LAND
AMETEK®
PROCESS & ANALYTICAL INSTRUMENTS

Millwatch / Silowatch
(CO single stream, including high-CO)

Silowatch
(CO + O_2 single stream)

User Guide

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IMPORTANT INFORMATION - PLEASE READ

AMETEK®
PROCESS & ANALYTICAL INSTRUMENTS

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 AMETEK 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 AMETEK 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 AMETEK 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 AMETEK 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 ISO 9001 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.

Copyright

Contents

1 General Description

This User Guide gives instructions on how to install, operate and maintain the following instruments:

- Millwatch / Silowatch (CO single stream, including High-CO)
- Silowatch (CO + O_2 single stream)

Each instrument is an extractive gas analyser designed to monitor carbon monoxide (CO) levels in coal pulverizing mills, hoppers and storage silos. The Silowatch also monitors Oxygen (O_2) levels.

Carbon monoxide is produced by incomplete or spontaneous combustion and its presence can give advanced warning of a fire.

There are two types of sample probe available, one sample probe has a hardened protective cover designed for highly abrasive pulverised coal.

A continuous sample of gas is drawn into the analyser via sample probes and lines.

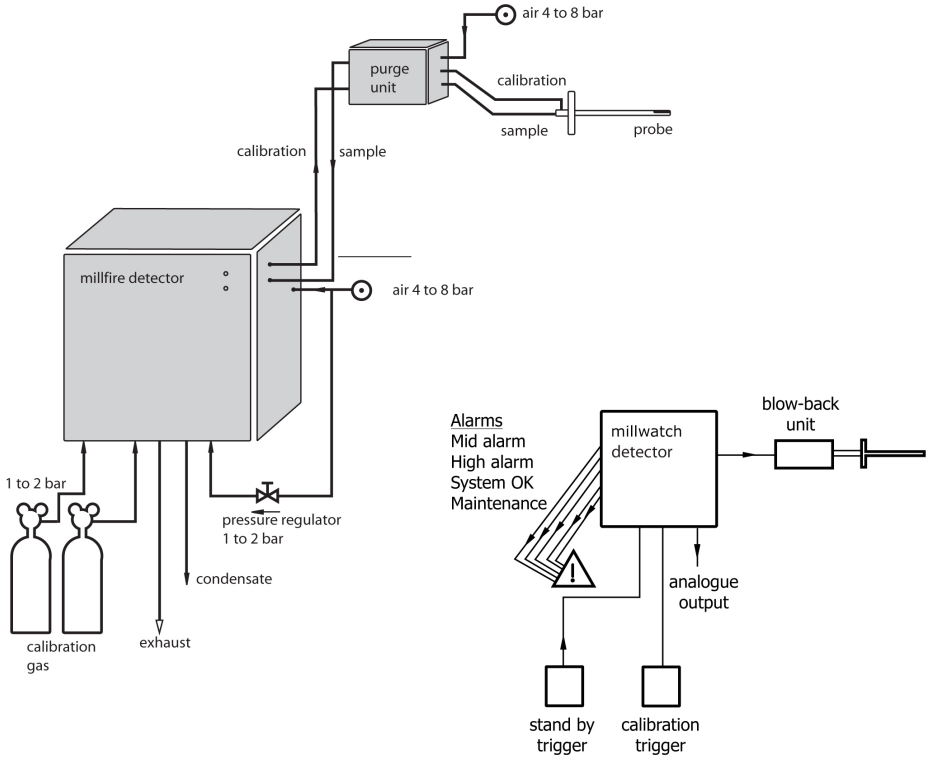
The sample gas is conditioned within the analyser and then analysed by dual sensors which operate alternately to improve sensor life and accuracy, whilst also providing a vital self checking function.

To prevent blockages the probe is automatically purged with compressed air at preset intervals.

WARNING

The Millwatch and Silowatch are **not** designed for use in hazardous areas.

The Millwatch and Silowatch are intended as an early warning device. It is not a substitute for a certified fire detection system.



2 Installation Dos and Don'ts

WARNING

Isolate the electricity supply before starting work.

WARNING

The Millwatch/Silowatch Detector is permanently connected to an electricity supply.

