment to meet the safety requirements of the above directives. However individuals installing, operating or maintaining the equipment are responsible for personal safety and for correct use of the equipment in accordance with the procedures detailed in this manual

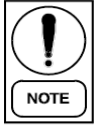
The following symbols are used throughout this manual to indicate procedures that, if not followed correctly, may result in injury to personnel or damage to equipment.



WARNINGS ARE USED TO ALERT THE READER TO A PROCEDURE OR PRACTICE, WHICH IF NOT FOLLOWED CORRECTLY, COULD RESULT IN PERSONAL INJURY.



Cautions are used to alert the reader to a procedure or practice, which if not followed correctly, could result in damage to the system or ancillary equipment.



Notes are used to highlight important information that may assist the reader in carrying out a procedure or in understanding the text.

1.4 Danger from Process

It is possible that the sensors are installed in ducting containing process particulate that is a hazard to health. This may take one or more of the following forms:

- Particulate which is inflammable or explosive
- Particulate which is toxic or in some other way a hazard to health
- Particulate contained within high temperature gas

Unless the process conditions are known to be entirely safe, suitable precautions such as the use of breathing apparatus or duct purging/detoxifying must be employed before any entry is made into the duct for installation or maintenance purposes. If in doubt, consult the local Safety Officer and/or local Safety procedures.

1.5 Limits of use

To achieve optimum performance and safe operation the equipment must be operated within the limits detailed in the Product Description. Operation outside these limits may result in damage to the equipment.

1.6 List of abbreviations

The following abbreviations are used in this manual:

AIM	Auxiliary Input Module
AOM	Analogue Output Module
PSU	Power Supply Unit
ROM	Relay Output Module

1.7 Associated Documents

Control Unit Reference Manual
Installation of Network Devices: Reference Manual
AMETEK Land Installation Notes

END OF SECTION



2

PRODUCT DESCRIPTION



2 Product Description

Process and Application Conditions

Certification range	0-15mg/m ³ (EN15267-3 QAL1 approved)
Long term zero drift	<0.1mg/m ³
Measurement capability	0-200mg/m ³
Inspection frequency	3 months
Application conditions	For measurement in non-condensing flue gases Not suitable for applications with water droplets
Velocity dependency	Negligible
Stack diameters	250 mm – 10 m

Sensor Specification

Enclosure temperature rating	-25°C to +55°C
Stack temperature rating	-25°C to +250°C (option to +500°C)
Enclosure rating	IP-65
Enclosure material	Die-cast aluminium (polyester powder coated)
Sensor body material	316 stainless steel
Sensor weight	11.5kg
Connection required on duct	Hole pattern to suit DN80 PN10/PN16 or 3" 150lb ANSI (hole ID at least 88mm)
Power requirements	24V provided by the control unit
Local outputs	RS-485 connection to control unit
Cable entries	3 x M20 gland/conduit entries
Cable type	4 core screen (see installation section for details)



Air Purge requirements	<p>Requires continuous air supply of 50 litres/minute.</p> <p>Provided either by a blower (AMETEK Land supplied) or instrument air.</p> <p>With instrument air, filtration is require (the use of AMETEK Land supplied air filtration kit is strongly recommended).</p>
Laser	<p>This product contains a class 3R laser. Maximum Power output = 5 mW Wavelength = 650 nm</p> <p>Complies with 21 CFR 1040.10 & 1040.11 and with IEC 60825-1 Edition 2 (2007)</p>

Sensor Options

Sensor Type options	<table border="1"> <tr> <td>Standard sensor</td> <td>0-250°C</td> </tr> <tr> <td>High temperature sensor</td> <td>0-500°C</td> </tr> </table>	Standard sensor	0-250°C	High temperature sensor	0-500°C
Standard sensor	0-250°C				
High temperature sensor	0-500°C				
Insertion length	The insertion length can be adjusted from 15mm to 600mm by adjusting the flange position.				
ATEX/ IECEx Category options	None				

Sensor Accessories

Air Filtration Kit	See section in manual
Low Pressure Blower	<p>Dimensions: 300 x 300 x 180 mm</p> <p>Rating: 100-240V 1.3A 50-60Hz</p>



Control Unit Specification

	4650-PM Single	4650-PM Multi
No of sensor channels	1	1 -16
ICON driven multilingual menus	Emission and Alarm levels Quality Assurance results Calibration screens Review data logs Show graph and bar chart Set up and password Advanced calculations (Mass, normalisation)	Emission and Alarm levels Quality Assurance results Calibration screens Review data logs Show graphs and multi bar charts Set up and password Advanced calculations (Mass, normalisation)
Outputs	1 x RS-485 (Modbus RTU) 1 x 4-20 mA (500 ohm) 2 x Relay (2A@250V, user selectable)	1 x RS-485 (Modbus RTU) 4 x 4-20 mA (500 ohm) 4 x Relay (2A @250V, user selectable)
Inputs	1 input for plant off indication, bag cleaning reference and multiple calibrations	4 inputs for plant off indication, bag cleaning reference and multiple calibrations
Enclosure Size (LxHxD)	220 x 123 x 80 mm	263 x 160 x91 mm
Power Supply	90 to 260 VAC (50/60Hz), 1A	90 to 260 VAC (50/60Hz), 1A

System Options

4-core Cable	Specify length required (10m per sensor included as standard)
--------------	---

END OF SECTION



3

SENSOR INSTALLATION



3 Sensor Installation

3.1 Safety



LASER SAFETY

**The sensor uses a Class 3R Laser, Max Power=5mW,
Wavelength=650nm**

AVOID DIRECT EYE EXPOSURE

**Caution: Use of controls or adjustments or performance of
procedures other than those specified therein may result in
hazardous radiation exposure**



or duct purging/detoxifying must be employed before any entry is made into the duct for installation or maintenance purposes. If in doubt, consult the local Safety Officer and/or local Safety procedures.



Probe Damage

Take care when handling the sensor to avoid damaging the probe. Probe damage may result in inaccurate measurements.



Supply Voltage

The sensor operates at 24V DC supplied from the Control Unit.

3.2 Location Requirements

- **Mount in the longest, straightest, unrestricted duct available.**
- **Avoid excessive vibration.**
- **Don't install too close to the top of an open stack where excessive ambient light could prevent operation. It is recommended to install on the most shaded side of the stack avoiding direct sunlight.**
- **Ambient or radiating temperatures in the vicinity of the mounting location must not exceed 50°C.**
- **See the Installation Guide for more details (available on CD).**



3.3 Installation Overview



Ensure air purge blower or filtered instrument air is connected and running before inserting the probe into the stack



Remove the cover from the measurement volume (see section below) before inserting sensor into the stack. This will expose the laser beam which travels between the two apertures. **AVOID DIRECT EYE EXPOSURE**

Removing the cover is essential for the measurement to work and allow the air purge to work correctly.

The installation of a 4650-PM system comprises the following steps:

Arrange location for sensor

Location relative to sampling ports and obstructions

Orientation of sensor

Provide orientation details to AMETEK Land on the site survey form at time of order (horizontal or vertical stack).

Prepare flange mounting for the sensor

Sufficient hole size

Correct flange type

Insertion distance (avoid approx. 150mm boundary layer)

Prepare purge air supply (unless using a blower)

Use air filter/regulator system as recommended by AMETEK Land to ensure air is filter for water, oil and particulate.

Set flow rate between 30 and 40 Litres/min

Provide air heating so purge air > 0°C

Prepare blower mounting (if using blower)

Requires mains power supply

Install within 2m of the probe

Blower tubing supplied (cut to length)



- Install control unit**
(see separate manual section) Requires mains power supply
- Install cabling to sensor** 4 core cable from control unit to sensor (24V power + RS485 comms)
Optionally install isolated spur between control unit and sensor to provide surge protection
- Install Probe into flange mounting** Remove cover from measurement volume (see picture above)
Ensure air purge blower or instrument air is connected and running before insertion
- Additional optional setup** **Add other network devices to network**
Other AMETEK Land network sensors
- Arrange data outputs from the control unit**
Relay alarm outputs
4-20 mA outputs
Modbus RTU output to PLC/DCS



3.4 Measurement cover removal

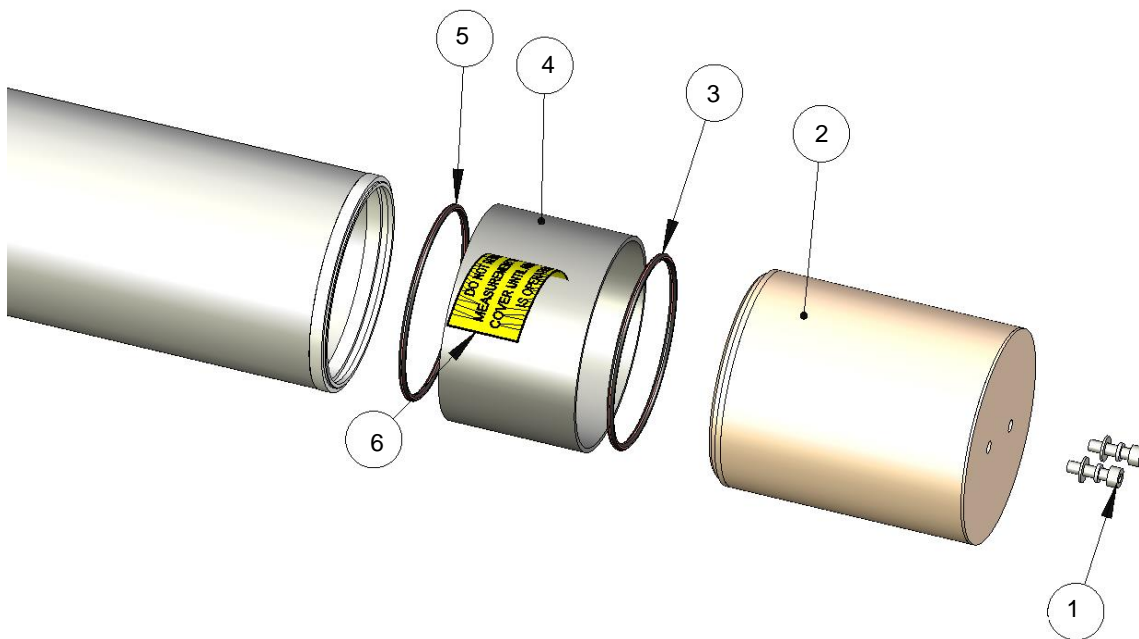


Ensure air purge blower or filtered instrument air is connected and running before inserting the probe into the stack



Remove the cover from the measurement volume (see section below) before inserting sensor into the stack. This will expose the laser beam which travel between the two apertures. AVOID DIRECT EYE EXPOSURE

Removing the cover is essential for the measurement to work and allow the air purge to work correctly.



To remove the measurement cover:

- Remove the screws [1] from the end cap (Allen key required)
- Slide the end cap [2] off the end of the instrument. Keep the O-ring [3] attached to the end cap.
- Remove the Measurement cover [4]. Keep this in case it is required for later shipment.
- [IMPORTANT] Refit the end cap and screws.

3.5 Sensor Tube Orientation



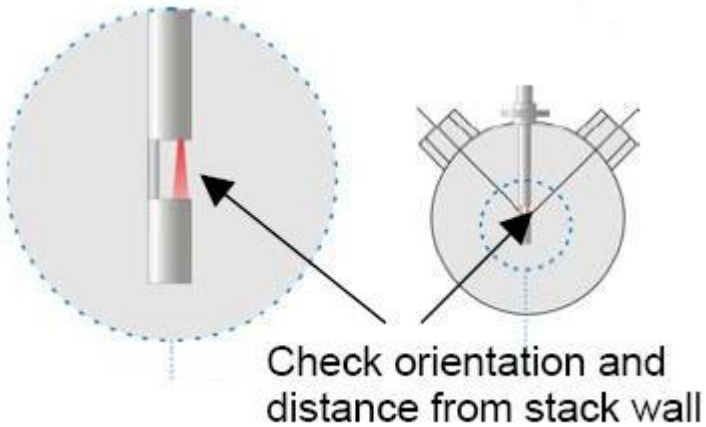
AMETEK Land supply instruments with 2 options of probe tube orientation. This is to satisfy the following installation requirement:

- the Inner Tube must not obstruct the direction of flow
- the enclosure must be installed with the cable glands and air purge entry pointing downwards.

On the site survey form specify one of the following options:

VERTICAL Flow direction from down to up
 Flow direction from up to down

HORIZONTAL Flow direction from right to left
 Flow direction from left to right



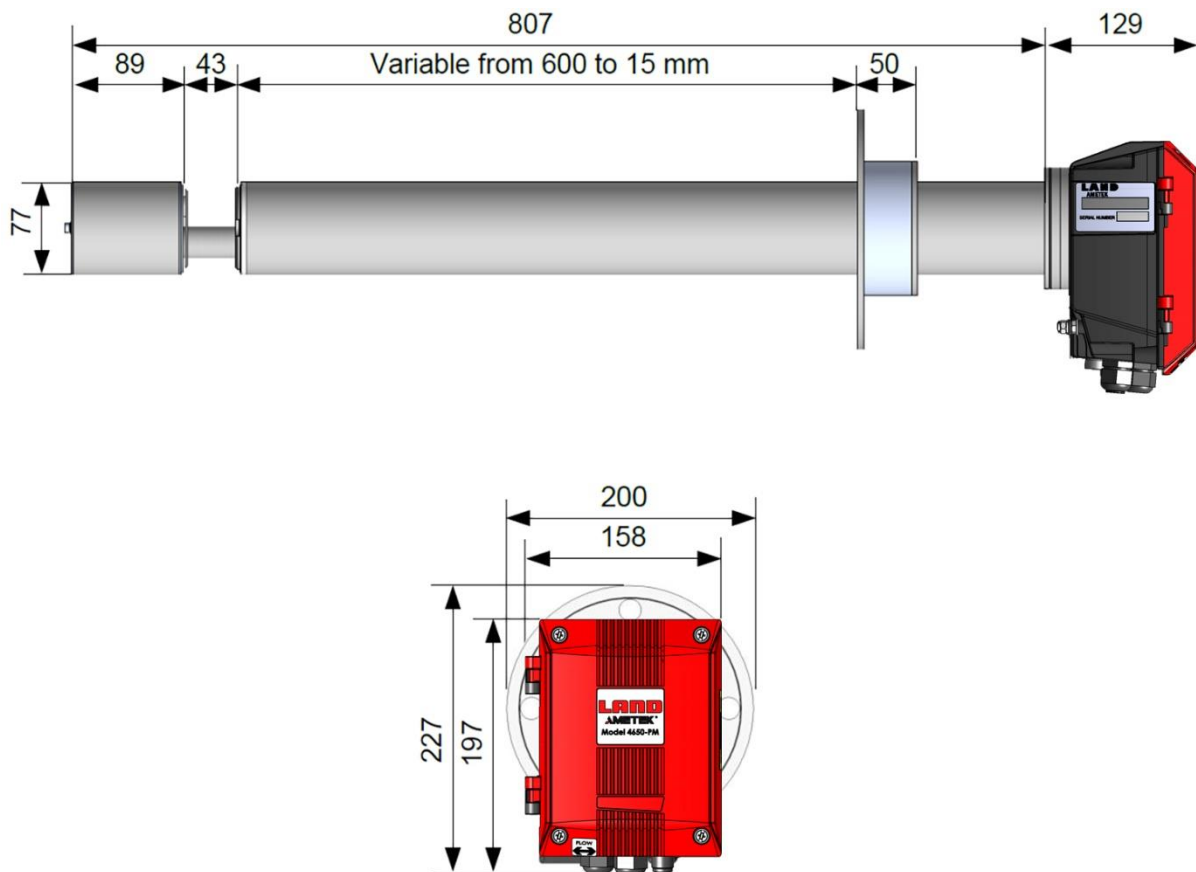


3.6 Insertion Distance

Ensure the measurement volume is at a sufficient distance from the side of the stack. A general guide is it should be at least 150mm from the stack wall to avoid the boundary layer.

The 4650-PM is provided with a single length probe. However the flange position is site adjustable to suit the installation details (stack diameter, standoff distance).

See the diagram below for range of insertion distances from the flange:



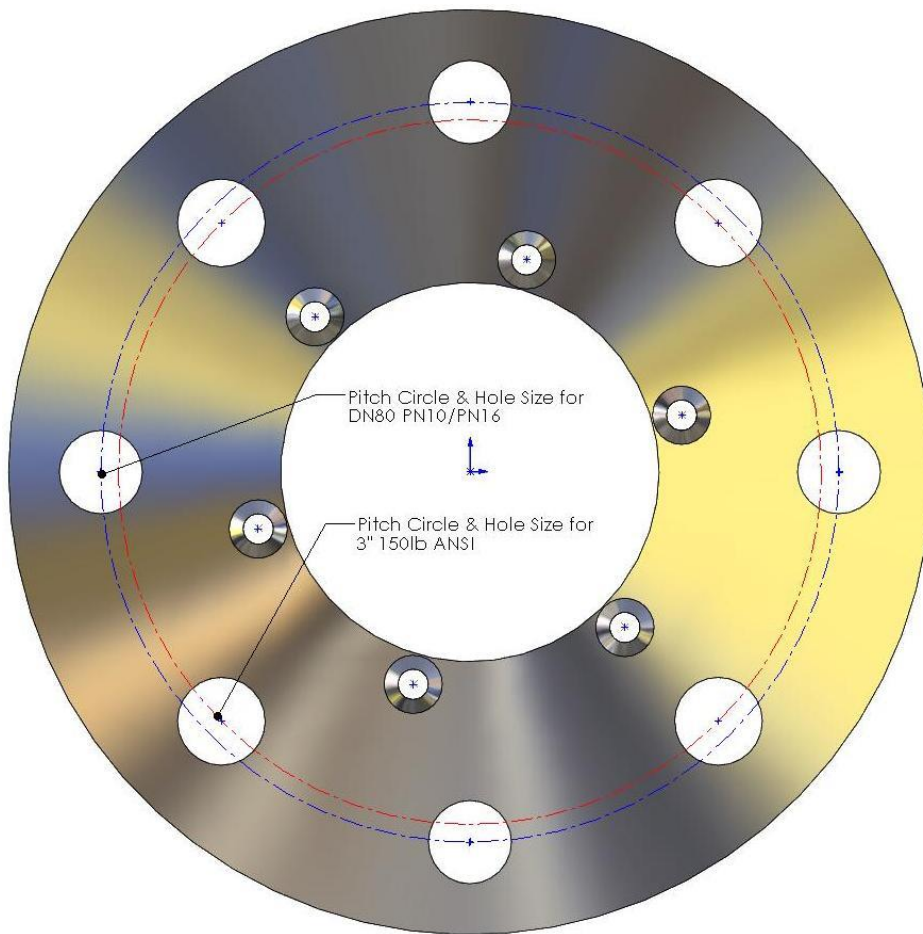


3.7 Flange Mounting

The 4650-PM is supplied with a flange with 2 sets of bolt holes.

		Pitch circle	Hole size	OD
Option A	DN80 PN10/PN16	160mm	18mm	200mm
Option B	3" 150lb ANSI	152.4mm	19mm	200mm

Note: Option B provides near compatibility for use with PN6 DN80 with 12mm bolts.





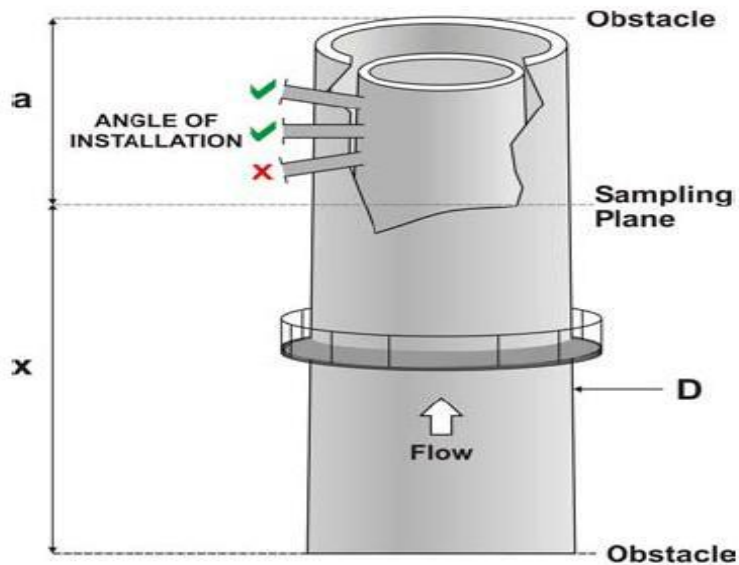
Provide a sufficient opening/hole in the stack wall:

Minimum hole size	88mm (allows for rust build up in flange mounting)
Maximum hole size	110mm

IMPORTANT: Weld the flange mounting tube so the 'angle of installation' is horizontal or pointing slightly downward e.g. 5°, to allow condensate to drain off.

On horizontal ducts, do not install the probe pointing vertically downwards. This will cause dust to drop into the end cap.

On thin walled ducts provide suitable reinforcements to minimize vibration.





3.8 Supplying Instrument Air

It is recommend to use the Air Filter Regulator Assembly with Automatic Flow Control supplied by AMETEK Land.

Key Requirements

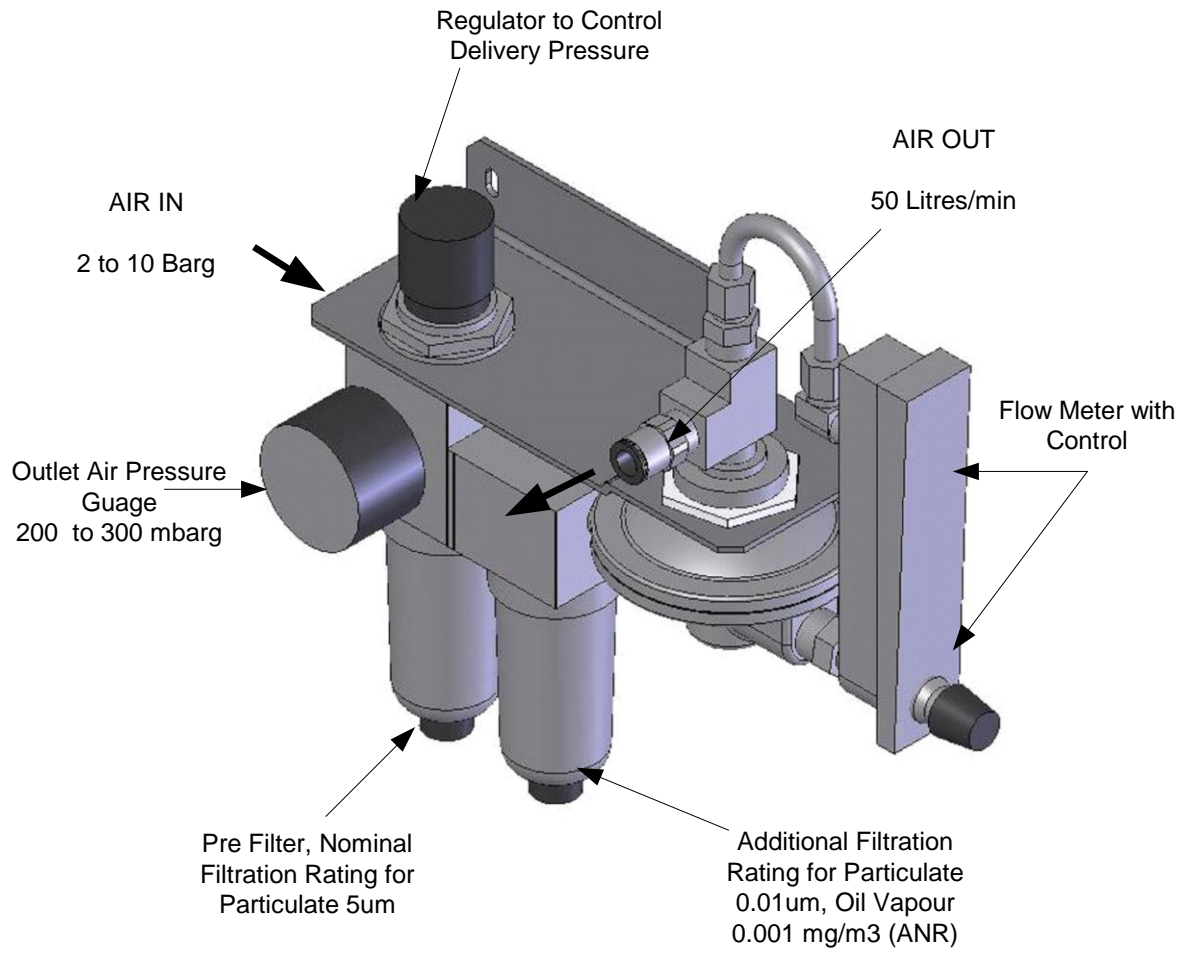
- Ensure air is filtered for water, oil and particulate
- Full control of air delivery to purge system. Flow set and automatically controlled
- Where appropriate, provide air heating so purge air $> 0^{\circ}\text{C}$.

Filtration requirements

- Filter/Regulator for Pressure Regulation and Primary Filtration
- Filter for Primary Particle Filtration ($0.1\ \mu\text{m}$)
- Filter for Secondary Particle Filtration ($0.01\ \mu\text{m}$) + Oil Vapour Removal ($0.1\text{mg}/\text{m}^3$ (ANR) saturated ($0.001\ \text{mg}/\text{m}^3$ before saturation $\approx 0.008\ \text{ppm}$)
- Flow measurement and control. Normally between 30 Litres/min and 40 Litres/min (up to 60 Litres/min if high dust loading or high velocity flow).
- Yoke to mount Filter/Regulator
- Wall Mounting Bracket

Usage

- Set the input pressure regulator to supply sufficient pressure for the flow controller to operate (a sensible level is 2 bar = 30 PSI).
- Set the output flow control to the recommended flow rate (50 Litres/min)





3.9 Mounting the blower unit (Option)

This section describes the installation of the optional AMETEK Land Small Blower Unit for use with the 4650-PM sensor. This may be used as an alternative to the use of instrument air. The blower is designed to supplying sufficient purge air (30-40 Litres/min) under normal stack conditions.



**HAZARDOUS VOLTAGES
THIS EQUIPMENT CONTAINS LETHAL VOLTAGES (100-240VAC 50/60HZ).**



Disconnect mains supply before opening enclosure.
Positive stack pressure will reduce the air purge capability.
With zero stack pressure, blower delivers 50 Litres/minute
Above 15mbar positive stack pressure it is recommended to use an instrument air line.



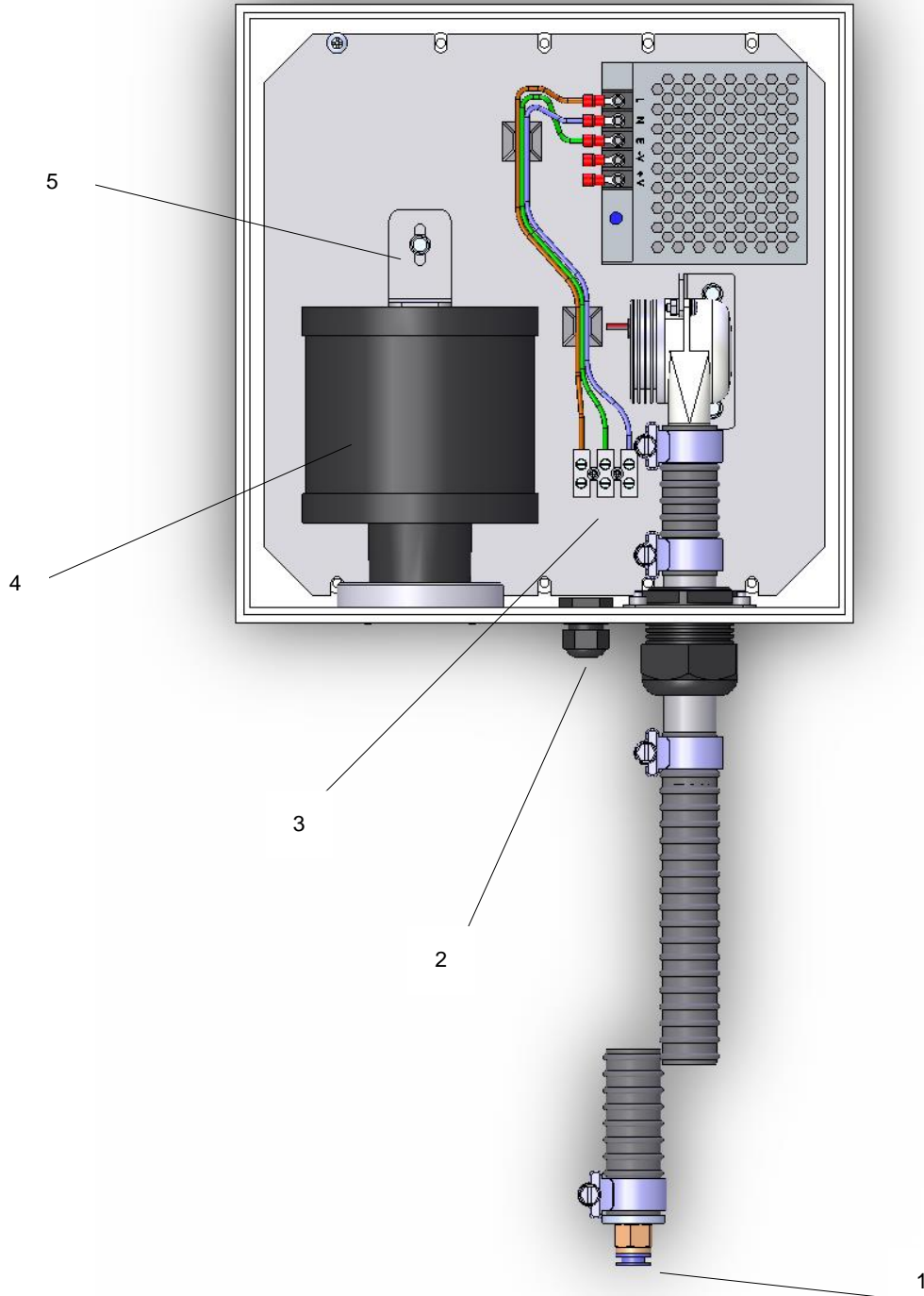
The blower is supplied pre-fitted with 2m tubing, ended with a short piece of narrow tubing to connect to the sensor. Do not add any additional restrictions to the tubing. This will reduce the air supply to the sensor.



Ensure the lid is tightened fully (using ¼-turn screws). This ensures the filter can operate fully to keep the air clean.



The filter is a replaceable part. To remove the filter slacken the filter bracket (shown below).





- 1 Tube fitting to sensor (60mm length of connecting tube supplied OD=10mm)
- 2 Gland for mains power cable
- 3 Mains power connector
- 4 Filter
- 5 Filter Bracket

Install the blower as follows:

Ensure distance from blower to sensor is less than 2m to allow connection of the supplied blower tube (you need to be able to remove the sensor easily without removing the blower tube). A 2m length of blower tube is supplied with the correct connections to attach to the sensor.

The blower enclosure is designed to be wall mounted with the air and power connections pointing downwards. Feet are supplied to aid mounting.

The blower unit requires a mains power supply (110/230 VAC 50/60Hz 1.3A). This is separate from the power supplied to the control unit and sensor. The internal voltage to the blower is 21V DC.

Mounting dimensions

The blower box should be mounted in the orientation shown below. Feet are supplied to screw in the 4 corners of the box.

Box Dimensions 300 mm (L) x 300 mm (W) x 180 mm (H)

Mounting holes
(with feet extended
horizontally) 275 mm (L) x 325 mm (W)

Mounting holes
(with feet extended vertically) 325 mm (L) x 275 mm (W)



3.10 Electrical Connection

Data Cabling Specification

The cabling provided by AMETEK Land has the following specification:

- 2 pair (4 core), 0.5 mm² (16/0.2)
- BS5308 part 2, type 1
- Overall tinned copper braided or foil screen
- Flame retardant PVC outer sheath (outside diameter 7.9mm)
- Colour coding (power): black (0v), brown (24 Vdc)
- Colour coding (comms): green (A), blue (B)

Network Layout

Connect multiple sensors to the control unit by daisy chaining as shown below.

For large systems it is best to place the control unit in the centre of the network to minimise voltage drop along cables.

For large systems you may need to boost power using a Power Supply Repeater – contact AMETEK Land for details.

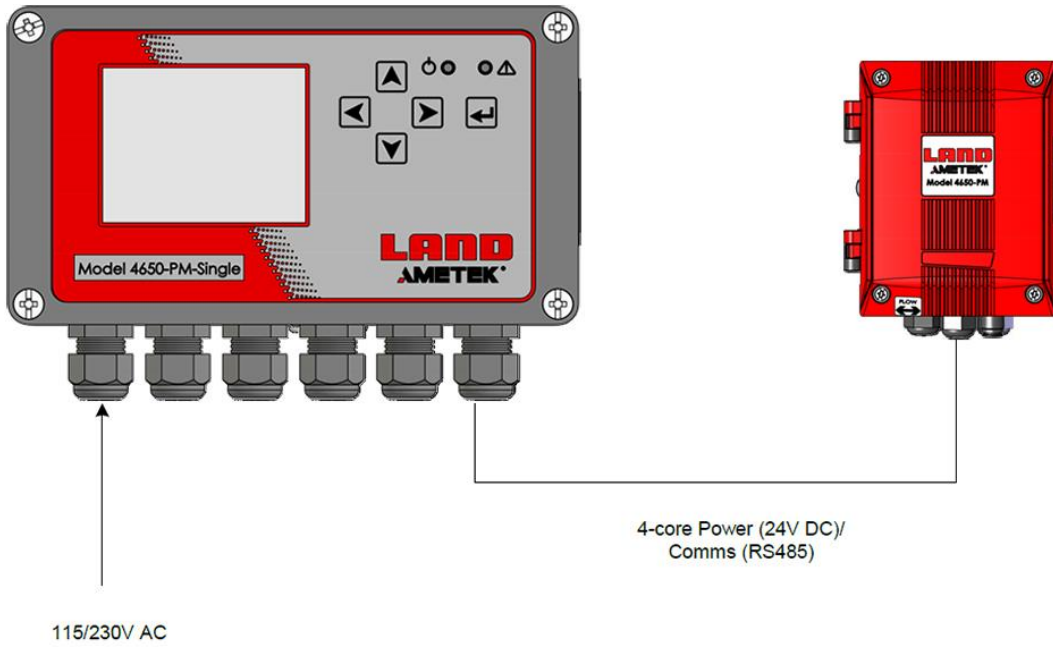


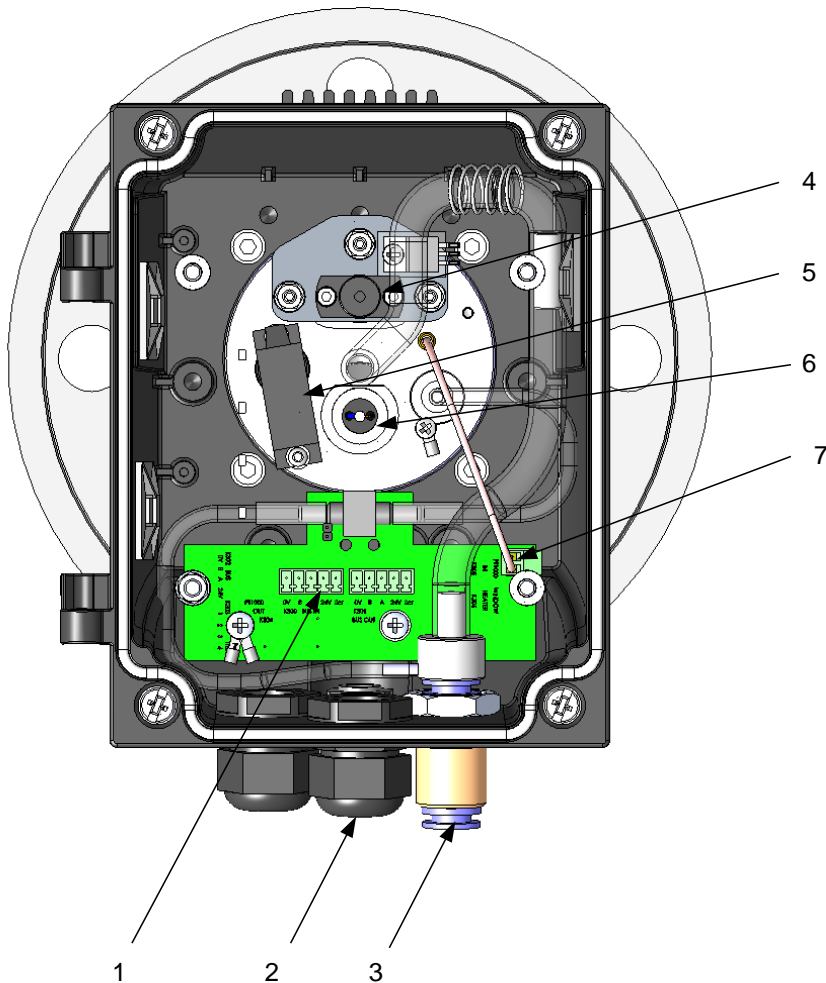
Figure 3-1 Standard System



Figure 3-2 4650-PM Multi System ("Daisy Chained")



Sensor Wiring



Ensure the cabling is not connected to the Control Unit power during wiring.

Figure 3-4 Sensor Wiring

- | | |
|----------------------------------|------------------------------|
| 1. BUS-IN and BUS-OUT connectors | 4. Laser |
| 2. M20 cable glands | 5. Servo motor for span test |
| 3. Air purge connector (M10) | 6. Receiver |
| | 7. PT1000 temperature sensor |

Refer to Figure 3-4 for location of terminals. After installation of the Sensor to the stack make the communications and power connections as follows:



For "daisy chained" Sensor Systems

Route the input cable through the cable gland nearest to the BUS IN terminals. Make the connections to the BUS IN terminals as follows from left to right:

0V	Black
Comms B	Blue
Comms A	Green
24V	Brown
Screen	Cable Screen

BUS IN TERMINAL

Connect the next Sensor in the network to the BUS OUT terminals. Route the cable through the cable gland nearest to the BUS OUT terminals. Make the connections to the BUS OUT terminals as follows from left to right:

0V	Black
Comms B	Blue
Comms A	Green
24V	Brown
Screen	Cable Screen

BUS OUT TERMINAL

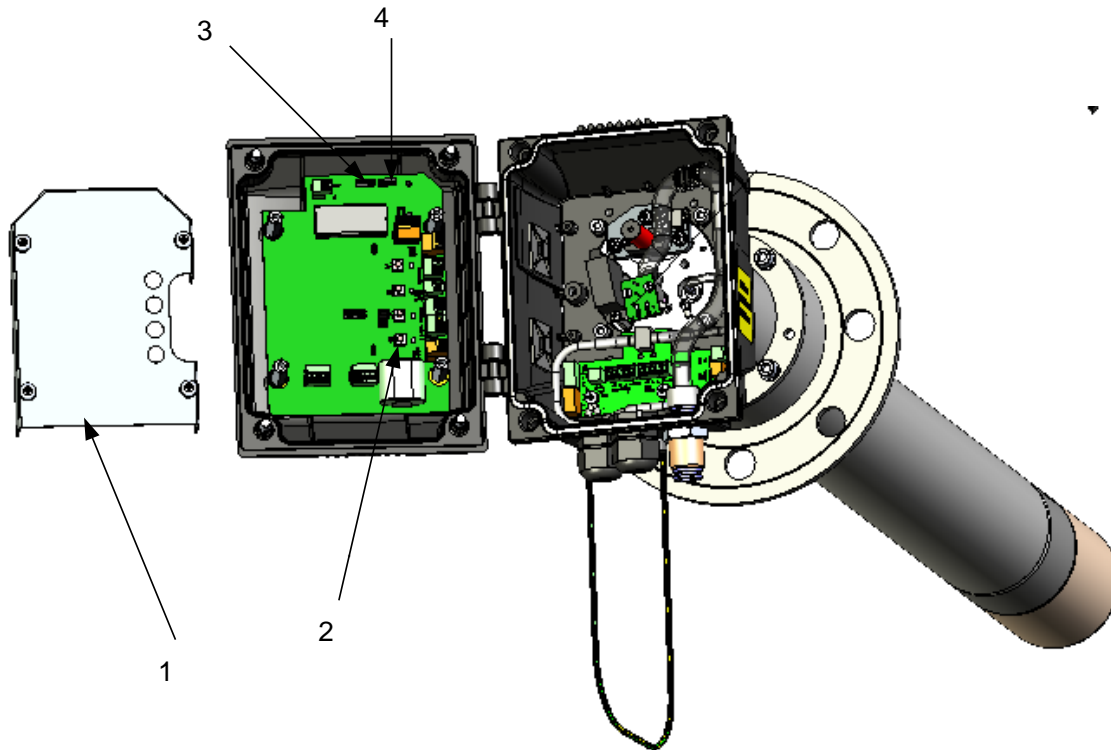


Figure 3-5 PCB installed in enclosure lid

- | | |
|------------------------------|---------------------------------------|
| 1 PCB Safety cover | Service Buttons (from top to bottom) |
| 2 Service Buttons | A. Entry Shutter Open/Close |
| 3 Set Comms Switch (SW201) | B. Exit Shutter Open/Close (not used) |
| 4 Set Address Switch (SW200) | C. Span Element Open/Close |
| | D. Laser On/Off |



Cable Routing

When routing cables observe the following:

- Ensure the cable sheath penetrates the Sensor Unit entry gland
- Fit blanking plugs to unused cable entry glands
- Ensure cable entry glands are tightened to the cable
- Support cables at appropriate intervals
- Do not route cables over roofs

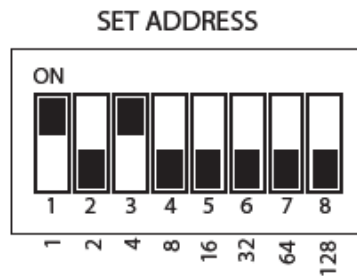
3.11 Setting Up

Additional setup functions require access to the sensor PCB installed in the enclosure lid. To access this PCB first remove the safety cover by undoing the 4 attaching screws. For a single sensor installation it is not necessary to adjust these settings.

Bus Termination Switch

There is no bus termination switch on this product. Bus termination is fixed as terminated.

Set address switch (SW100)



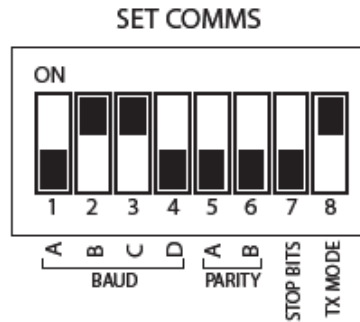
Each sensor must have a unique address on the network. The address is set by means of the DIP switch (SW100). Only switch positions 1 to 6 are used giving valid address settings from 1 to 64. The illustration above shows address 5. The address switch uses binary coding to calculate the required address.



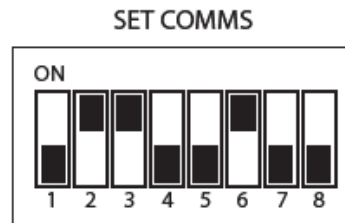
For example, to set address number 5: Set switch 1 (binary 1) ON and switch 3 (binary 4) ON (4 + 1 = 5).

Communication Settings (SW101)

The sensor has two comms settings, ASCII and RTU. The default setting is ASCII: 19200 Baud, No Parity, 1 Stop Bit, ASCII mode (7-bit). The DIP switch should be set as follows:



RTU is a faster communications protocol but is not available for all devices; refer to the Control Unit Reference Manual. If RTU mode is required set the DIP switch as follows:



Refit the Sensor Cover and secure with the four screws. Do not over tighten the screws.

END OF SECTION

A decorative graphic in the top left corner. It features a large, bold, black number '4' on a light gray background. To the right of the '4', there are several overlapping, semi-transparent gray rectangular shapes that create a sense of depth and movement. A bright blue triangle is positioned at the top right of this graphic area.

4

4650-PM MULTI-CONTROLLER INSTALLATION



4 4650-PM Multi-Controller Installation

This section provides information on installing and setting up a controller used in the 4650-PM Multi-Controller Version.

4.1 Safety



HAZARDOUS VOLTAGES
THIS EQUIPMENT CONTAINS LETHAL VOLTAGES (100-240VAC 50/60HZ).



DO NOT REVERSE LIVE AND NEUTRAL.
THE NEUTRAL LINE IS NOT FUSED.



HAZARDOUS VOLTAGES
SWITCH OFF AND ISOLATE THE UNIT POWER SUPPLY BEFORE REMOVING THE FRONT COVER.



HAZARDOUS VOLTAGES
A SUITABLE APPROVED AND RATED ALL POLE DISCONNECT DEVICE MUST BE INSTALLED IN THE BUILDING INSTALLATION IN A READILY ACCESSIBLE POINT NEAR THE CONTROLLER. THE CONTACT GAP OF THE DISCONNECT DEVICE MUST BE AT LEAST 3.0MM. THE CONTACTS SHOULD BE RATED AT LEAST 240VAC 1AAC



HAZARDOUS VOLTAGES
HAZARDOUS VOLTAGE ARE STILL PRESENT WHEN THE MAIN POWER SUPPLY FUSE HAS FAILED



EARTHING
THIS EQUIPMENT MUST BE EARTHED



NO User Serviceable parts within.
If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



The 4-20 mA outputs are SELV circuits in accordance with EN 60950-1:2001 and must only be connected to other SELV circuits.