An external switch or circuit breaker is required. An external over current protection device must be provided as close to the monitor as possible.

Please read and follow these instructions carefully.

The Detector is **not** designed to be used in conjunction with any equipment unless specified by LAND. The Detector and probe must not be connected to any other devices. The protection provided by the equipment may be impaired if it is not used in the manner specified in this document.

DO	DON'T
Provide a working platform with access for installation and servicing. Install the probe and Detector as described in this document. Install the power and signal lines in accordance with local regulations. Provide all of the services as stated in the technical specification. Remove exhaust gas and condensate to a safe area. Keep the Detector door closed. Mount vertically on a dry, clean surface. Mount upright with the fittings at the bottom. Use all four of the mounting brackets. Provide certified calibration gas. Purge and leak test the calibration gas pipework before use. Calibration gas is expensive! Install the mill probe at the classifier outlet, where there is a predictable flow direction Do: Install the mill probe with the abrasion shield facing the flow of pulverized coal	Install where there is excessive vibration. Mount the Detector more than 15 m (50 feet) from the probe, as this will increase the response time. Loop the sample line, this will cause condensate to collect. Install the Detector in areas of extreme temperature. See technical specification. Install the flange more than 75 mm (3 in) from the extraction point. Exceed the maximum probe temperature. See technical specification. Site the analyser where the ambient temperature is less than 0 ºC (32 ºF) or greater than 45 ºC (113 ºF). The probe must be situated where the temperature will not exceed the rating of the sample line. Unless cabinet heaters or coolers are provided. Install the probe where the filter can be eroded by coal dust.

NOTE

You must install the peristaltic pump tube. It has been removed for transportation and storage.

See Preventative Maintenance.

3 Service Requirements

Service		Requirement	Size/Specification
1	Calibration gas*	1 to 2 bar (15 to 30 psi) CO in Nitrogen 20 litres (0.7ft^3)	4 l/min (0.15 ft^3/min) during calibration 1/4 in outside diameter PTFE, nylon or stainless steel tube
2	Instrument air*	1 to 2 bar (15 to 30 psi) dry. regulated, clean, oil free compressed or bottled air	1/4 in outside diameter PTFE, nylon or stainless steel tube
3	Condensate removal	Optional	1/2 in NPT - 14 female route to collection device
4	Electrical power supply+	83 to 132 V or 165 to 264 V a.c. 50 to 60 Hz 300 W	Cable 3 way Core size 24/0.2 minimum
5	Cooling air	4 bar (60 psi) minimum 8 bar (120 psi maximum) Clean. Oil-free	300 l/min (10 ft^3/min) 1/4 in outside diameter PTFE, nylon or stainless steel tube
6	Sample line connection	15 m (50 ft) maximum nylon/antifreeze	Outside diameter 1/4 in Sample flow rate is 1.5 l/min (0.05 ft/min)
7	Exhaust Must be kept at atmospheric pressure. Do not allow back pressure	Optional	3/16 in barbed fitting for 4.7 mm inside diameter tubing. Vent to safe area.
8	Cable glands	Customer's connections	Cable diameter 7 to 10.5 mm (0.58 to 0.41 in)
9	Calibration gas to probe	15 m (50 ft) maximum nylon/antifreeze	1/4 in outside diameter PTFE, nylon or stainless steel tube
10	Blow-back air	4 to 8 bar (60 to 120 psi)	1/4 in outside diameter PTFE, nylon or stainless steel tube