The controller should be cleaned with a dry or lightly dampened cloth only

4.2 Tools and Materials

No special tools are required to install the MultiController.

Drilling Template

The Multicontroller should be mounted to a vertical surface by 4 mounting screws.

Template Width **	240-245.2mm
Template Height	110 mm

** the mounting holes are elliptical to allow flexibility of position

Data Cabling Specification

Data cabling for the MultiController provided by AMETEK Land meets the following specification:

- 2 pair (4 core), 0.5mm
- BS5308 part 2, type 1
- Overall tinned copper braided or foil screen
- Flame retardant PVC outer sheath (outside diameter 7.9mm)
- Colour coding (power): black (0v), brown (24 Vdc)
- Colour coding (comms): green (A), blue (B)

Power Supply Cabling Specification

For mains connections, use appropriate cable with conductor area in range 0.75mm² to 2.5mm², according to your local regulations.

All cabling should be rated for operation at 65°C (to allow for ambient temperature of 55°C).



4.3 Location Requirements

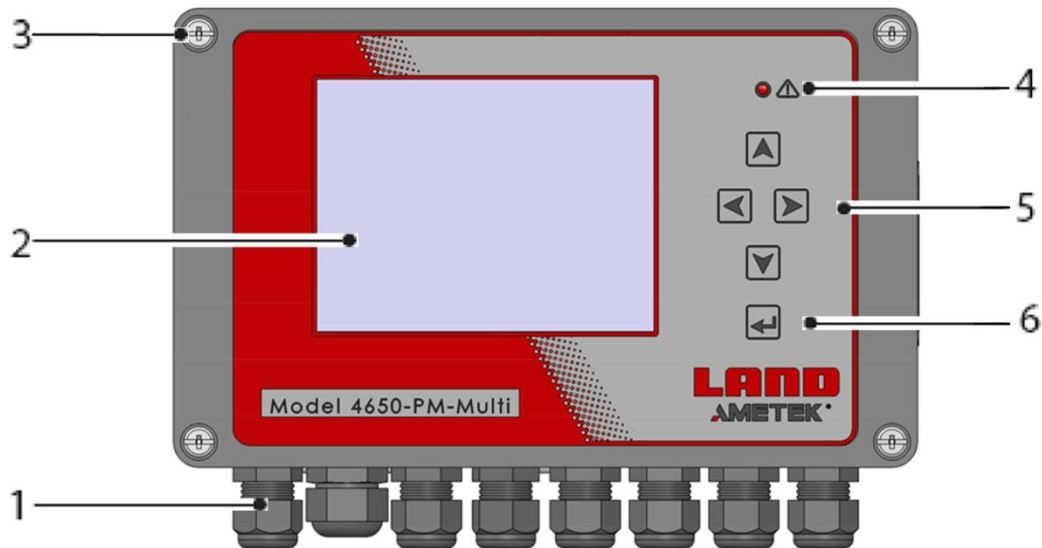
When selecting a mounting location for the MultiController, the following should be taken into consideration:

Avoid excessive sun exposure and if possible some form of environmental protection should be provided.

If the unit is located in an area which is accessible to unauthorised personnel it is recommended that access to the unit be restricted by some form of lockable cabinet.

4.4 Component Location

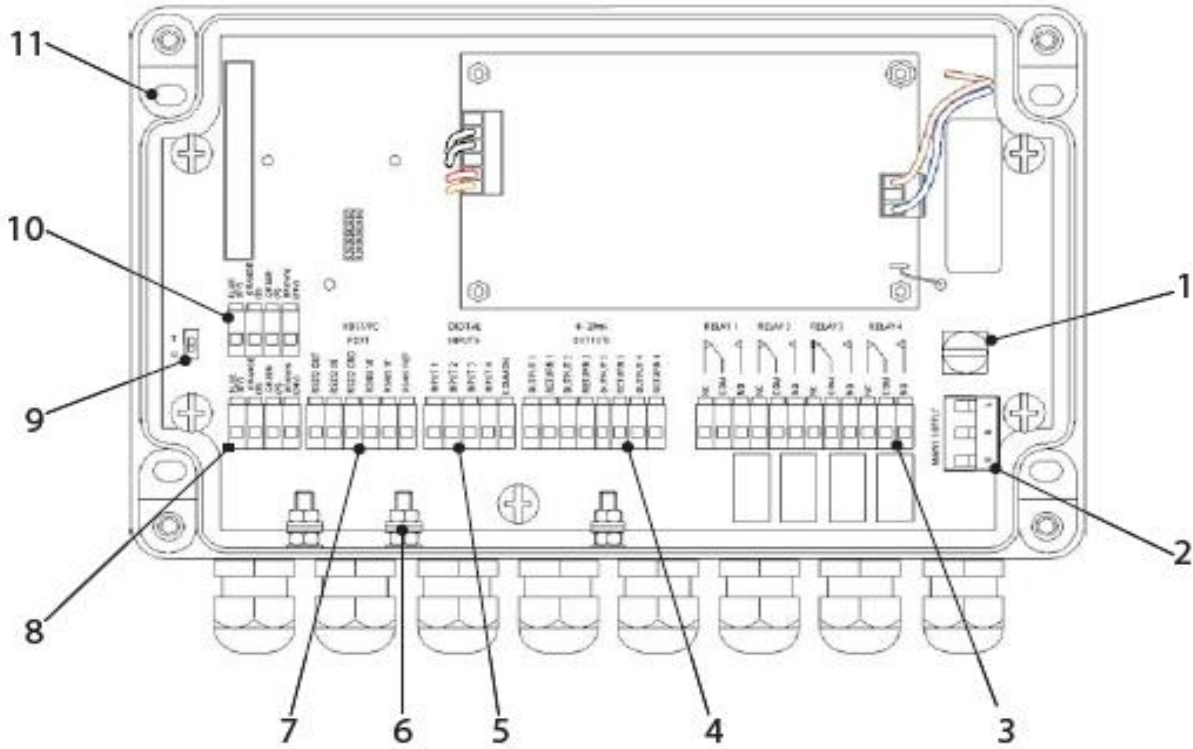
Figure 4-1 MultiController Front Panel



- | | |
|--|---|
| 1. Cable entry gland (8 off) | 4. Power-on indicator / alarm indicator |
| 2. Back-lit graphical display (320 x 240 pixels) | 5. Cursor keys (up, down, left, right) |
| 3. Front cover securing screw (4 off) | 6. Enter key |



Figure 4-2 MultiController Connections



- 1 Mains fuse (see below for rating)
- 2 Mains supply terminals (PL6)
- 3 Alarm contacts terminals (PL5)
- 4 Isolated 4-20 mA outputs (PL4)
- 5 Digital inputs terminals (PL3)
- 6 Earth stud - cable screen (3 off)
- 7 RS232/RS485 terminals (PL2)
- 8 Data Bus (Sensor/Network) (PL1)
- 9 Bus termination switch (SW200)
- 10 Data Bus (Sensor/Network) (PL7)
- 11 Fixing hole (4 off)

Mains fuse rating: Quick blow, rated 240VAC 1A, with 1500A interrupt capability, HRC ceramic, UL-recognised



4.5 Installation



**HAZARDOUS VOLTAGES
THIS EQUIPMENT CONTAINS LETHAL VOLTAGES (100-240VAC 50/60HZ).**



MAKE ALL THE DATA CONNECTIONS BEFORE MAKING THE POWER SUPPLY CONNECTIONS. LEAVE THE RIGHT HAND CABLE GLAND ENTRY (VIEWED FROM THE FRONT) FREE FOR THE POWER SUPPLY CABLE.

Mounting the Control Unit

Refer to Figures 4-1 and 4-2. Remove the four screws securing the unit front cover and remove the cover.

Identify the four fixing holes and using suitable fixings secure the unit to a suitable flat, vertical surface.

Data Cable Connection

Data cable connections are as follows from left to right:

0V	Black
Comms B	Blue
Comms A	Green
24V	Brown

**SENSOR/NETWORK
CONNECTORS
(PL1, PL7)**

Installing the MultiController at the end of a network

Route the data cable through the cable gland nearest to the Data Bus PL1 and make the connections to the Data Bus PL1 terminals

Connect the cable screen to the nearest earth stud using an eyelet tag

Installing the MultiController in the middle of a network

For larger networks it is recommended that the MultiController be placed in the middle of the network to reduce voltage drops.

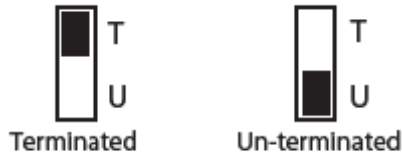
Route the data cable for one half of the network through the cable gland nearest to the Data Bus PL1 and make the connections to the Data Bus PL1.



Route the data cable for the other half of the network through the next cable gland and connect to the Data Bus PL7 terminals.

Connect the cable screen from each cable to the nearest earth stud using an eyelet tag.

Bus Termination Switch (SW200)



The Bus Termination Switch (SW200) identifies the MultiController's position in the network. Set the switch to "U" (Un-terminated) if the unit is in the middle of the network. If the unit is at the end of the network set the switch to "T" (Terminated).

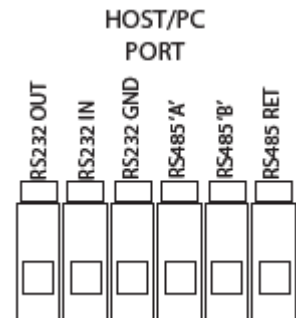
RS232/RS485 Connections (PL2)

The MultiController is fitted with an isolated RS232/485 port for connection to a PC/PLC.

Route a suitable cable through a vacant cable gland and connect to PL2 as shown.

The maximum cable length for RS232 is 25 metres.

The maximum cable length for RS485 is 1000 metres. RS485 can be used to "daisy chain" several Multi-Controllers together with separate Modbus addresses.

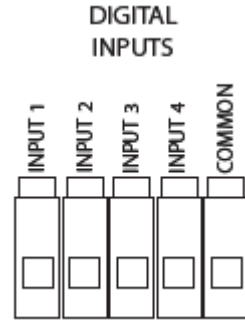


Digital Input Connections (PL3)

The MultiController has four digital (contact) inputs that may be assigned by the user.



These inputs are implemented using protected logic input gates. The inputs should either be switched to ground by an external switch (e.g. a relay), or driven from a low voltage logic output.



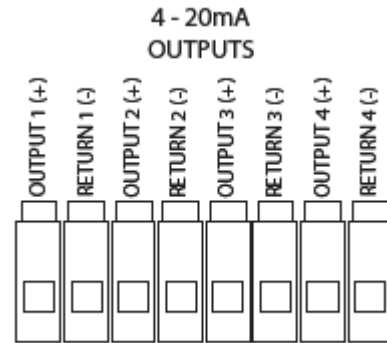
Route a suitable cable through a vacant cable gland and connect to PL3 as shown. The connection should be made between the required input and common ground.

4-20 mA Output Connections (PL4)

The MultiController is fitted with four isolated 4-20 mA outputs, each capable of driving a 500 Ohm load.



The four outputs share a common return that is isolated from chassis ground. The outputs should not be floated more than 30V above chassis ground.



Route a suitable cable through a vacant cable gland and connect to PL4 as shown.

Alarm Contact Connections (PL5)

The MultiController is fitted with four voltage-free SPCO with a 2A current rating. The relays can be used to switch mains voltages.



The maximum current through the alarm contacts must not exceed 2 Amps.

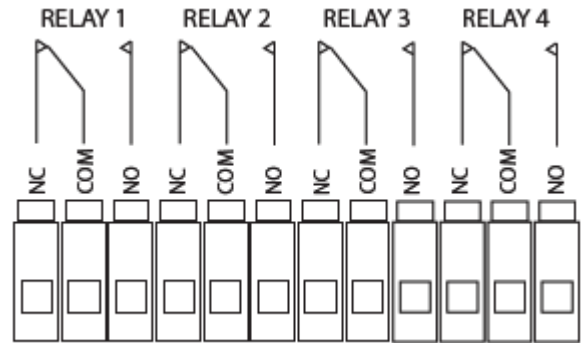
The following user-programmable alarms are provided:



- Relay 1: Comms alarm
- Relay 2: Limit alarm
- Relay 3: Warning alarm
- Relay 4: Self-test alarm

Relay contacts are shown in the normal operating positions- power is applied and no alarm exists.

Route a suitable cable through a vacant cable gland and connect to PL5 as shown.



Power Supply Connections (PL6)



**HAZARDOUS VOLTAGES
ENSURE THE POWER SUPPLY IS SWITCHED OFF AND ISOLATED BEFORE CONNECTING THE UNIT TO THE POWER SUPPLY WIRING.**



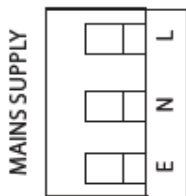
**DO NOT REVERSE LIVE AND NEUTRAL.
THE NEUTRAL LINE IS NOT FUSED.**



**EARTHING
THIS EQUIPMENT MUST BE EARTHED.**

All electrical wiring must be carried out in accordance with local regulations.

The unit does not contain a power disconnect device. An easily accessible external disconnect device and fuse must be fitted in the power supply wiring. The disconnect device must have a contact separation of not less than 3mm and must be mounted as near as possible to the Multi-Controller.



Route the power supply cable through the right-hand cable gland (viewed from the front of the unit) and connect to the mains power supply terminals as shown.

Refit the unit cover and secure with the four screws. Do not over tighten the screws.

Carry out the initial set-up procedures given in the Initial Setup section

END OF SECTION

A decorative graphic at the top of the page. It features a large, bold, dark gray number '5' on the left. To the right of the '5' is a series of overlapping, light gray diagonal stripes that create a sense of motion or depth. At the top right of this graphic is a solid blue triangle pointing towards the right.

5

4650-PM SINGLE CONTROLLER INSTALLATION



5 4650-PM Single Controller Installation

This section provides information on installing and setting up an Interface Module used in the 4650-PM Single Controller.

5.1 Safety



**HAZARDOUS VOLTAGES
THIS EQUIPMENT CONTAINS LETHAL VOLTAGES (100-240VAC 50/60HZ).**



**DO NOT REVERSE LIVE AND NEUTRAL.
THE NEUTRAL LINE IS NOT FUSED.**



**HAZARDOUS VOLTAGES
SWITCH OFF AND ISOLATE THE UNIT POWER SUPPLY
BEFORE REMOVING THE FRONT COVER.**



**HAZARDOUS VOLTAGES
A SUITABLE APPROVED AND RATED ALL POLE DISCONNECT
DEVICE MUST BE INSTALLED IN THE BUILDING
INSTALLATION IN A READILY ACCESSIBLE POINT NEAR THE
CONTROLLER. THE CONTACT GAP OF THE DISCONNECT
DEVICE MUST BE AT LEAST 3.0MM. THE CONTACTS SHOULD
BE RATED AT LEAST 240VAC 1AAC**



**HAZARDOUS VOLTAGES
HAZARDOUS VOLTAGE ARE STILL PRESENT WHEN THE MAIN
POWER SUPPLY FUSE HAS FAILED**



**EARTHING
THIS EQUIPMENT MUST BE EARTHED**



**NO User Serviceable parts within.
If the equipment is used in a manner not specified by the
manufacturer, the protection provided by the equipment may
be impaired.**



The 4-20 mA outputs are SELV circuits in accordance with EN 60950-1:2001 and must only be connected to other SELV circuits.



The controller should be cleaned with a dry or lightly dampened cloth only

5.2 Tools and Materials

No special tools are required to install the Interface Module.

Data Cabling Specification

Data cabling for the Interface Module must meet the following specification:

- 2 pair (4 core), 0.5mm
- BS5308 part 2, type 1
- Overall tinned copper braided or foil screen
- Flame retardant PVC outer sheath (outside diameter 7.9mm)
- Colour coding (power): black (0v), brown (24 Vdc)
- Colour coding (comms): green (A), blue (B)

Power Supply Cabling Specification

For mains connections, use appropriate cable with conductor area in range 0.75mm² to 2.5mm², according to your local regulations.

All cabling should be rated for use up to 65°C (to allow for ambient temperature of 55°C).



5.3 Location Requirements

When selecting a mounting location for the Interface Module the following should be taken into consideration:

Exterior locations should be selected for minimum sun exposure and if possible some form of environmental protection should be provided.

If the unit is located in an area which is accessible to unauthorised personnel it is recommended that access to the unit be restricted by some form of lockable cabinet.



5.4 Component Location

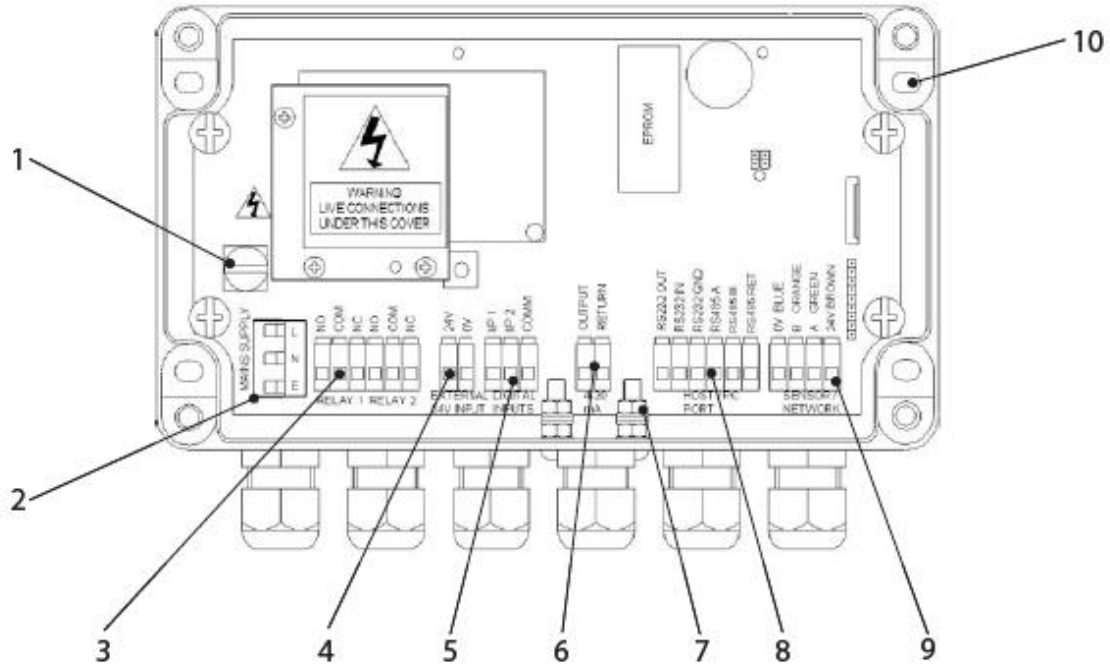


Figure 4-1 Interface Module Connections

- 1 Mains fuse (1Amp)
- 2 Mains supply terminals
- 3 Alarm contacts terminals
- 4 24V input
- 5 Digital inputs terminals
- 6 Isolated 4-20 mA Output
- 7 Earth stud - cable screen (2 off)
- 8 RS232/RS485 terminals
- 9 Data Bus (Sensor/Network Connector)
- 10 Fixing hole (4 off)



5.5 Installation



**HAZARDOUS VOLTAGES
THIS EQUIPMENT CONTAINS LETHAL VOLTAGES (100-240VAC 50/60HZ).**



MAKE ALL THE DATA CONNECTIONS BEFORE MAKING THE POWER SUPPLY CONNECTIONS. LEAVE THE RIGHT HAND CABLE GLAND ENTRY (VIEWED FROM THE FRONT) FREE FOR THE POWER SUPPLY CABLE.

Mounting the Interface Module

Refer to Figures 4-1. Remove the four screws securing the unit front cover and remove the cover.

Identify the four fixing holes and using suitable fixings secure the unit to a suitable flat, vertical surface.

Data Cable Connection

Data cable connections are as follows from left to right:

0V	Black
Comms B	Blue
Comms A	Green
24V	Brown

**SENSOR/NETWORK
CONNECTOR**

Route the data cable through the cable gland nearest to the SENSOR/NETWORK connector and make the connections to the terminals.

Connect the cable screen to the nearest earth connection terminal using an eyelet tag.

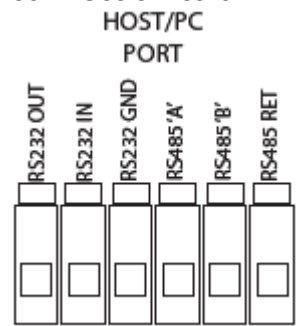
RS232/RS485 Connections



The Interface Module is fitted with an isolated RS232/485 port for connection to a PC/PLC.

The maximum cable length for RS232 is 25 metres.

The maximum cable length for RS485 is 1000 metres.





Digital Input Connections

The Interface Module has two digital (contact) inputs that may be assigned by the user.



These inputs are voltage-free and should not be connected to logic outputs from PLCs.

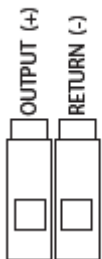


Route a suitable cable through a vacant cable gland and connect to DIGITAL INPUTS as shown. The connection should be made between the required input and common ground.

4-20 mA Output Connections

The Interface Module is fitted with one isolated 4-20 mA outputs, each capable of driving a 250 Ohm load.

4 - 20mA
OUTPUTS



Route a suitable cable through a vacant cable gland and connect as shown.

Alarm Contact Connections

The Interface Module is fitted with two voltage-free SPCO with a 3A current rating. The relays can be used to switch mains voltages.



The maximum current through the alarm contacts must not exceed 3 Amps.



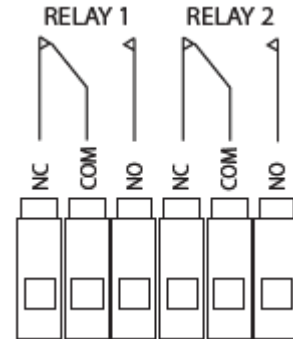
The following user-programmable alarms are provided:

Relay 1: Comms alarm

Relay 2: Limit alarm

Relay contacts are shown in the normal operating positions- power is applied and no alarm exists.

Route a suitable cable through a vacant cable gland and connect as shown.



Power Supply Connections



HAZARDOUS VOLTAGES
ENSURE THE POWER SUPPLY IS SWITCHED OFF AND ISOLATED BEFORE CONNECTING THE UNIT TO THE POWER SUPPLY WIRING.



DO NOT REVERSE LIVE AND NEUTRAL.
THE NEUTRAL LINE IS NOT FUSED.