* these MUST be set to the same pressure

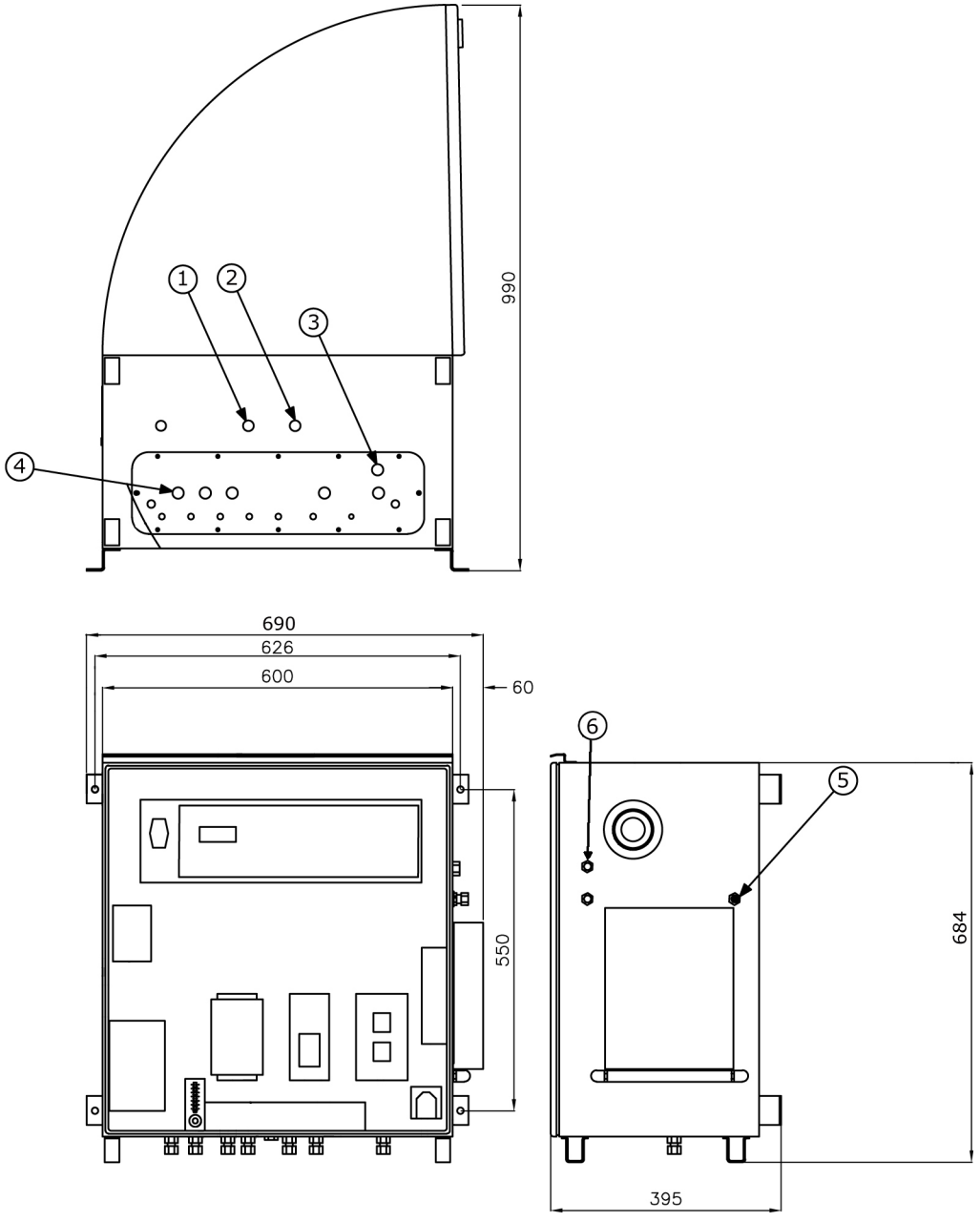
+ electrical power supply connected to terminal rail, where fitted

4 Diagram of Monitor

Weight: 53 kg (117 lb)

1 Instrument air
2 Calibration gas
3 Condensate removal
4 Cable glands
5 Cooling air
6 Sample line connection

Note blow-back air is supplied directly to the blow-back unit.

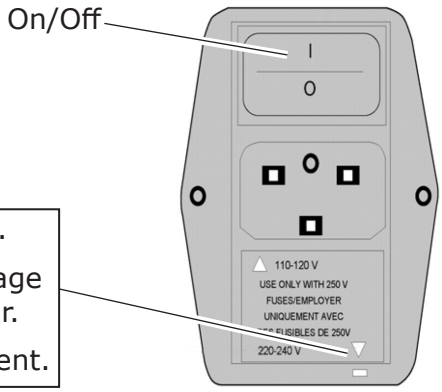


5 Connecting the Electrical Power Supply

Where no case heater or antifreeze line are used, the power supply is connected using the plug supplied with the instrument.