EARTHING
THIS EQUIPMENT MUST BE EARTHED.

All electrical wiring must be carried out in accordance with local regulations.

The unit does not contain a power disconnect device. An easily accessible external disconnect device and fuse must be fitted in the power supply wiring. The disconnect device must have a contact separation of not less than 3mm and must be mounted as near as possible to the Interface Module.



Route the power supply cable through the right-hand cable gland (viewed from the front of the unit) and connect to the mains power supply terminals as shown above.

Refit the unit cover and secure with the four screws. Do not over tighten the screws.

Carry out the initial set-up procedures given in the Initial Setup section.

END OF SECTION



6

INITIAL SET-UP



6 Initial Set-up

6.1 Introduction

This section provides information on initial set-up and operation of the Control Unit. The same procedure applies to both the 4650-PM and 4650-PM Multi.

6.2 Power-Up

Switch on the external power supply to the Control Unit. Check the power-on indicator is on and the graphical display illuminates. The icon bar is shown as follows:



The required display is selected using the cursor and enter keys:



Selects 'Multiple Devices' display



Selects 'Bar Graph' display



Selects 'System Overview' display



Selects 'Alarm Log' display



Selects 'Graph Data' display



Selects 'Quality Assurance / Self Tests' display



Selects 'Password Entry' display



Select 'Setup' display


6.3 Checking the Communications Mode

When using the multicontroller for the first time, communication must be established between the multicontroller and all the sensors in the network. If the multicontroller is being re-configured, all existing settings can be cleared by performing a 'Master Reset'.



A Master Reset will delete all settings and logged data.

To perform a Master Reset


Select 'Setup' display 

Menu route:

- Other Functions ↓
- Reset Functions ↓
- Master Reset

The Communications Mode is set by AMETEK Land prior to installation and should have been checked during the system installation.

To check the Communications Mode

Select 'Setup' display 

Menu route:

- Other Functions ↓
- Advanced Functions ↓
- Sensor Comms Mode

The settings should be as follows:

Setting	Mode	Baud Rate	Parity
Standard	ASCII	19200	Odd
Optional	RTU	19200	None

If problems are encountered communicating with a sensor, check that the sensor communication setting (SW101) is the same as the multicontroller Sensor Comms Mode setting.


6.4 Autodetect Sensors

Sensor channels can be added to the multicontroller by autodetect or manually.



The manual mode should only be used to add sensors when manual control of the order in which the devices are displayed is required or only specific sensors are to be added.

In the 'Autodetect' mode the multicontroller scans all the modbus addresses to identify all the sensors in the network.

Select 'Setup' display 

Menu route:
Autodetect

The controller will attempt to configure all the sensors in the network with the default settings. When this is complete a bar graph or text display of all the sensor data will be displayed.

Select 'Bar/Text' on the display to switch between bar graph and text display. The display sequence is shown below.

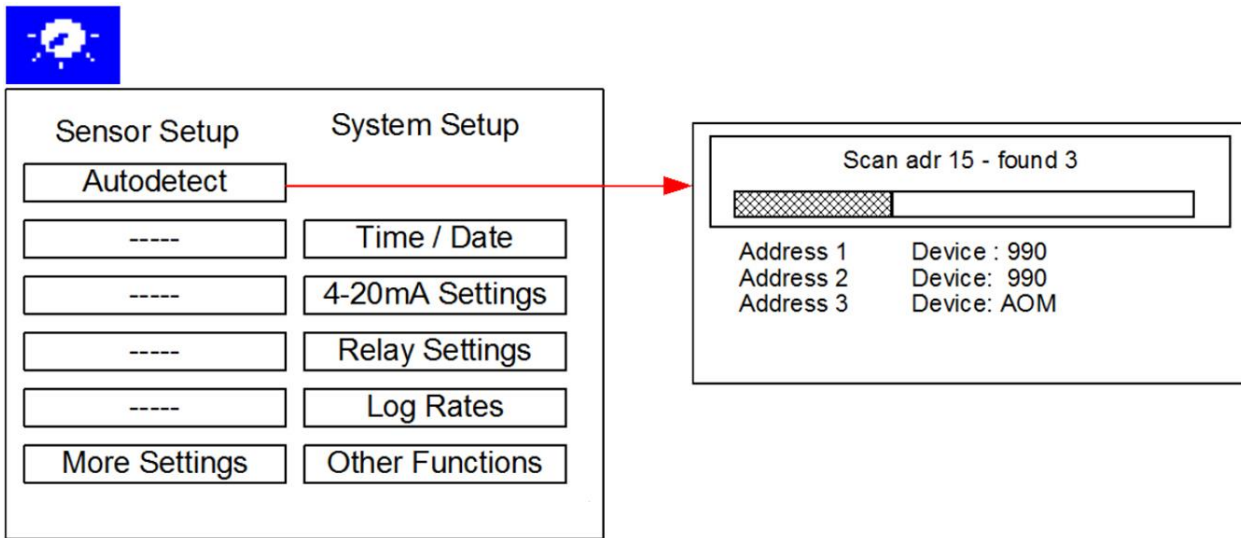


Figure 6-1 Autodetect Sensors



6.5 Editing Basic Sensor Settings

After running autodetect, a configuration button for each detected channel (up to a maximum of four) will be displayed on the configuration page.

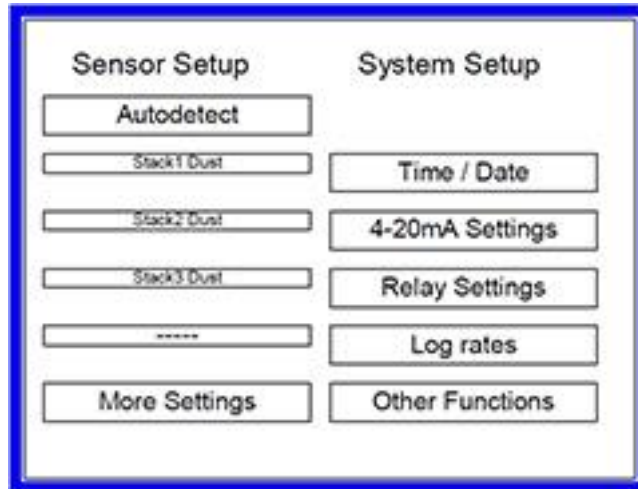


Figure 6-2 Sensor Settings



Advanced settings and additional sensors are accessed through the 'More Settings' menu.

To edit the basic settings for a channel choose the channel and select enter. The following screen will be displayed:

Calibration Factor	<input type="text" value="1.0000"/>
Instant Warning Alarm	<input type="text" value="0.0000"/>
Instant Limit Alarm	<input type="text" value="0.0000"/>
Averaging Time (sec)	<input type="text" value="60"/>
Average Warning Alarm	<input type="text" value="0.0000"/>
Average Limit Alarm	<input type="text" value="0.0000"/>
Alarm Delay (sec)	<input type="text" value="5"/>
<input type="button" value="Cancel"/>	<input type="button" value="Save"/>

Figure 6-3 Basic Sensor Settings

6.6 Calibration Factor

The Calibration Factor is used to scale the raw dust reading to provide a mg/m³ reading within the instrument. Alternatively the raw dust reading can be output to your own system (using Analogue or Modbus outputs) and calibrated within that system.

The Calibration Factor scales the raw reading as follows:

$$\text{Dust Reading (mg/m}^3\text{)} = \text{Raw instrument reading} \times \text{Calibration Factor}$$

The Calibration Factor is applied to:

- The Bar Graph / Text display values (used to generate emission alarms)
- Logged data within the instrument
- Analogue (4-20 mA) Outputs
- Modbus RS485 Output values

The procedure to calculate the correct calibration factor is described in the calibration section.

The default Calibration Factor is 1.00.



When the calibration factor is adjusted, the new calibration factor is only applied to NEW logged data. Existing logged data remains calibrated to the old calibration factor. The control unit maintains a history of calibration factor changes for use by the AMETEK Land Dust Reporter PC software

6.7 Emission Alarm Settings

The Emission Alarm Settings are used to set up emission alarms in the Control Unit. Alternatively the dust reading can be output to your own system (using Analogue or Modbus outputs) and the emission alarms set within that system.

The Emission Alarm Settings are used to:

- Generate alarms within the control unit (recorded in the alarm log)
- To activate Relays out of the control unit.

The Emission Alarm Settings allow the following adjustments:

- Setup of two alarm levels: a Warning Alarm (High Alarm) and a Limit Alarm (High High Alarm). It is recommended to set the Limit Alarm to your regulatory compliance emission limit. Optionally, set the warning alarm to a lower value to give early warning of a potential problem.
- Option to setup either Instant Alarms or Average Alarms.

Instant alarms:

Instant alarms use the pulse reading read from the sensor (usually once every second). Instant alarms should only be used if quick detection of a sudden change in dust reading is required.

Average alarms (Averaging Time):

Average alarms use a smoothed reading by averaging data based on the Averaging Time.

For regulatory compliance it is recommended to set up only the Average Alarm with the Averaging Time set to the averaging time specified in your regulation.

Typical values are:

30 mins = 1800 secs

1 hour = 3600 secs



Alarm delay:

The alarm delay is used to prevent a temporary high dust spikes from generating unnecessary alarms. Dust spikes are typically generated at process start up or by bag filter cleaning. The default Alarm Delay is set to 5 secs. Increase this as required to the duration of the dust spikes you are seeing (look at the pulse log to access this).

Notes:



Note 1: The alarm delay is applied to both instant and average alarms.



Note 2: Averaging is done using a walking window filter. This means the average values used to generate alarms may differ from the averaged logged data which uses simple averaging.




Note 3: The averaging filter is reset at power up and after making sensor setting adjustments. During the initial period the reading will be an average of a shorter period than the averaging time. This may result in unwanted alarms.



Note 4: To disable any of the alarm levels set the value to 0.00.



6.8 Set Time / Date

Select 'Setup' display 

Menu route:
Time / Date

The following screen is displayed.

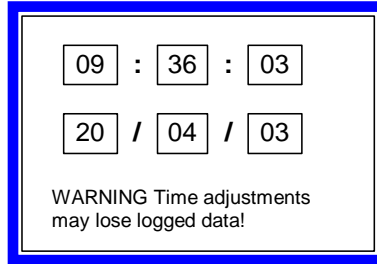


Figure 6-4 Time / Date Configuration



Changing the time / date may result in loss of logged data.

The system does not automatically change the time for daylight saving hours (clocks forward or back).

Default setting is Greenwich Mean Time.

Use the cursor keys to highlight the parameter to be changed and the enter key to change the value. To save the changes and return to the main menu select the Clock icon on the top left of the screen.

If the time is set back the Controller will not log new data until the time has passed the latest timestamp in the log. (i.e. if the time is put back 1 hour from 10.00 to 09.00 the Controller will not log data until the time reaches 10.00. If the time is put back by more than 24 hours the Controller will clear all logs and start logging again immediately.



6.9 4-20 mA Settings


The AutoDetect procedure automatically assigns the detect sensor channels to 4-20 mA outputs in the control unit (scaled 0->100 mg/m3). The 4-20 mA settings function allows:

- Re-scaling of the 4-20 mA outputs
- Applying filtering to the 4-20 mA outputs
- Reassigning of the 4-20 mA outputs (both within the control unit and from additional Analogue Output Modules)
- Fine tuning (calibration) of the 4mA and 20mA levels of the outputs.

The MultiController has four independent 4-20 mA outputs. The Interface Module has a single 4-20 mA output. These outputs can be user assigned to any sensor in the network. The outputs have the following specification:

- Isolated outputs
- Maximum loading: 500 Ohms
- Update rate: 1 second

Scaling and Filtering 4-20 mA Outputs

Select 'Setup' display 

Menu route:
4-20 mA
Settings

The following screen is displayed:

4-20mA Settings			
Device	Zero	Span	Filter (secs)
1 <input type="text" value="None Selected"/>	<input type="text" value="0.000"/>	<input type="text" value="100.0"/>	<input type="text" value="0001"/>
2 <input type="text" value="None Selected"/>	<input type="text" value="0.000"/>	<input type="text" value="100.0"/>	<input type="text" value="0001"/>
3 <input type="text" value="None Selected"/>	<input type="text" value="0.000"/>	<input type="text" value="100.0"/>	<input type="text" value="0001"/>
4 <input type="text" value="None Selected"/>	<input type="text" value="0.000"/>	<input type="text" value="100.0"/>	<input type="text" value="0001"/>

Figure 6-5 4-20 mA Settings

The four rows in the table correspond to outputs 1, 2, 3 & 4. To assign a sensor to an output, select the group and name box then select the required sensor from the device list. The zero, span and filter may then be changed as required:



Zero: The displayed reading corresponding to 4mA output. Factory setting is 0.000.
 Span: The displayed reading corresponding to 20mA output. Factory setting is 100.
 Filter: The time constant in seconds of the smoothing applied to the 4-20 mA output. Factory setting is 0001.

An example is shown below:

4-20mA Settings			
Device	Zero	Span	Filter (secs)
1 Stack1 Dust	0.000	50.00	0001
2 Stack3 Dust	20.00	40.00	0030
3 None Selected	0.000	100.0	0001
4 None Selected	0.000	100.0	0001

Back Calibration


Figure 6-6 4-20 mA Configuration Example

Output 1 set up to output Stack1 Dust readings in the range 0 to 50 with no additional filtering applied. Output 2 is set up to output Stack 3 Dust readings between 20 and 40 with a 30 second filter applied.

Therefore if Stack1 Dust = 25mg/m³ then Output 1 = 4 + 25/50 * (20-4) = 4 + 8 = 12mA.
 If Stack3 Dust = 25mg/m³ then Output 2 = 4 + (25-20)/(40-20) * (20-4) = 4 + 4 = 8mA.

Testing and Calibrating 4-20 mA Outputs

The 4-20 mA outputs can be tested for correct output current.

Select 'Setup' display 

- Menu route:
- 4-20 mA Settings ↵
- Calibration



The following screen is displayed:

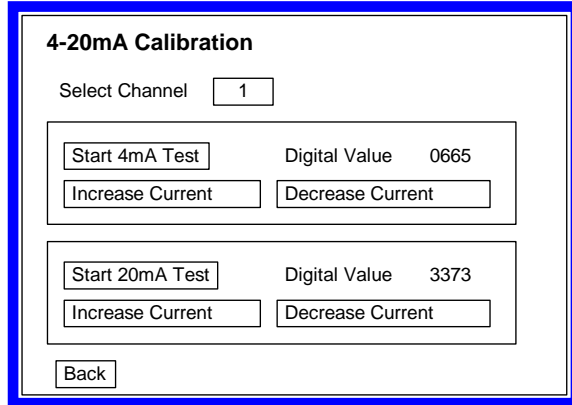


Figure 6-7 4-20 mA Calibration

Select the 4-20 mA output channel to be tested. Connect a multimeter to the output to be tested.

Select **Start 4mA Test**. The multimeter should display a current of 4mA.

If the current is less than 4mA, repeatedly select **Increase Current** until a 4mA reading is reached.

If the current is greater than 4mA, repeatedly select **Decrease Current** until a 4mA reading is reached.

Select **Start 20mA Test**. The multimeter should display a current of 20mA.

If the current is less than 20mA, repeatedly select **Increase Current** until a 20mA reading is reached.

If the current is greater than 20mA, repeatedly select **Decrease Current** until a 20mA reading is reached.

Repeat the above tests for each 4-20 mA output channel as required. Select Back to return to the main menu.



6.10 Relay Settings

The Relays Settings function assigns the use of the alarm relay both within the control unit and from additional Relay Output Modules. The Multi Controller has four relay outputs (The Interface Module has two relay outputs). Additional relay outputs can be supplied by including one or more Relay Output Modules (ROM) at any point in the sensor network (8 outputs per module).

Multi and Single Module Relays

The default use for the relays is detailed below:

Relay 1 Comms Alarm (e.g. caused by faulty wiring to the sensor)


Relay 2 Limit Alarm from any channel/sensor (either instantaneous or average)

Relay 3 Warning Alarm from any channel/sensor (either instantaneous or average)

Relay 4 Self Test Fail Alarm (e.g. caused by contamination of a sensor)



Only Relay 1 and 2 are available on the Single.

Select 'Setup' display 

Menu route:



The relay default settings are global to all channels. i.e. relay 2 will trigger if any channel generates a Limit Alarm.

Relay Settings	
Alarm Type	Device
1 Comms Error	All devices
2 Limit Alarm	All devices
3 Warning Alarm	All devices
4 Self Test Fail	All devices
Back	



Relays can be assigned to individual channels/sensors and the alarm types can be user specified.

	Alarm Type	Device
1	Limit Alarm	Stack 1 Dust
2	Limit Alarm	Stack 2 Dust
3	Limit Alarm	Stack 3 Dust
4	Limit Alarm	Stack 4 Dust

Back


To change the Alarm Type select the Alarm Type button for the relay and select, from the list, the alarm type required. The following alarm types are available:

- Warning Alarm
- Limit Alarm
- Comms Error
- Self Test Fail
- Test Running
- Maintenance
- Zero/Span Fail
- Contam Fail

To allocate the device select the Device button for the relay and select the device required.

Select 'Back' to return to the 'Setup' display.

If it is required for alarms to stay latched after the end of an alarm condition use the Latch Alarm function:

Select 'Setup' display 

Menu route:

- Other Functions ↓
- Latch Alarms?

The relays can be put in a failsafe mode. In this mode during normal non-alarm conditions the relays are energised and de-energised when an alarm is generated. In the event of a power failure or a power loss to the Control Unit the relays will de-energise and alarms generated.



Select 'Setup' display



Menu route:


Other Functions ↵

FailSafe Relays?



6.11 Log Rates

The Log Rates option allows the storage rate for the long-term memory and the short-term memory to be viewed or changed.

Select 'Setup' display 

Menu route:
Log rates

The following screen is displayed:

Long Term (mins)	<input type="text" value="15"/>
Short Term (secs)	<input type="text" value="60"/>
	<input type="button" value="Back"/>


Select Long Term or Short Term as required.

The Long Term memory may be set to log at any of the following intervals:
1, 2, 5, 10, 15, 30, 60, 120, 240 minutes.

The short-term memory may be set to log at any of the following intervals:
10, 15, 20, 30, 60, 120, 240 seconds.

6.12 More Sensor Settings

The More Settings menu enables advanced changes to be made to sensor settings or manually add or delete sensors.

Select 'Setup' display 

Menu route:
More Settings



The following screen is displayed:

Sensor Settings

Manually Add Sensors

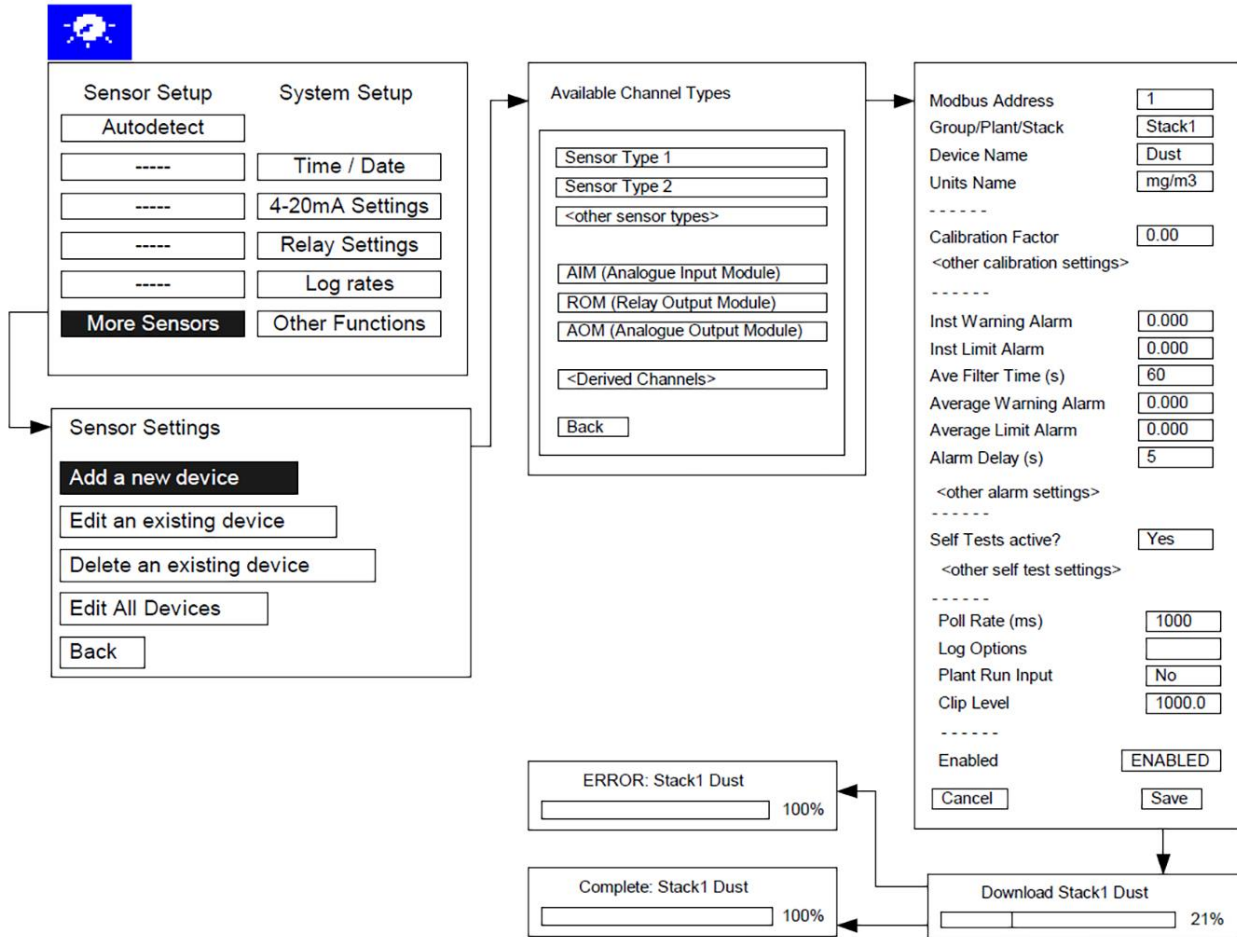


Figure 6-9 Manually Add Sensors



The manual mode is used to add sensors when:

- manual control of the order in which the devices are displayed is required
-
- only specific sensors are to be added.

Select 'Setup' display



Menu route:

More Settings ↵

Add a New Device

Choose the correct channel type from the list and set the following parameters

Modbus Address: set to the address set on the sensor dip switches

Group and Device Name: set to identify the channel. (Default is Stack1 Dust)

Select Save at the bottom of the settings list. For some sensor types this will initiate a download to the sensor. If this fails, an error message will be displayed and the display will revert to the settings screen. Re-check the modbus address and retry. If the download repeatedly fails select Cancel. Refer to the Trouble Shooting section to diagnose the problem.

For sensors which do not need to download configuration settings, a sensor channel will automatically be added to the bar graph display. Select the Bar Graph display and check the sensor is reading correctly. If the sensor fails to communicate for 10 seconds a No Response alarm will appear for that device. If this happens select Edit an Existing Device and check the Modbus Address. If the No Response alarm remains refer to the Trouble Shooting section to diagnose the problem.

Editing Sensor/Device Settings

To edit the settings for an individual sensor or device:

Select 'Setup' display



Menu route:

More Sensors ↵

Edit an existing device


Select the device to be edited and change the settings as required.

Select Save to download the new settings to the sensor/device.



Delete Sensor/Device

To delete an individual sensor or device:

Select 'Setup' display 

Menu route:

More Settings ↵
Delete an existing device

Select the device to be deleted.



This will permanently remove all settings and logged data associated with the device. Entries in the Event Log for the device will be marked as deleted.



Editing Settings for all Sensors/Devices at Once

For large systems it may be easier to set all sensor/device settings to the same value at the same time:

Select 'Setup' display



Menu route:

More Settings ↵

Edit all devices

Select the parameter to be edited and set the value. Select Save to apply the new settings to all the sensors/devices.

Advanced Settings

For information on more advanced sensor/device settings refer to the Control Unit Reference Manual.

END OF SECTION

A decorative graphic in the top left corner. It features a large, bold, black number '7' on a light gray background. To the right of the '7', there are several overlapping, semi-transparent gray shapes that create a sense of depth and movement. A bright blue triangle is positioned at the top right of these shapes, pointing towards the right.

7

QUALITY ASSURANCE AND SELF TESTS




7 Quality Assurance and Self-Tests

7.1 Introduction

The Controller QA screen provides the following maintenance and testing functions:

Function	Purpose
Maintenance Mode (Start/Stop)	Puts sensor in a maintenance mode to allowing cleaning and maintenance of sensor
Sensor Self Tests (Zero, Span)	Run internal sensor self tests to check the validity of measurements
Comms Check	Check communication between Controller and Sensor
Calibration	Carry out calibration using results from Isokinetic sampling
Cleaning	Functions to aid cleaning of the instrument
Purge Flow Check	Check the air purge is operating correctly

To access the QA menu:

Select 'Quality Assurance / 'Self Tests' display 

The following screen will be displayed:

Quality Assurance / Self Tests

i Device:

<input type="button" value="Activate"/>	Zero Test	17
<input type="button" value="Activate"/>	Span Test	9855
<input style="background-color: #cccccc;" type="button"/>	Adc Counts	2305
<input style="background-color: #cccccc;" type="button"/>	Comms Check	PASS



7.2 4650-PM Sensor Self Tests

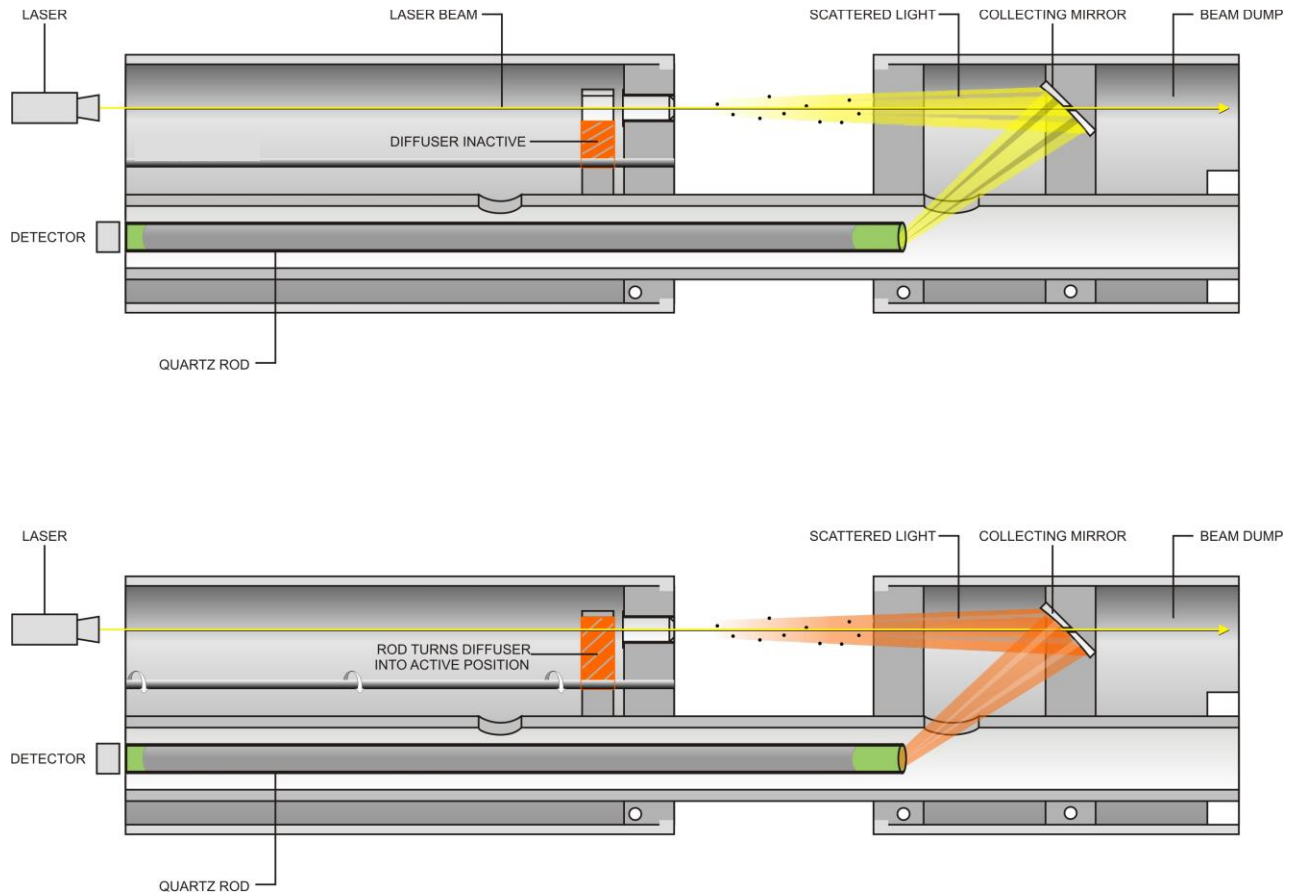
The main display box on the QA page displays various Self Check Results for the currently selected sensor. The choice of sensor is made from the edit box at the top of the main display box. For each test, the display alternates between PASS or FAIL and a numerical result of the test: the meaning of these numbers is explained below.

Zero Test

The zero test is performed by turning the laser off. The result is reported in raw receiver counts (approximately 1 count = 0.001mg/m³). An alarm is generated if this result is outside +/-200 (i.e. 0.2mg/m³).

Span Test

The span test is performed by rotating a scattering device into the main beam path. This approximately simulates the effect of dust scattering from the measurement region. The scattering device is located just before the measurement volume. The test is performed without changing the receiver system. The result of the test is compared against a factory-measured level then the result expressed as a proportion of 10000. In this way it is simple to read off the % drop in signal due to contamination. e.g. a reading of 9500 means a 5% contamination.



Purge Flow Check

The 4650-PM sensor is fitted with a pressure sensor to measure the volume of air being supplied by the air purge. The current Purge Flow can be noted by entering the Cleaning screen. The displayed reading is in Litres/min. The expected reading is 50Litres/min. If the reading drops below 15 Litres/min a "Low Purge Flow" alarm is indicated in the control unit.

Self Test Values

The following table gives the numerical values required for the self tests to pass:


Self Test	Min. Pass Level	Optimum Level	Max. Pass Level
Zero Check	-200	0	200



Span Check	5000 (cleaning is recommended at 8000)	10000	12000
Purge Flow	15 (adjustable)	50	

Disabling Self Tests


To enable/disable the running of the zero/span checks:

Select 'Setup' display 

Menu route:

- More Settings ↵
- Edit an existing device ↵
- Select device to edit
- Self Tests Active
- Yes / No

Select Save to save the settings and return to the main menu. **Note this does not disable the Purge Flow alarm.**

To enable/disable the zero/span alarms: Select 'Setup' display 

Menu route:

- More Settings ↵
- Edit an existing device ↵
- Select device to edit
- Zero/Span alarm?
- Yes / No

To adjust the Low Purge Flow alarm level: Select 'Setup' display 

Menu route:

- More Settings ↵
- Edit an existing device ↵
- Select device to edit
- Purge Alarm Level

The default level is 15 Litres/minute. To prevent the Low Purge Flow alarm, set the Purge Alarm Level = 0.

Select Save to save the settings and return to the main menu.



Note: this feature is available from software version 7.80.

Comms Check

Tests the communication between the controller and the selected sensor. If this test fails, check the wiring between the controller and the sensor. Check the address and comms settings on the sensor and controller.

END OF SECTION



8

MAINTENANCE MODE



8 Maintenance Mode


Maintenance mode allows sensors to be disabled for routine maintenance.

There are three ways of disabling a sensor:

Power off the Control Unit: this removes power from all sensors in the network. A 'Power Interruption' alarm will be recorded in the event log indicating the maintenance period. A gap will appear in all emission logs.

Disconnect the Sensor from the network: if the sensors are connected into the network using spurs it is possible to physically disconnect the sensor from the network without affecting polling to the other sensors. A 'No Response' alarm will be generated in the Control Unit for that channel during the maintenance period.

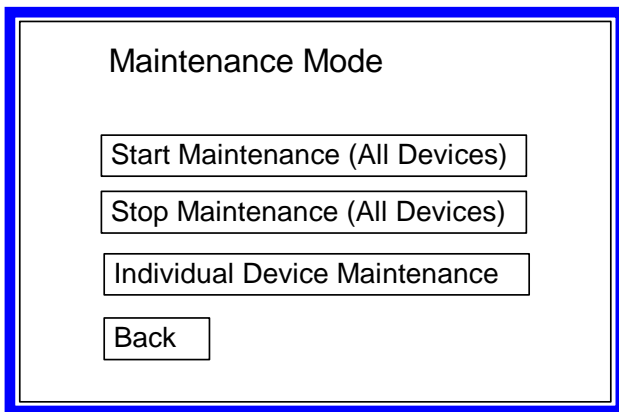
Maintenance Mode Menu in the control unit: Sensors placed in the maintenance mode will be automatically enabled after 8 hours. To place a sensor in the Maintenance Mode:

Select 'Setup' display 

Menu route:

Other
Functions,↓
Maintenance
Mode

The following screen is displayed:



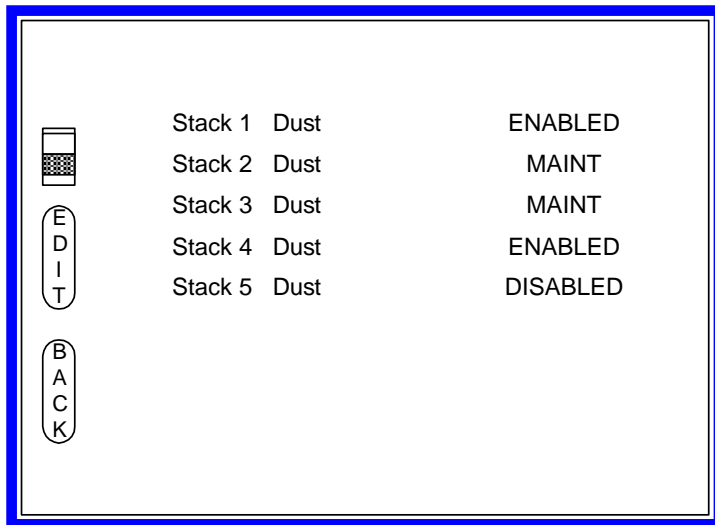
To put all sensors into Maintenance Mode select Start Maintenance (All Devices).

To return all sensors into Enabled Mode select Stop Maintenance (All Devices).

To place individual sensors in Maintenance Mode: select Individual Device Maintenance:



The following screen will be displayed:



Use the scroll bar to move the cursor to the required channel.

Press Edit to change sensor to Maintenance Mode.

The following table details the status of various functions according to sensor status:

Function	Sensor Status		
	Enabled	Maint	Disabled
Emission Alarms (Control Unit relays and ROM devices)	Active	Inactive	Inactive
Comms and Self Test Alarms	Active	Active	Inactive
4-20 mA and AOM Outputs	Active	Set to 0	Set to 0
Bar Graph Displays	Active	Active (labelled MAINT)	Set to 0
Logging	Active	Active (labelled MAINT)*	Inactive
Alarm Log	-	Maintenance Alarm	-

*Data may be excluded from AMETEK Land Dust Tools (Dust Reporter) reports.

END OF SECTION



9

SERVICE MESSAGES



9 Service Messages

The Control Unit generates Service Messages at various points in the life of the sensors to ensure the sensors are correctly maintained.

Three types of Service messages are created. The meaning of these messages is explained below:

Message	Time after installation	Action Required
Inspection due	6 months	Remove sensor from stack for inspection and cleaning
Service due	12 months	Arrange service visit by AMETEK Land Service Engineer or a local PMCE representative
Major Service due	4 years	Recommended return to AMETEK Land for testing and refurbishment if required

Also messages advising inspection occur 1 month prior to Inspection due. Also if the Messages are not cleared within 1 month, Overdue messages will occur and the controller LED will flash red.

9.1 Clearing Service Messages


All active service messages can be cleared by entering maintenance mode, performing the required actions on the sensor then returning to normal mode (see Maintenance Mode section for details).

For a single sensor:

Select 'Quality Assurance/Self Tests' display 

Choose the Sensor from the "Device" list
 Select "Start Maint"
 <Perform maintenance>
 Select "Stop Maint"

For all sensors:

Select 'Setup' display 



Menu route:

```
Other Functions.↓
Maintenance Mode
Select "Start Maintenance (all Devices)"
<Perform maintenance>
Select "Stop Maintenance (all Devices)"
```

9.2 Inspecting and Cleaning Sensors

Put the sensor in Maintenance Mode. This will force 4-20 mA outputs to 4mA and disable relays (see Maintenance Mode section for details).

At the Sensor:

Refer to the special cleaning procedures for the 4650-PM sensor at the back of this manual.

At the Control Unit:

Check the time and date are correct. The control unit does not automatically adjust 1 hour for Daylight Saving – you may wish to leave it unchanged.

- Check that the connections to the control unit are correct and secure.
- Wipe the face panel of the control unit with a damp (not wet) cloth (do not use cleaning agents).
- Check the "Quality Assurance/Self Tests" display in the controller. All results should show PASS.
- Watch the instrument performance with the process running and ensure that the process is still being followed correctly. This is best done by downloading data using AMETEK Land Dust Reporter software. Compare the data before and after cleaning: if cleaning has significantly altered the reading then more regular maintenance may be required.
- Test outputs from the control unit as required. Check with Control Room before testing any outputs. Note: outputs are disabled in Maintenance Mode.
- Test 4-20 mA outputs for correct output current (see "4-20 mA Settings" section in "Initial Settings" chapter)
- Test relay outputs will activate correctly in case of all alarm conditions (see "Relay Settings" section in "Initial Settings" chapter).

END OF SECTION



10

CALIBRATION



10 Calibration

10.1 Introduction

The 4650-PM sensors attached to the control unit can be calibrated in mg/m³ in certain applications.



Calibration of each sensor is necessary on at least an annual basis and should be carried out either by AMETEK Land or an authorised AMETEK Land representative.

The calibration is carried out with reference to an isokinetic sample (manual stack method). The isokinetic sample should be carried out to the relevant standards as defined by your local environmental authority or government agency.

At its simplest level, the calibration procedure is carried out to calculate a Calibration Factor used to scale up the raw sensor readings into a true dust concentration value displayed directly in mg/m³. The use of a simple calibration factor is possible since the response of the instrument is directly proportional to the dust concentration over a predefined range.

10.2 Calculating the Calibration Factor

The basic method to calculate a new Calibration Factor a sensor uses the formula:

$$\text{New Cal Factor} = \text{Current Cal Factor} \times (\text{Test Result} / \text{Sensor Average})$$

The Test Result is the result obtained from a single sample of the stack.

The Current Cal Factor is the calibration factor entered into the instrument at the time of the sampling.

The initial Cal factor setting is 1.0.

The Sensor Average is the average of the readings displayed in your control unit using the current calibration factor.

Example

Sampling test result = 50mg/m³

Current Cal factor setting = 2.5

Instrument average = 20 units


New Cal factor = $2.5 \times (50 / 20) = 6.25$



10.3 Calibration Procedure

To obtain a valid Calibration Factor, carry out the following procedure:

- Ensure that the sensors and controller are running properly.
- Ensure the plant is running normally with representative conditions.
- Carry out an isokinetic test.
- Calculate the average sensor response displayed in your control unit (Sensor Average)
- Record the sensor settings
- Obtain the isokinetic sampling results (Test Result).
- Calculate the New Cal Factor (See Calculating the Calibration Factor above).
- Enter the New Cal Factor:


Select 'Setup' display 

Menu route:

More Settings	↵
Edit an existing device	↵
Select device to edit	
Calibration Factor	

Select Save to save the settings and return to the main menu.

If required the Units can be set to mg/m³

Select 'Setup' display 

Menu route:

More Settings	↵
Edit an existing device	↵
Select device to edit	
Units Name	

Select Save to save the settings and return to the main menu.




10.4 Using the Calibration Tool

The Controller software contains a calibration tool to aid the Calibration procedure.

The calibration tool can be used either to:

- carrying out a simple calibration with a single sample.
- obtaining sensor averages for sample runs to send to AMETEK Land

Select 'Quality Assurance / 'Self Tests' display 

Menu route:

```

Device
Select Device
Select device to calibrate
Select Calibration

```

The following screen will be displayed:

	D	M	Y	h	m
Start Time	<input type="text" value="20"/>	<input type="text" value="04"/>	<input type="text" value="03"/>	<input type="text" value="10"/>	<input type="text" value="32"/>
Duration				<input type="text" value="00"/>	<input type="text" value="45"/>
Max Reading	7.3200		Short Term		
Sensor Average	<input type="text" value="5.6315"/>				
Test Result	<input type="text" value="0.000"/>				
			<input type="button" value="Calc"/>	<input type="button" value="Exit"/>	

Set the Start Time using the Left and Right cursor keys to change fields and the + and - keys to change values.

The Controller will search the logs and calculate and display the Sensor Average. A Max Reading will also be displayed. By Comparing the Max Reading to the Sensor Average it is possible to judge if the sensor readings were steady during the period.



The controller will use the Short Term Log to calculate the average. If the Short Term Log is not available an approximate average will be calculated from the Long Term Log. The log used for the calculation is displayed to the right of the Sensor Average display.

Calculating the Calibration Factor: Manual Method

The Calibration Factor can then be calculated manually or automatically using the controller Calibration Tool.

Calculate the Calibration Factor manually as follows:


Record the Sensor Average.

Obtain the isokinetic sampling test result.

Calculate the Calibration Factor as follows:

New Calibration Factor = Current Cal Factor x (Test Result / Sensor Average).

Enter the new Calibration Factor into the Controller:

Select 'Setup' display 

Menu route:

```
More Settings      ↵
Edit an existing device ↵
Select device to edit
Calibration Factor
```

Select Save to save the settings and return to the main menu.

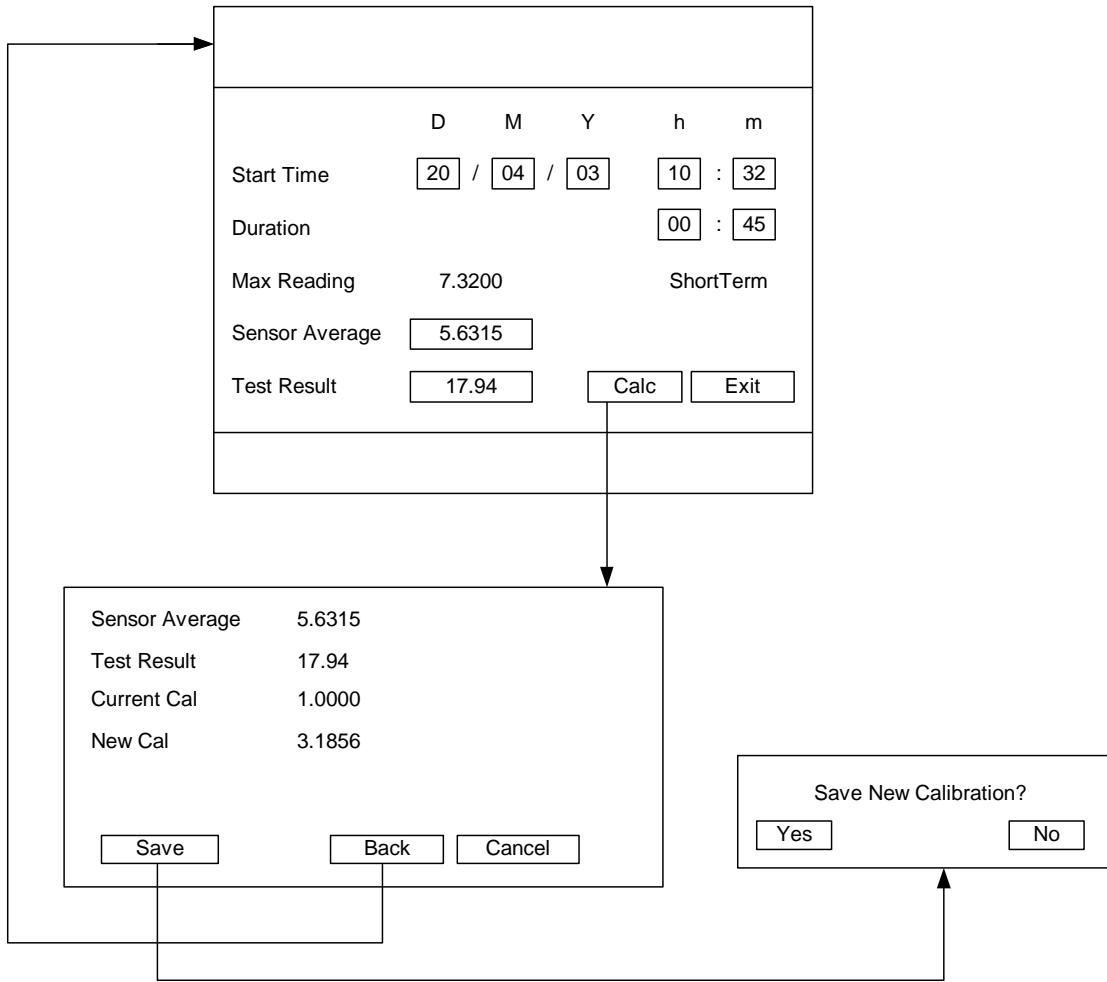
Calculating the Calibration Factor: Automatic Method

Obtain and enter the isokinetic sampling test result.