Where a case heater and/or antifreeze line are used, the power supply is connected on the terminal rail.

L	Live	Brown
N	Neutral	Blue
⏚	Earth (Ground)	Green/yellow

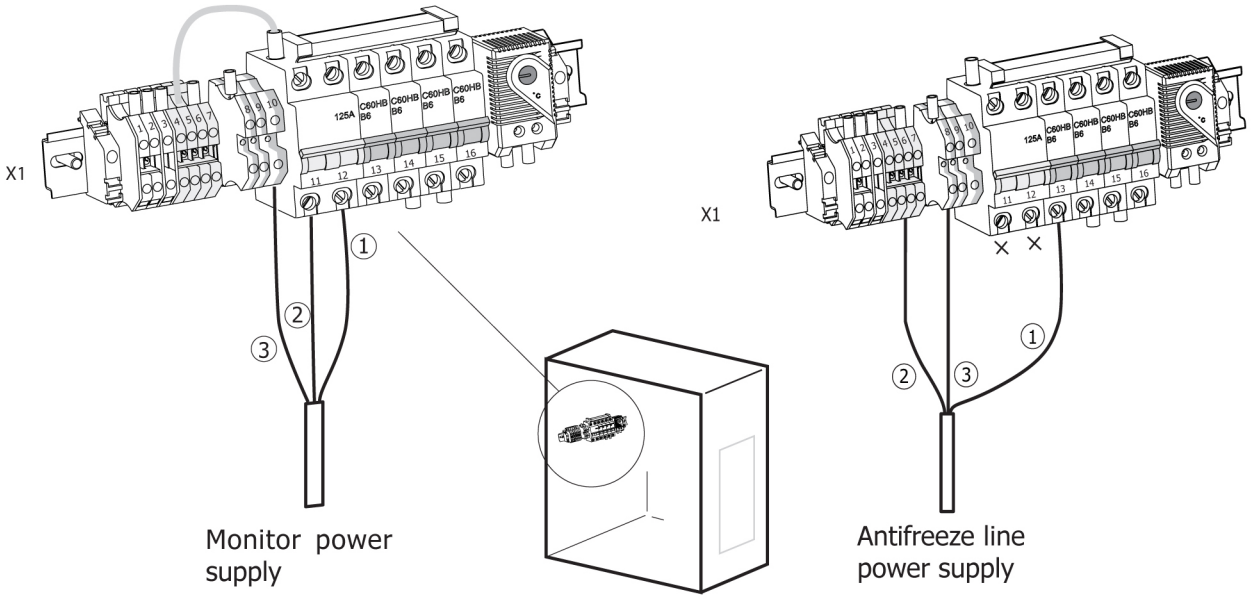


Check the fuse is installed correctly.

The arrow showing the correct voltage should be aligned with the white bar.

A plug is provided with the instrument.

When an antifreeze line and/or case heater is fitted the power supply must be connected on the terminal rail.

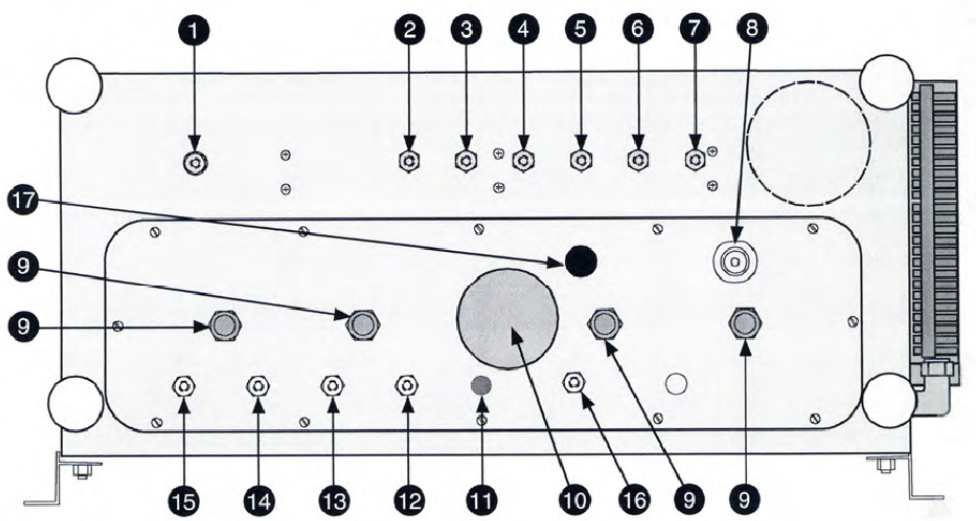


Connections viewed from inside.