Select Calc to perform the calculation. The new calibration factor will be displayed.

If the new calibration factor is acceptable select Save to automatically update the Calibration Factor in the sensor configuration and return to the QA main menu.

If the new calibration factor is unacceptable select Back to return the calculation screen and repeat the calculation procedure or select Cancel to return to the QA main menu.



END OF SECTION



11

4650-PM

CALIBRATION AUDIT







11 4650-PM Calibration Audit

The 4650-PM audit testing consists of two tests:

- a) Run and record the automatic QA checks
- b) Perform the audit check

a) Run and record the automatic QA checks – NOTE; This section of testing is performed at the CONTROL UNIT ONLY

- Do this test at the control unit before removing the probe from the process.
- In the control unit go to the QA Page: 

Quality Assurance / Self Tests		Start Maint
		Calibration
		Cleaning
	Device: <input type="text" value="Stack1 Dust"/>	
<input type="button" value="Activate"/>	Zero Test	17
<input type="button" value="Activate"/>	Span Test	9855
	Adc Counts	2305
	Comms Check	PASS



In turn, activate the two QA Checks: Zero Test and Span Test.

- Record the results of the test and check they are within the tolerances shown below:

QA Check	Minimum Pass Level	Ideal Level	Maximum Pass Level
Zero Test	-200	0	200
Span Test	8000	10000	12000

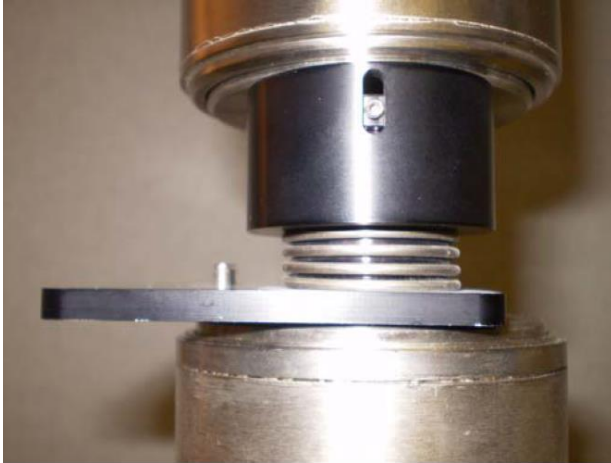
Before leaving the control unit, place the sensor in Maintenance mode. This ensures automatic self-checks don't run during the audit check procedure (described below).

Start maintenance mode from the QA Screen by selecting the **Start Maint** button. Note: this also disables alarms and forces the 4-20mA to zero (4mA) and "tags" the data being logged.

- b) Perform the audit checks** – NOTE: This section of testing is performed at the sensor. You will need to return to the control unit to record the test results

LEAVE THE BLOWER/AIR PURGE RUNNING THROUGHOUT THE TESTING.

- Go to the sensor and remove it from the process.
- Allow the sensor to cool below 30°C so it is safe to touch the end of the probe without gloves.
- Carefully clean excessive amounts of dust away from the measurement region of the probe – refer to manual for full procedure (Section 14 – Cleaning Procedures). Remember to leave the blower running during cleaning. Incorrect preparation may lead to contamination via holes at either end of the measurement region.
- Check that the Audit Unit is clean and dry*.
- Insert the audit unit(s) into the measurement path as shown below. Use the slot to guide it into the correct position. Make sure the unit is inserted up to the full depth of the slot.



* Store the Audit Unit in a clean dry environment at room temperature.

- Leave each audit unit in position for about 30 s with a gap of about 30 s between (if using 4-20 mA signals check storage rate and what, if any, averages are being used to ensure you can review tests afterwards) . If the control unit is near to the sensor go to the control unit and record the current Dust reading. Alternatively, note the time of the start of the tests to obtain the results.
- To perform a zero test, leave the instrument for a few minutes for the dust to settle. In a dusty environment you may need to re-fit the cover originally supplied with the instrument in the measurement region. If the control unit is nearby, note the approximate average Dust level. Otherwise note the time of the test and check the recorded data at a later time. If fitted, remove the cover after the test.

THE AUDIT CHECKS ARE NOW COMPLETE: Re-install the sensor. Return to the control unit and STOP Maintenance mode.

TO OBTAIN THE AUDIT RESULTS FROM THE LOGGED DATA:

There are ways to obtain the logged data, namely;

- 1) Via Control Unit display
- 2) Via 4-20 mA into SCADA or PLC – if using this method check that system will allow for access to instantaneous readings, or obtain 'average rates set' so that you can amend the above procedure accordingly (how long you leave the Audit Units in position).

What to do if the 4650-PM fails its audit

- 1) Clean the optics as shown in Section 14 of the Operating Manual. Cleaning Level 2 and Level 3 are usually necessary
- 2) Repeat the Calibration Audit
- 3) If the 4650-PM still fails the calibration audit, adjust the Gain Factor as described below.



Adjusting the Gain Factor

Adjusting the Gain Factor should only be done after ensuring that the optics are thoroughly clean.



- Choose the Sensor Setup menu
- Choose "More Settings"
- Choose "Add a New Device."
- There are the two 'devices' you need, namely Modbus Read and Modbus Write.
- Add the Read channel for Register 61 which is the Audit Cal Factor (typical value between 700 and 1000).
- $\text{New Cal Factor} = \text{Old Cal Factor} \times \text{Audit Value} / \text{Instrument Reading}$
- Add Modbus Read channel and write the new cal factor to Register 61.
- Change Write channel Register from 61 to 54 and value to 1.
- Run the Zero test, then when finished Run the Span test
- **It is important to do these in the correct order**
- **VERY IMPORTANT.** Write value 0 to register 54 after resetting. This switches off the internal algorithm. Otherwise it will always recalculate and give the same answer.

You can leave these two additional 'devices/channels' for future use.

IMPORTANT NOTE: If there is any uncertainty calibration audit, please contact AMETEK Land. The above information is referenced to AMETEK Land sensors only. All references to international standards are subject to

END OF SECTION



12

TROUBLESHOOTING



12 Troubleshooting

12.1 Communication Failure

The Controller can support a large number of sensors and devices that may be spread over a wide area of plant. It is therefore essential to be methodical in the approach to locating the cause of communications problems. If you can't get the complete network to communicate it is best to disconnect some of the sensor and add in one by one to see where the problem occurs.

12.2 Diagnostics

Use the Controller to check the Sensor Comms Mode (refer to the Initial Setup section).

Run **AutoDetect** Devices and note which devices failed to be detected.

If existing devices have stopped communicating this will show up as:

- A "No Response" message at the bottom of the screen
- A flashing red LED
- On the check page (Quality Assurance/Self Tests), Comms Check = "No Response"

If the problem exists with only one or two devices, visit those devices and check:

- Cable connections
- Comms DIP settings
- Network address DIP settings
- Bus termination setting.

To prevent bus conflicts it is essential that each device has a unique address. Devices must not use address zero.



12.3 Checking Spurs

Where spurs are used, the internal yellow and green LED's may be used as a service guide. The devices communicate by a set of query-response cycles. If either LED is stuck on, this indicates a wiring error or possibly an incorrectly set bus termination switch at some point in the network.

12.4 Sensor Power Check

Each Sensor has a Red LED located internally that flashes at approximately 1Hz (with equal spacing: 0.5 secs on, 0.5 secs off) when power is correctly applied to the sensor (before the controller has been set up to communicate with the sensor). If the LED is off, check the connections to the sensor and measure the network supply voltage (between the black and red cores).

12.5 Sensor Communications Check

When the Controller communicates with the sensor and the Sensor has accepted the Controller data and decided that it is a valid command, the operation of the red LED changes – it then flashes briefly (maybe 50-100mS) every time it receives a valid command from the Controller. If the Controller commands stop, the Sensor waits 4 secs with the LED off, then reverts to the 0.5sec on, 0.5sec off mode of operation.

12.6 Power Loss

The sensors are powered from the control unit (24V). With long cable runs there will be voltage drop along the cable. If the voltage drop is too large (<18V) the sensor will not communicate correctly. Check the voltage at each sensor with a multimeter between the 24V and 0V pins.

Notes:

- if the voltage is too low at any sensor in the network this may cause communication problems in the whole network
- correct voltage problems by adding a power supply repeater in the network. If you are already using a power supply repeater, check it has not been powered off

12.7 Frozen readings

If a sensor reading is not updating then:

If there is also a "No Response" alarm then you have either:

- a communication problem which must be fixed (see sections above).
- a faulty sensor pcb: replace it.



If there is NOT a "No Response" alarm then either:

- the sensor is running a self check (go to QA screen to check this)
- the sensor is disabled (go to Sensor Setup->More Settings->Edit an existing device and check Enabled setting)
- the sensor is in Plant Stop mode. The word "STOP" will be displayed under the sensor reading
- the controller software is too busy reading other sensors. To solve this power the control unit off/on then the control unit will restart sharing its time between all sensors on the network.

12.8 Sensor Reading too Low or too High

The controller gets the reading from the sensor using digital modbus communication which has error checking. Therefore if a reading is being displayed at the control unit without any "No Response" message (and not frozen – see section above) you can be confident this is a genuine reading from the sensor. If it is not the reading you expect consider the following:

- Adjust the calibration factor: dust monitors do not provide a reading pre-calibrated to mg/m³. To scale the Sensor reading adjust the Calibration Factor (go to Sensor Settings).
-
- The sensor may require cleaning. Refer to the Cleaning section at the end of the manual.
-

Refer to the tables below for details of how to diagnose other fault conditions:

Symptom: Low Reading:

Instrument does not respond to dust

Span result is low

Audit result is low

Possible Causes:

Laser	<p>Loss of power: laser will be totally blank</p> <p>Broken laser (caused by overheating or electrical surge): laser will be dim and possibly loss of focus</p> <p>Misaligned: laser will be bright but not get through to the measurement region</p> <p>Unmodulated laser (caused by modulation wire disconnected): laser will still be bright but receiver will not respond to it</p>
Span quadrant	May come loose or servo motor may be broken: result in span element or shutter blocking the laser beam from reaching the measurement volume



Mirror Tip of quartz rod	Contamination entering the end cap region (e.g. due to blower being switched off) will cause the mirror and/or the tip of the quartz rod being blocked. Results in a gradual drop of signal.
Quartz rod	Any crack in the rod will significantly reduce transmission of light back to the receiver
Receiver	The receiver is attached to the end of the quartz rod within the enclosure. The connections to this may be loose. Check continuity of the cable.
Electronics	Pcb may be faulty in some other way.

Symptom: High Reading

Reading remains high (>0.5mg) even when removed from stack

Possible Causes:

Laser	Misaligned: laser is clipping the edge of the iris creating increase in stray light
Beam dump	Contamination into the beam dump causing scattering of the dumped laser light back into the receiver
Zero setup	Electronic Zero test is reading high. Dust Reading = Reading due to scatter + Electronic Zero. Need to reset electronic zero back to 0.
Offset setting	Offset setting is set wrong: Dust Reading = Calibration Factor * Raw Reading – Negative Offset

END OF SECTION



13

MENU MAPS



13 Menu Maps

Main Screens



Stack1 Dust 7.23 mg/m3

Test Zero 17

Test Span 9855

Test Pcb T 29.5 °C

Test Tube T 150°C

Test Adc Cnts 9.10

BAR



Device: Stack1 Dust Pulse

Set

- Enable Lo
- Long Term Lo
- Short Term Lc
- Pulse Log
- Event Log



Stack1 Zoom out

Dust

7.23

mg/m3

7.23 mg/m3



Quality Assurance / Self Tests

Start Maint Calibration Cleaning

Device: Stack1 Dust

Activate Zero Test 17

Activate Span Test 9855

Adc Counts 2305

Comms Check PASS



Overview

Stack1 OK	Stack2 OK
Stack3 OK	Stack4 OK



Password Entry

To password protect your settings press LOCK

LOCK

To Set Password go to System Wide Settings



Event Log Reset Latched Alarms

Stack1 Dust Warning Alarm

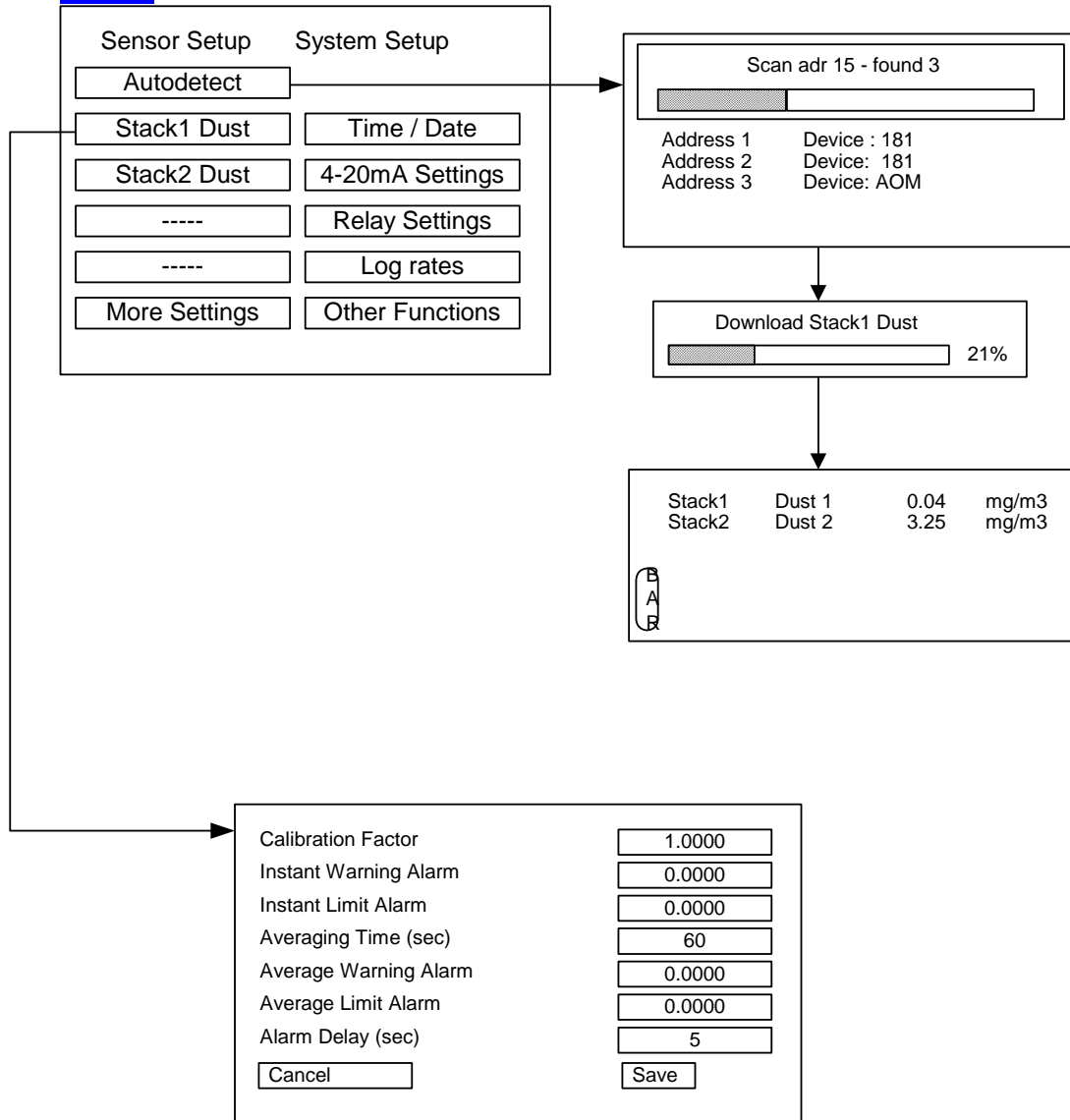
Start 09:14:44 23/07/03 Duration 00:05:00



Sensor Setup	System Setup
Autodetect	Time / Date
----	4-20mA Settings
----	Relay Settings
----	Log rates
More Settings	Other Functions

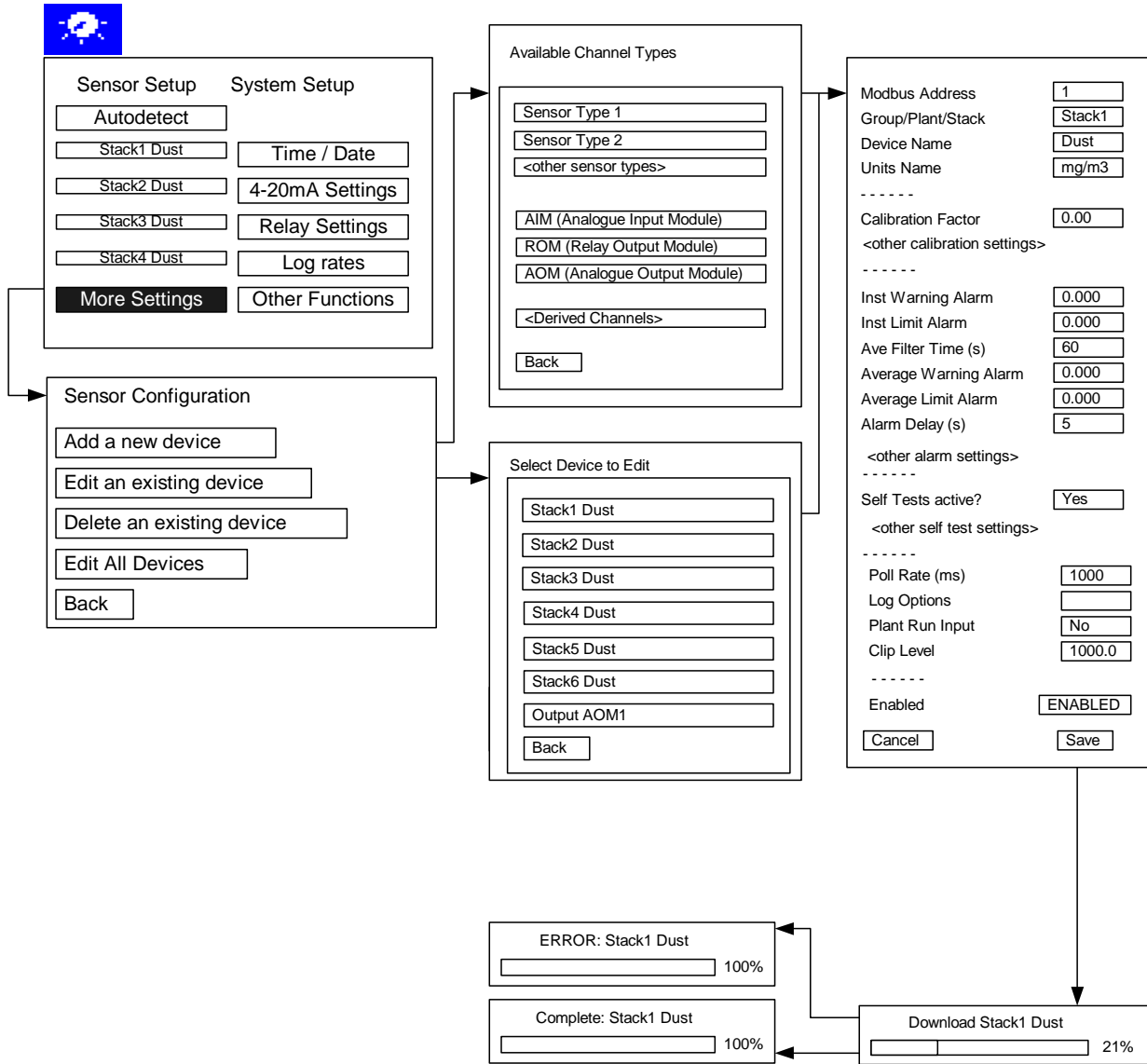


Basic Sensor Setup



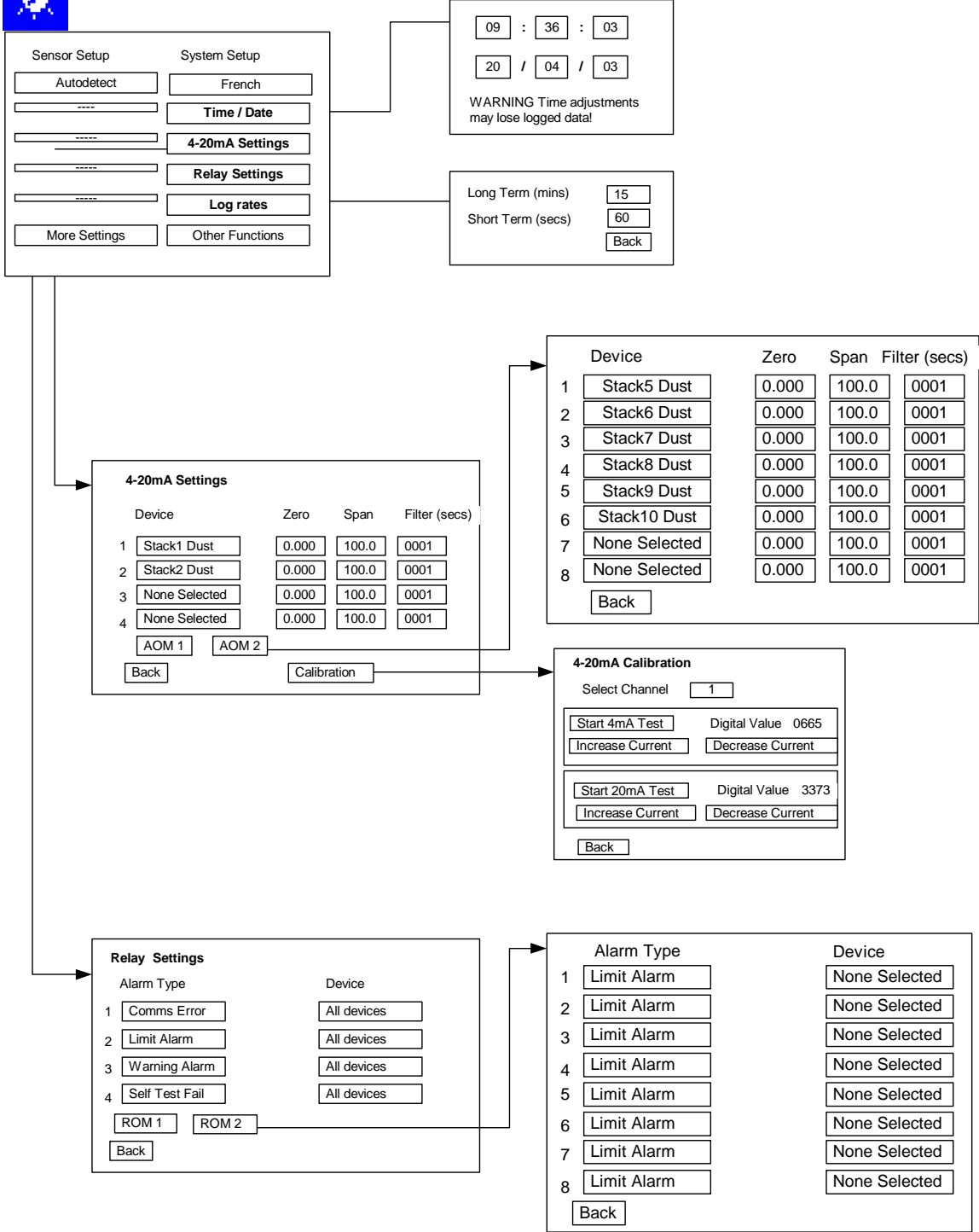


More Sensor Settings



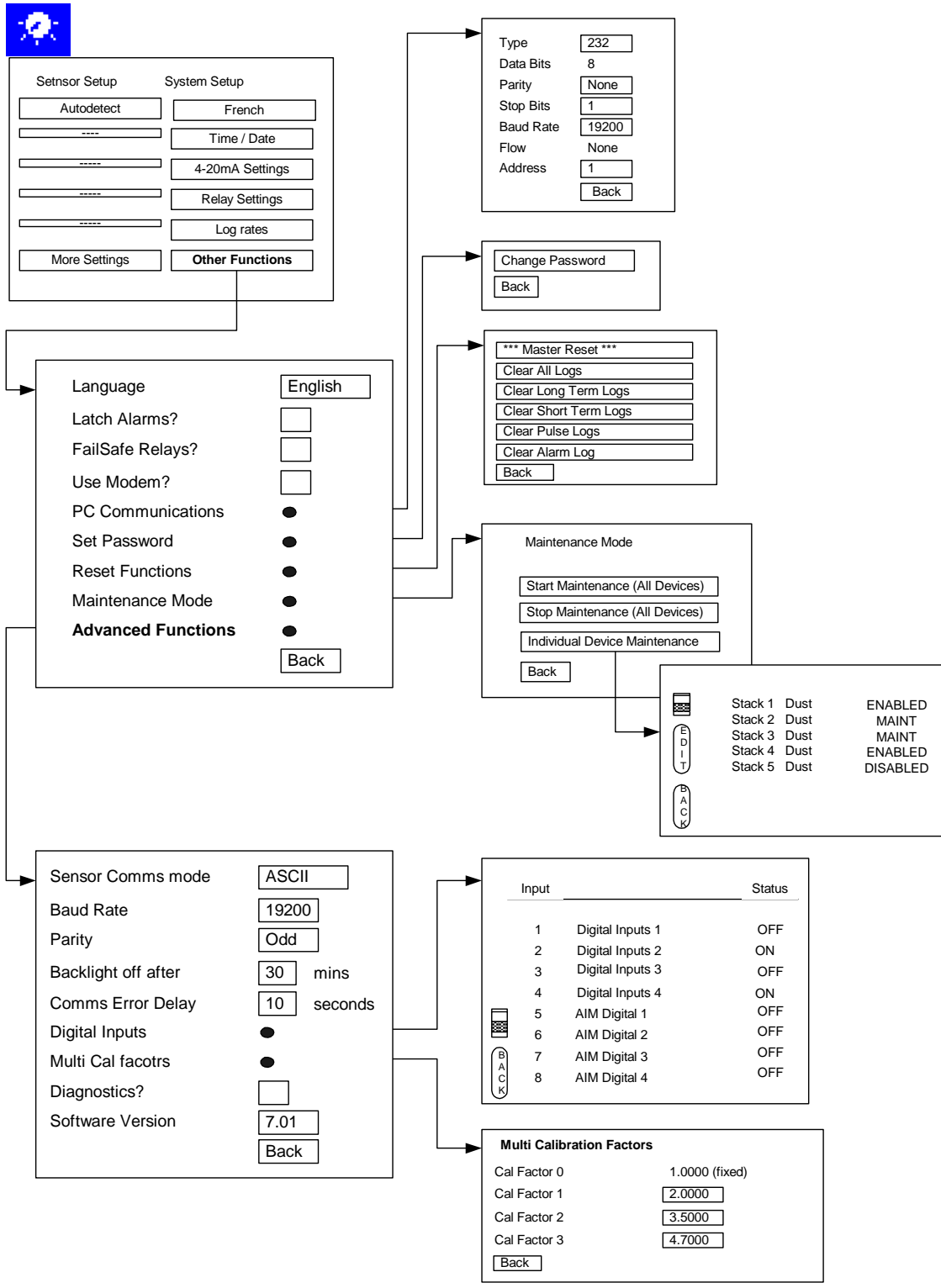


Basic System Setup



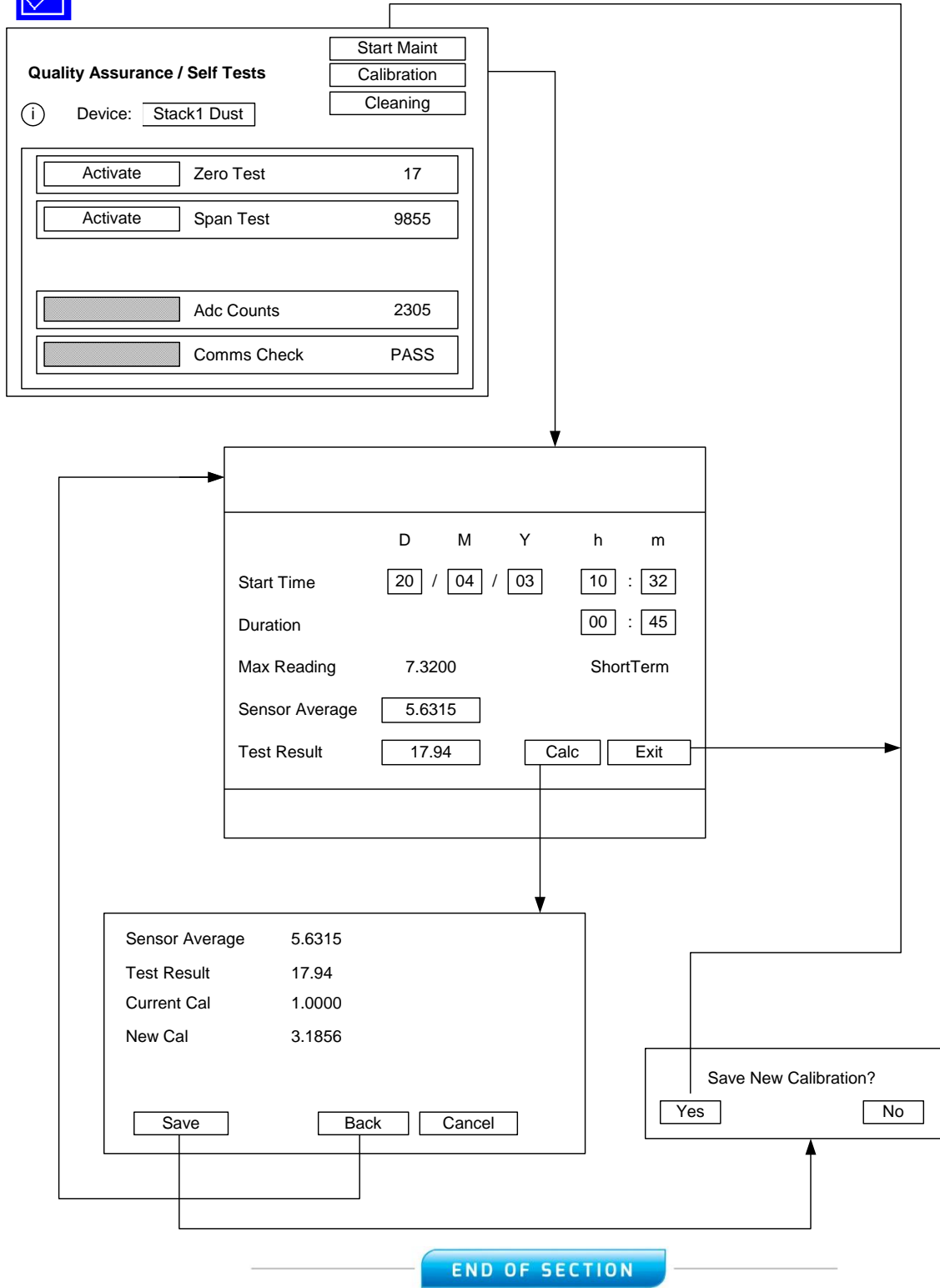


Other Functions





QA and Calibration





14

CLEANING
PROCEDURES



14 Cleaning Procedures


There are several controls both at the control unit and within the sensor enclosure to aid the following cleaning procedures.

The Cleaning Screen in the Control Unit

Select 'Quality Assurance/Self Tests' display 

Select Device = 4650-PM Dust channel
Select "Cleaning"

The Cleaning Screen is displayed:

Cleaning		
<input type="button" value="Activate"/>	Entry Shutter	Open / Closed
<input type="button" value="Activate"/>	Exit Shutter	Open / Closed
<input type="button" value="Activate"/>	Span Element	Open / Closed
<input type="button" value="Activate"/>	Laser	On / Off
	Quadrant Position	<input type="text" value="5.5"/>  v
<input type="button" value="Exit"/>	Purge Flow	30

The Cleaning Screen provides user control of the sensor:

Entry Shutter	Place the quadrant into the shutter position. This should be done before attempting to cleaning the measurement region to stop dust entering the sensor.
Exit Shutter	This function is not used.
Span Element	This places the quadrant into the Span Test position. This makes the span test element visible to aid cleaning of the span element.
Laser	Turns laser off to provide safety whilst cleaning.



The Quadrant Position setting adjusts the position of the quadrant. This should not normally be adjusted.

The Purge Flow reading displays the purge flow level in Litres/minute.

Note: after Exiting from the Cleaning Screen the setting return to their normal settings (laser On, Quadrant in normal open position).

The Cleaning Controls in the Sensor Enclosure

The same functions can be accessed directly at the sensor.

Unscrew the enclosure lid. This reveals 4 buttons labeled A, B, C and D.

Button A	Entry Shutter Open/Close
Button B	Exit Shutter Open/Close
Button C	Span Element Open/Close
Button D	Laser On/Off

See figure 3.5.

Note: after Powering off the sensor the settings return to their normal settings (laser On, Quadrant in normal open position).



Please be aware that in order to carry out the following procedures it is best to be able to see both the control unit and the sensor. Work at the platform (installation position) will be limited if this is not possible - options include possibly using a portable control unit or use second person with necessary communication capability.

Before carrying out any of the following cleaning procedures, please be aware as to the following;

Access to the maintenance mode is required.

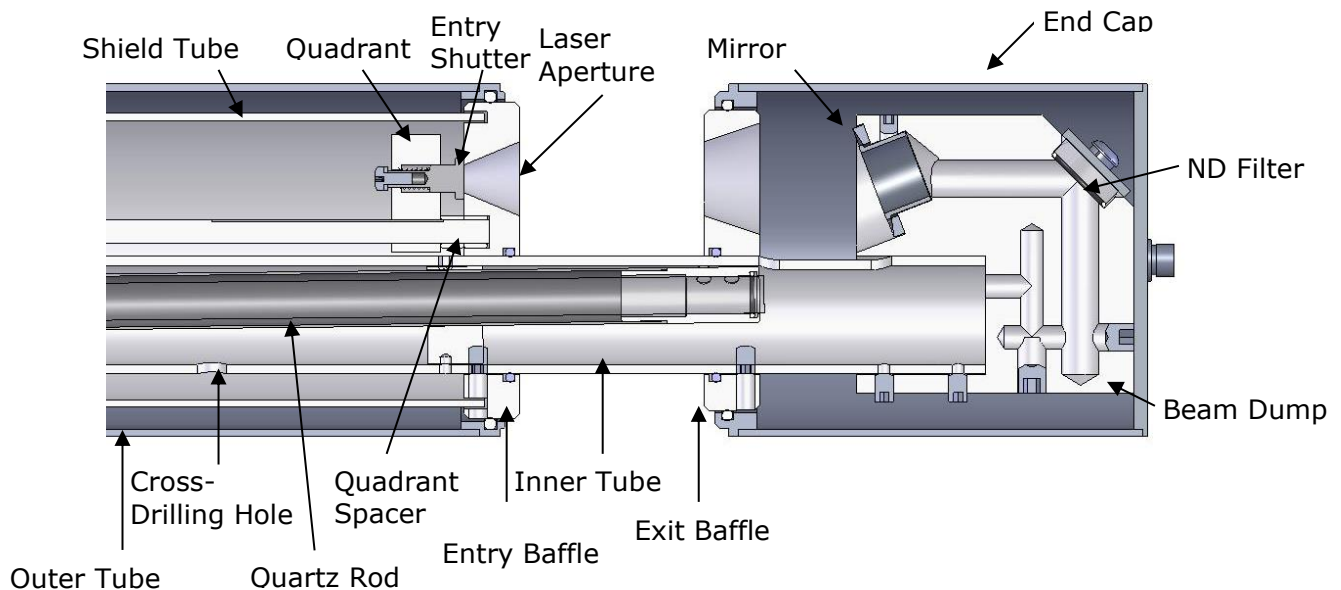
For safety the laser should normally be powered off during these procedures. This can be done by pressing button D inside the enclosure to turn off only the laser.

Note the type of contamination and take appropriate health and safety measures.

Clean oil free compressed air is required at the site or distributor workshops.

Damp or sticky contamination will require solvents or other cleaners to enable their removal using these procedures.

There are various levels of contamination that can occur. The following cleaning procedures are written to address these various levels of contamination. Please refer to the diagram below for identification purposes (there are also more specific diagrams throughout the following procedures). Each level is identified by a brief description of where you are likely to find contamination (**Contamination**), how you would identify the build up (**Symptom**), what tests you can carry out to confirm where contamination is likely to be (**Test**) and also advises where you would typically be able to carry out the cleaning procedure (**Location**).



**Level 1 - Cleaning the Sample Volume prior to inserting an Audit Unit (as part of a PM (Preventative Maintenance program)) or Linearity tests.**

Contamination - Typically the outer covers (Main and End Cap) and baffle faces can become contaminated – this will not affect the readings, but could be disturbed during installation of manual audit unit and so cause interference.

Symptom – None specific, for Routine Manual Testing purposes (the Span reading may have fallen (drifted down))

Location - On the platform.

Level 2 - Cleaning the Span Element (when the Span reading has fallen)

Contamination – In addition to the outer covers (Main and End Cap) and baffle faces, the cone in the exit baffle can become contaminated (the cone in the beam entry baffle is usually clean) as can the face of the span material.

Symptom - The Span reading has fallen (drifted down).

Test – Self check value has dropped (or reading low), result of manual Audit Unit is correct, most likely contamination is on the surface of the span element.

Location - On the platform or in the site workshop

Level 3 - Cleaning the Optical Elements (when the Span reading has fallen)

Contamination – In addition to level 2 contamination, further contamination may have entered the end cap and beam dump.

Symptom - The Span reading has fallen (drifted down) and the readings have drifted from 'expected'/normal.

Test – Self check value has dropped (or reading low) and the result of manual Audit Unit is also low, the most likely contamination is A) on the mirror of the beam dump B) on the surface of the span element C) build up in the end cap (which can lead to contamination of the beam dump, end of Quartz Rod and possible interference signal as floating dust).

Location - On the platform or in the site workshop

Level 4 - Cleaning the Optical Elements after an air purge failure (with 'dry' dust)

Contamination – When the air purge fails, contamination can enter into the probe assembly, end cap and potentially coat all optics.

Symptom - The Span reading has dropped (likely to be failing), the readings have changed from 'expected'/normal.

Test – Self check value is reading low and the result of manual Audit Unit is also low and a visual inspection confirms contamination present within the end cap.

Location - In the site workshop (must be clean ie no dust) or at an off site workshop (AMETEK Land or its distributors).

Notes

- If significant contamination has entered unit and it is not easily removed (sticky) it is recommended that you return the unit to AMETEK Land for cleaning. Internal components may have suffered due to contamination and





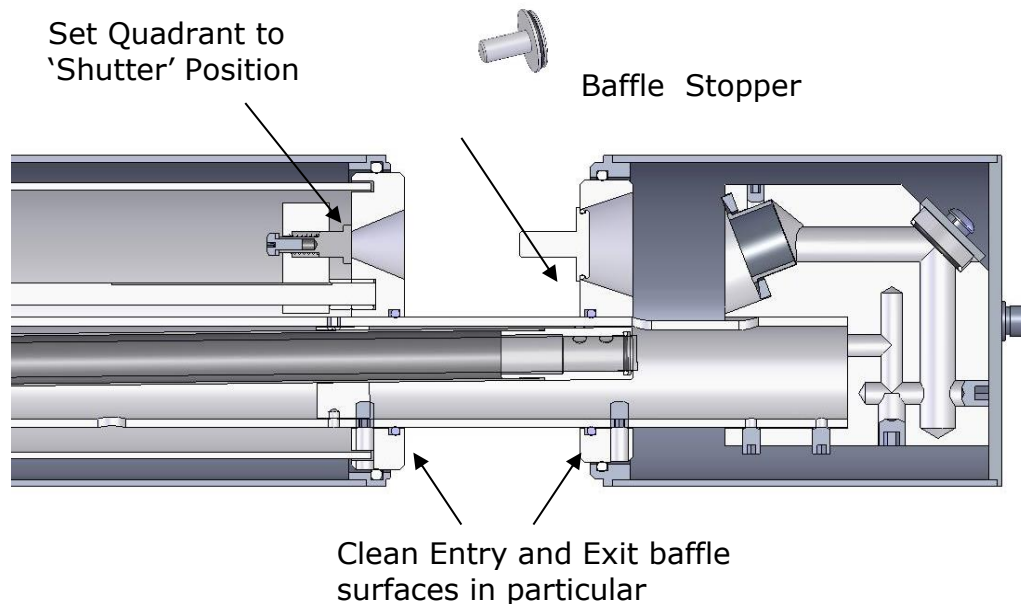
may need replacing. Also some parts may move during cleaning, requiring re setting. Some factory resetting may also be required.

- If the sensor has been removed from the stack in order to carry out the following procedures, then you can ignore the 'air supply' steps as long as working environment is clean ie dust free and dry.

Level 1 - Cleaning the Sample Volume prior to a linearity check

Tools - Exit Baffle Stopper, Brushes, Wipes, Air Duster (Solvent cleaner)

- 1.1) Put the sensor in to Maintenance Mode (can be done from QA Screen )
- 1.2) Leaving Air Purge on and running, remove the 4650-PM sensor assembly from the stack and allow it to cool to a safe working temperature eg 30°C (typically 20-30mins for a 200°C stack).
- 1.3) Set the quadrant to the 'shutter'  to block the 'Entry Baffle' – From QA Screen, select 'Cleaning' (check 'Quadrant Position' should be 5.5 ± 0.2) then 'Activate' Entry Shutter Closed.
- 1.4) Carefully fit the 'Baffle Stopper' to block the entry baffle (trying not to disturb loose dust too much such that it enters 'Exit Baffle'), then disconnect the air supply.
- 1.5) For dry dust, brush and/or wipe clean the Outer Cover and the End Cap, carefully brush and blow away the contamination from the baffle faces and exit cone (you may need to hold the stopper for more 'aggressive' cleaning). NB Sticky dust may require small amount of solvent to help remove build up and may require use of other cleaning material e.g. cloth.
- 1.6) Reconnect the air supply, then remove the 'Baffle Stopper', then 'Activate' Entry Shutter Open.
- 1.7) Take the Audit Unit reading.
- 1.8) For damp (sticky) contamination a solvent and stiffer brushes may be required
- 1.9) A small amount of contamination may have entered the 'Exit Baffle' cone when fitting the Stopper, if so the End Cap may be removed to clean the cone, taking care that the mirror, beam dump and Quartz Rod do not become contaminated.





Level 2 - Cleaning the Span Element when the Span reading has fallen

Tools – Air Duster (Optional alternative, Optical Cleaner and Swabs)

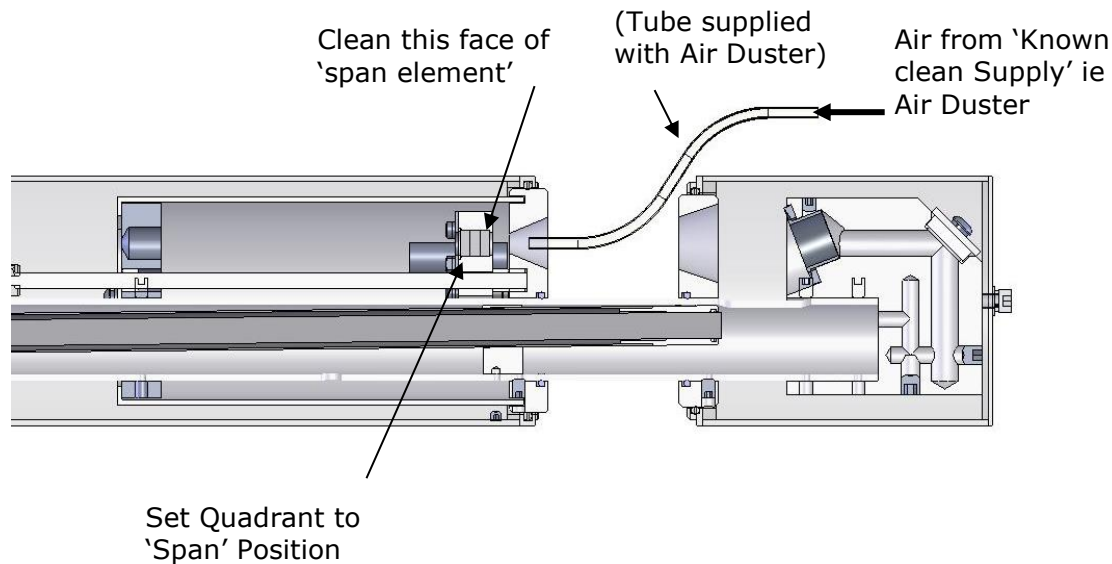
Complete steps 1.1 – 1.4 then set the quadrant to the span test position – From QA, select 'Cleaning' (check 'Quadrant Position' should be 5.5 ± 0.2) then 'Activate' Span Element Closed.

Using an 'Air Duster' (tin of clean compressed air), push the tube supplied through the Entry Baffle hole so that it almost touches the span element, then blow.