1	L	Live	Brown
2	N	Neutral	Blue
3	⏚	Earth(ground)	Green/yellow

5.1 Connecting the Autocal Unit*

*Millwatch / Silowatch (CO single stream, including high-CO)

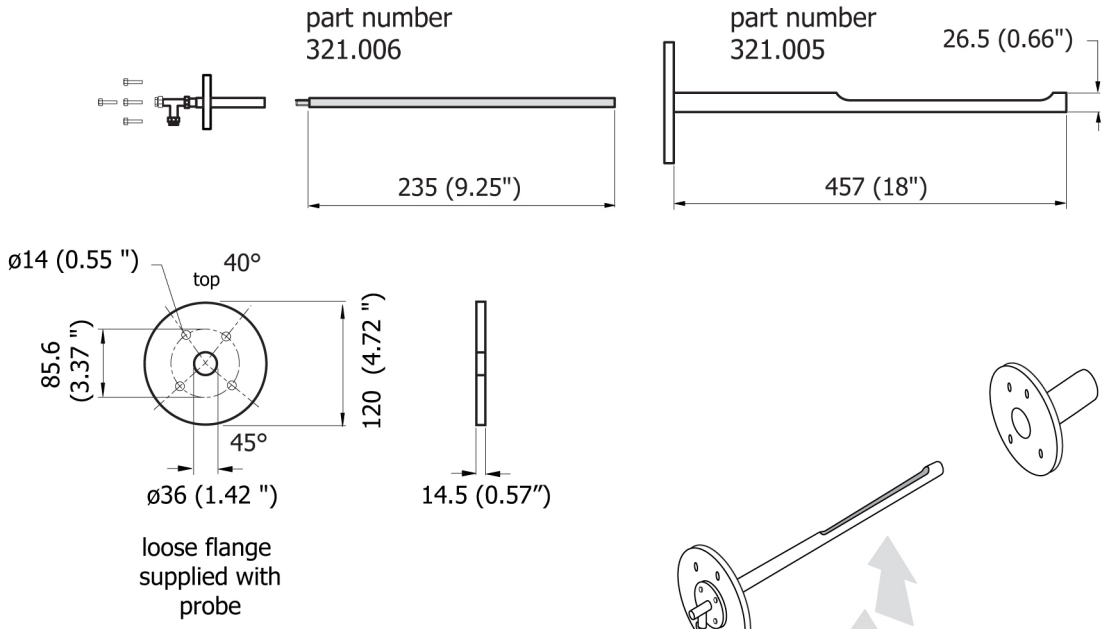


Nº	Description
1	Not used
2	Instrument air (for calibration)
3	Not used
4	CO calibration gas
5	Not used
6	Not used
7	High-range CO calibration gas
8	Condensate drain (½" - 14 NPT Thread)
9	Cable glands
10	Safety pressure exit
11	Not used
12	By-pass gas exhaust (Red channel)
13	By-pass gas exhaust (Blue channel)
14	Sample gas exhaust (Blue channel)
15	Sample gas exhaust (Red channel)
16	Ambient air inlet
17	Blanking plug

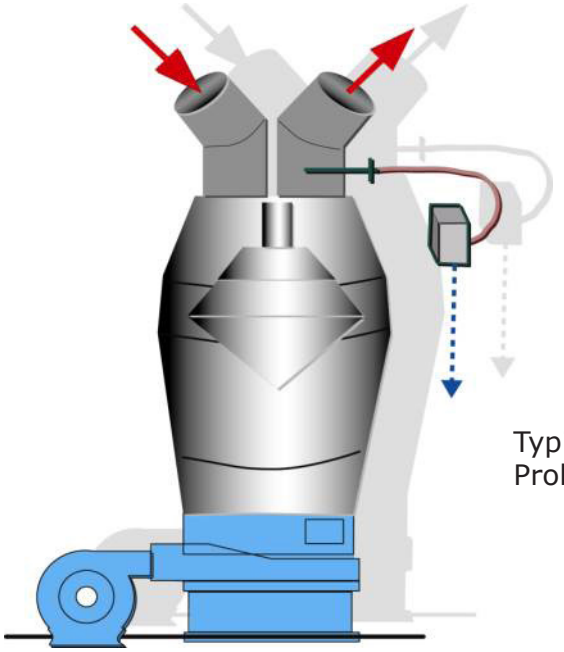
6 Probe Dimensions and Mounting Flange Details