Return the quadrant to 'normal position' ('Activate' Span Element Open), switch on the air supply and remove the stopper..

Re run span test - If this fails (due to type of contamination ie very sticky), rotate the quadrant again ('Activate' Span Element Closed) and apply optical cleaner to a swab and clean the opal through the Entry Baffle cone. Dry the opal through the cone using a clean dry swab).

Repeat 2.3 (note, air is already on)

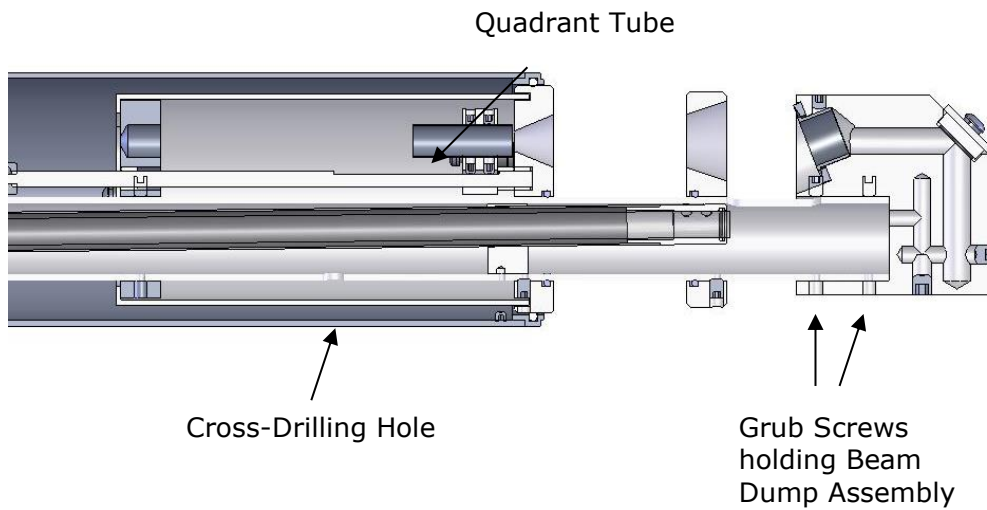




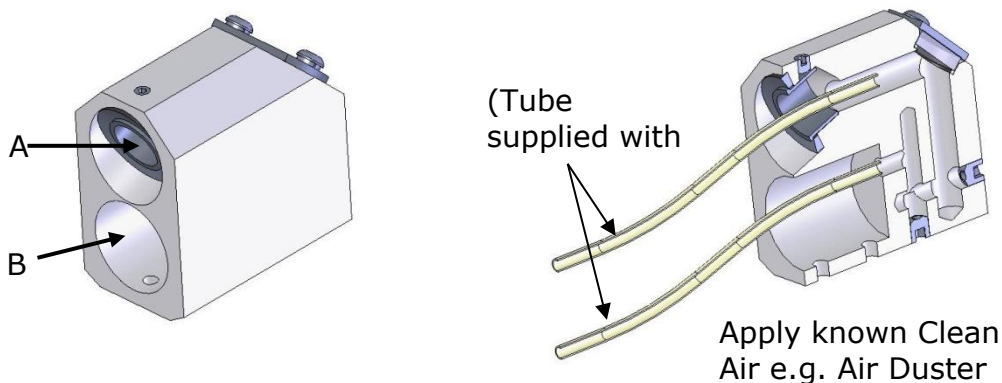
Level 3 - Cleaning the Optical Elements when the Span and Linearity Test readings have fallen

Tools – As for steps 1 and 2 plus a service toolkit

- 3.1) Complete steps 1.1 – 1.4
- 3.2) Clean the outer surfaces of the End Cap and the Outer Tube, remove the End Cap.
- 3.3) Check for signs of contamination within end cap (both liquid and dry). Note type(s) and clean.
- 3.4) Using 'Air Duster' blow the mirror surface clean and the tip of the quartz rod (through the slot in Inner Tube). Also clean the 'Exit Baffle' cone.
- 3.5) Refit End Cap and air supply, then re test with Audit Unit.



- 3.6) If the test is now OK with the Audit Unit, re test with Span Element. If the Span Element result is low carry out procedures 2.1 to 2.5 as appropriate.
- 3.7) If both are correct, but the 'Off Set' is high and/or the 'normal reading' is higher than expected, it maybe that the ND Filter has become contaminated. In addition to steps 3.1 to 3.4 carry out additional steps –
- 3.8) Remove the Beam Dump. This is done by removing the two M3 grub screws on the base of the Beam Dump assembly, then pulling off from the 'Inner Tube' (Tip remove one grub screw but just loosen other so easier to refit)
- 3.9) Using 'Air Duster' blow the surface of the ND filter clean. This is best achieved by first applying air in to the 'mounting hole' (position B) , followed by through the mirror (position A)

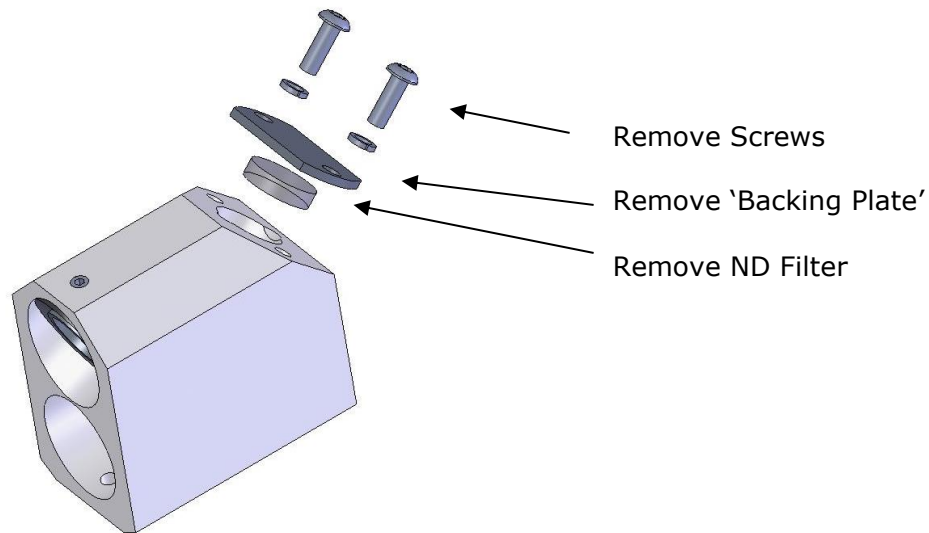




- 3.10) Refit Beam Dump taking care to align holes in Inner Tube with hole in Beam Dump and fix in place with the M3 grub screws, (Tip – loosely fit both, these should 'Self Centre' due to shape, before finally tightening).

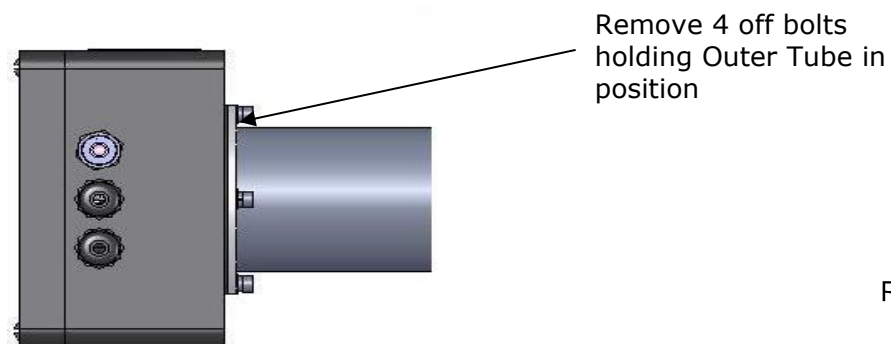
In addition to blowing the ND filter, it is sometimes necessary to clean by use of optical cleaner. In this case carry out additional steps;

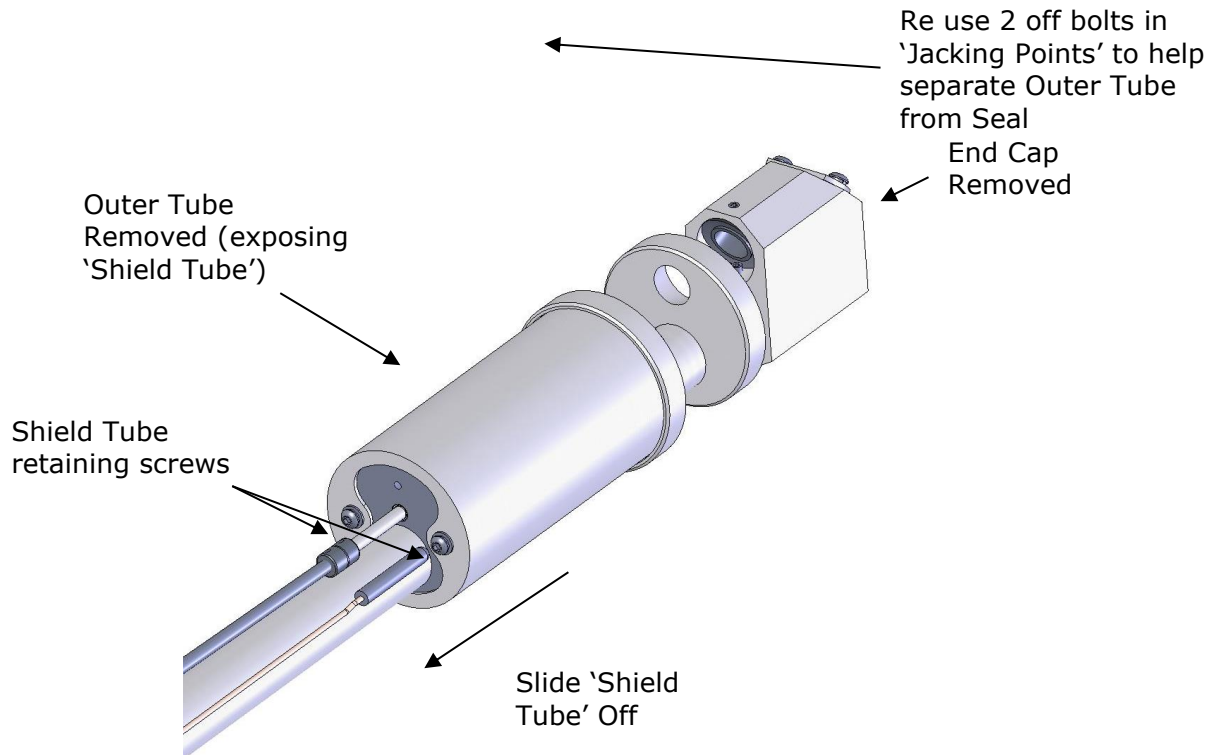
- 3.11) Remove ND Filter from the Beam Dump/Mirror Mount.
- 3.12) Carefully clean with optical cleaner and swabs, replace the ND Filter.
- 3.13) Clean the Quartz Rod tip with optical cleaner and swabs (also take opportunity to clean the inside surface of the exposed Inner Tube) and refit the Beam Dump/Mirror.
- 3.14) Refit End Cap and air supply and check the Zero, Span and Audit Unit readings



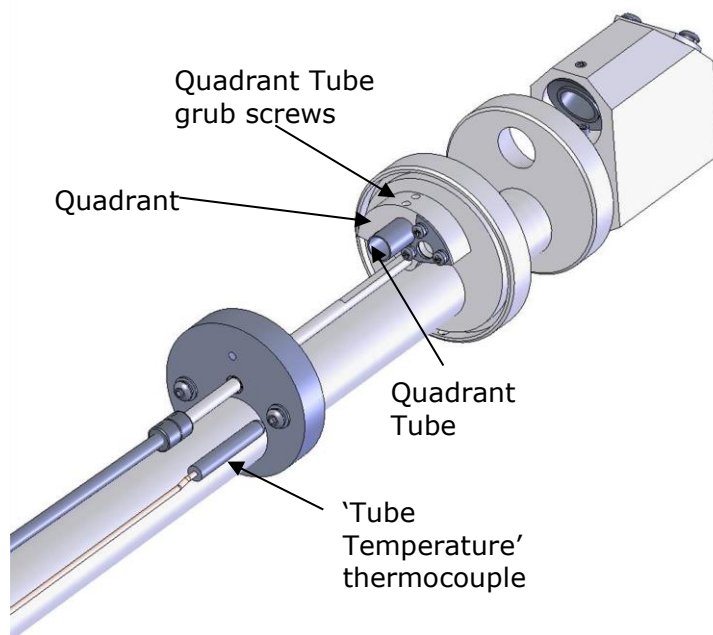
If the 'Span Element' (Opal) has become very heavily contaminated then it may be necessary to move the Quadrant so that the Opal can be cleaned more thoroughly.

- 3.15) Complete steps 3.1 – 3.4
- 3.16) Clean the outer surfaces of the End Cap and the Outer Tube, remove the End Cap.
- 3.17) Check for signs of contamination within end cap (both liquid and dry). Note type(s) and clean.
- 3.18) Undo and remove the 4 Hex head bolts holding the Outer Tube in position. 'Release' from seal (if necessary use the 'jacking threads') and remove the Outer Tube.





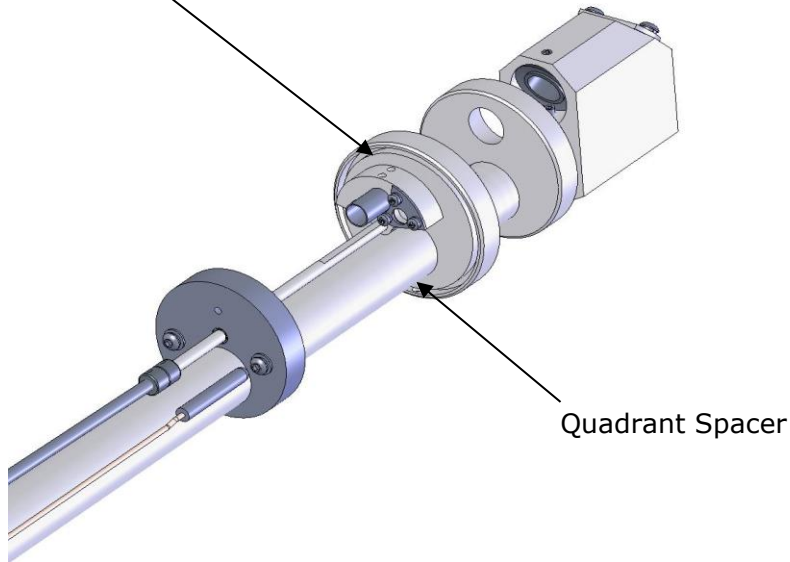
- 3.19) Check for signs of contamination and if necessary, brush and blow away the contamination (including the inner surface of the Outer Tube if required).
- 3.20) Remove the Shield Tube screws and slide the Shield Tube back. Brush & blow the revealed surfaces and the inside of Shield Tube.





3.21) Undo the 'Quadrant Tube' grub screws and remove 'Quadrant Tube'.

Quadrant 'grub screws'-
accessed through the
'Quadrant Tube grub
screw' holes



3.22) Slacken the Quadrant grub screws, accessible through the Quadrant Tube fixing holes (or with earlier versions set the quadrant to a Span position - From QA, select 'Cleaning' then 'Activate' Span Element 'Closed' and slacken the Quadrant grub screws).

3.23) Slide the Quadrant back. Clean both faces of the 'Span Element' (Opal).

3.24) Relocate the Quadrant against its spacer, loosely-tighten the grub screws.

3.25) Check the correct operation of the Quadrant Span & Shutter elements -

3.25.1) Activate the Entry Shutter 'Closed'. Place a 'Shim' (0.1mm - if not available you can use a sheet of 80g/m² paper which is approximately 0.1mm thick) between Quadrant and Inner Tube.

3.25.2) Adjust as necessary, loosely tighten grub screws and un activate.

3.25.3) Activate Span test 'Closed' to and check with 'Shim' that it does not contact with 'Inner Tube'. If necessary adjust and retest in opposite position.

3.25.4) When satisfied, fully tighten grub screws and refit the 'Tube' in to the Quadrant, leaving it 0.5mm (as a guide, you can use a sheet of 80g/m² paper folded in to 4) clear of the Baffle.

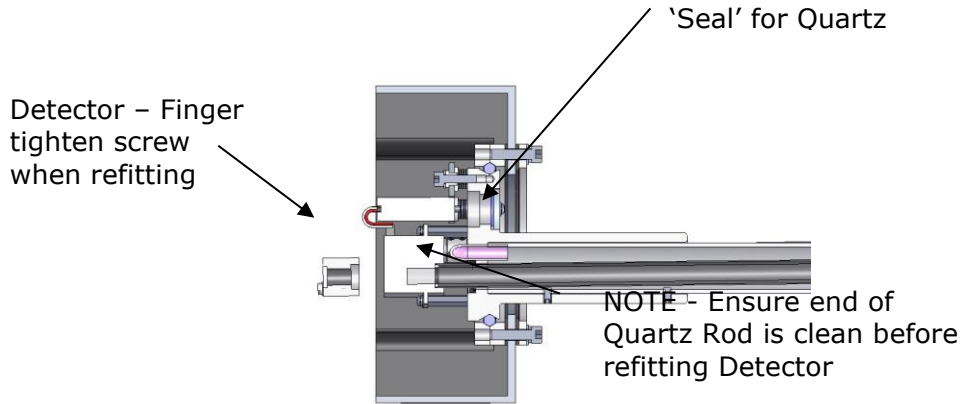
3.26) Refit the Shield Tube

3.27) Refit Outer Tube, End Cap and air supply and check the Zero, Span and Audit Unit readings



Cleaning after an Air Purge Failure with Dry Contamination

- 4.1) Complete steps 3.1 to 3.7 include additional procedures 3.8, 3.9, 3.11 and 3.26
- 4.2) Open the enclosure lid and disconnect the Detector from end of the Quartz Rod – done by releasing the nylon screw in the side of the detector holder body.



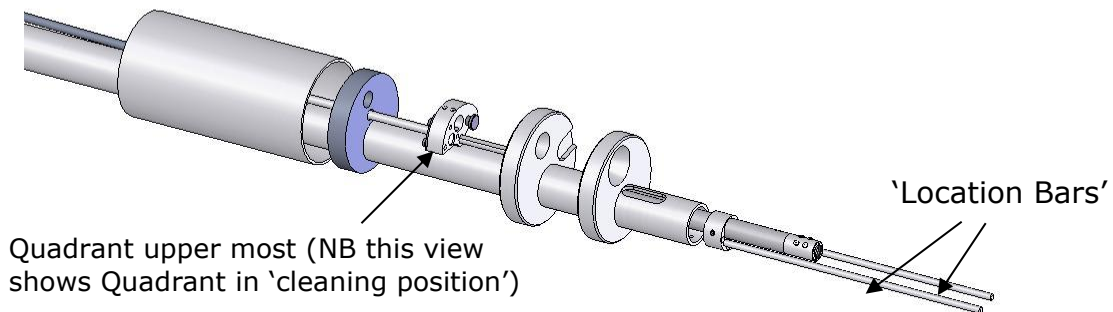
- 4.3) Remove the Quartz Rod locating grub screw from the Inner Tube and carefully push the Quartz Rod, from the enclosure end, through the Seal in the enclosure, and remove it from the Inner Tube
- 4.4) Block the Cross-Drilling in the Inner Tube and blow-out the contamination with the Air Duster (may require an air line, BUT ensure that the airline and air supply are clean and dry) from the enclosure end of the tube (subject to how it was blocked, remember to unblock the cross drilling)



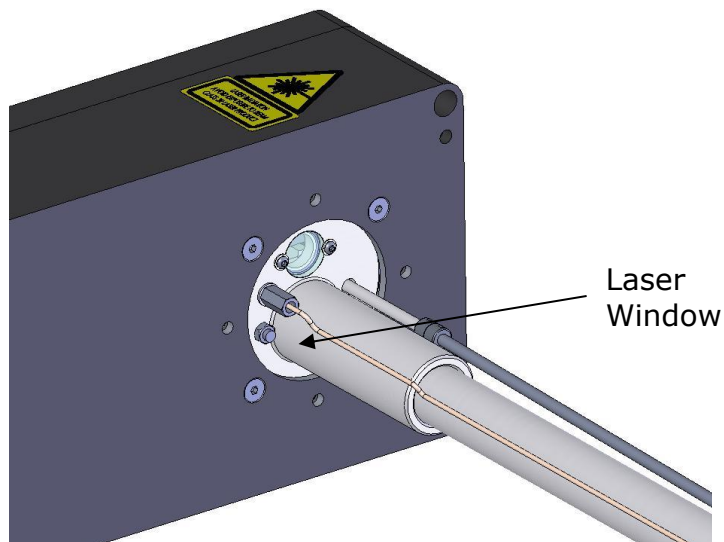
- 4.5) Clean the tube covering the Quartz Rod, then clean both exposed ends of the Quartz Rod with optical cleaner.



- 4.6) Fit the 2 Location Bars to the Quartz Rod assembly. With the enclosure such that the Quadrant is uppermost (this will place the 'seal' at the bottom of the inner tube), carefully insert the Quartz Rod using the location bars into the Inner Tube - Note the locator rods should be at the bottom, feed the Quartz Rod along the Inner Tube and through the enclosure seal. Turn the unit over and continue feeding the Quartz Rod until the locating hole is aligned with the grub screw hole in the Inner Tube. Fit the grub screw and remove the locator rods



- 4.7) Clean the Laser Window, and wipe/brush all exposed surfaces prior to reassembly.



- 4.8) Refit the Beam Dump/Mirror Mount, the Outer Tube, End Cap and air supply, then check the Zero, Span and Audit Unit readings.

END OF SECTION

A decorative graphic in the top left corner. It features a light gray background with a diagonal line. The number '15' is written in a large, bold, black sans-serif font. To the right of the '5', there is a blue triangle pointing towards the top right corner.

15

MATERIALS LIST



15 Materials List

The following materials have been used in the construction of this product:

0 - 250°C Version:

Material	Use
Aluminium Alloy	Enclosure body
Stainless Steel	Rod and sensor body
PEEK	Insulator
Fibre Glass	PCB
Electronic Components	

0 - 500°C Version:

Material	Use
Aluminium Alloy	Enclosure body
Stainless Steel	Rod and sensor body
PEEK	Insulator
Sialon	High temperature insulator
Alumina	Insulator
Fibre Glass	PCB
Electronic Components	

For more information please contact your local distributor or AMETEK Land directly.

END OF SECTION

4650-PM

PARTICULATE MONITOR



CONTACT US



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land.enquiry@ametek.com



AMETEK Land's AMECare Performance Services ensure peak performance and maximum return on investment over the life of your equipment.

We deliver this by:

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- Optimizing solutions to meet your unique applications.
- Enhancing user skills by providing access to product and application experts.

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