6.1 Coal Mill Probe Abrasive Applications

099.392 0.5 m probe and mounting flange
321.006 Filter
321.005 Abrasion shield



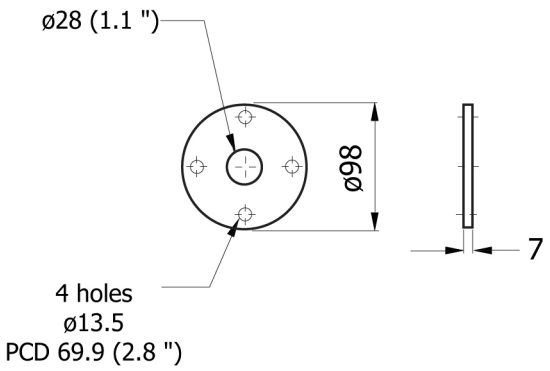
IMPORTANT
The hole centres are unequal to ensure the probe is facing in the correct direction. Install with care.

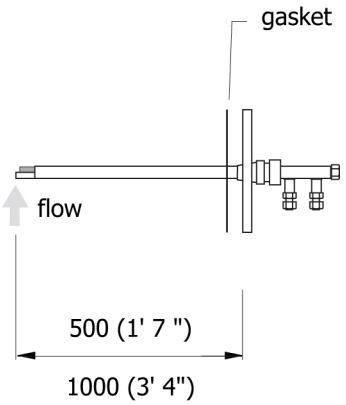


Typical installation of Mill Probe in a Classifier Outlet

6.2 Standard Probe Non Abrasive Applications

Flange 3/4" ASA 150 lb stainless steel



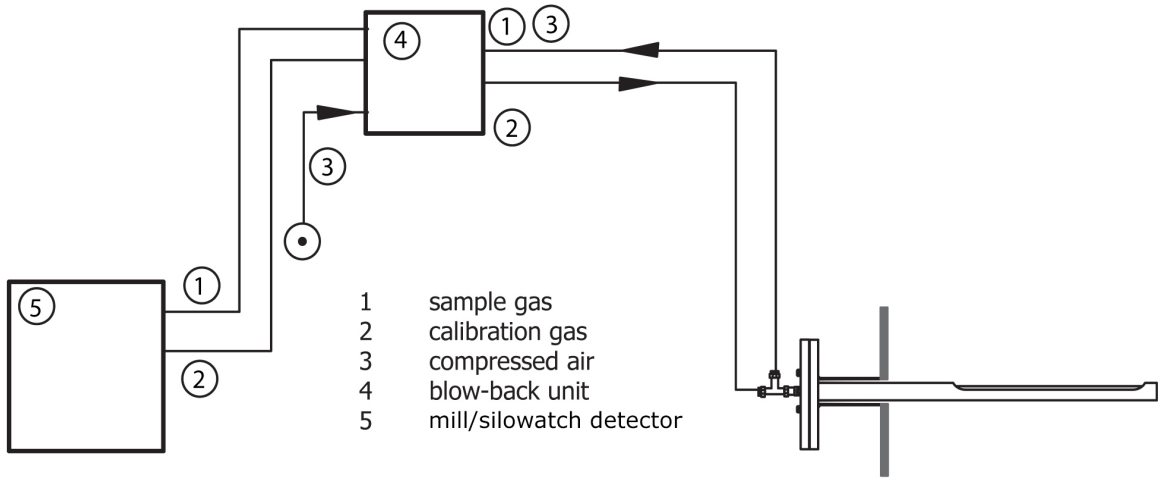


probe length
options available

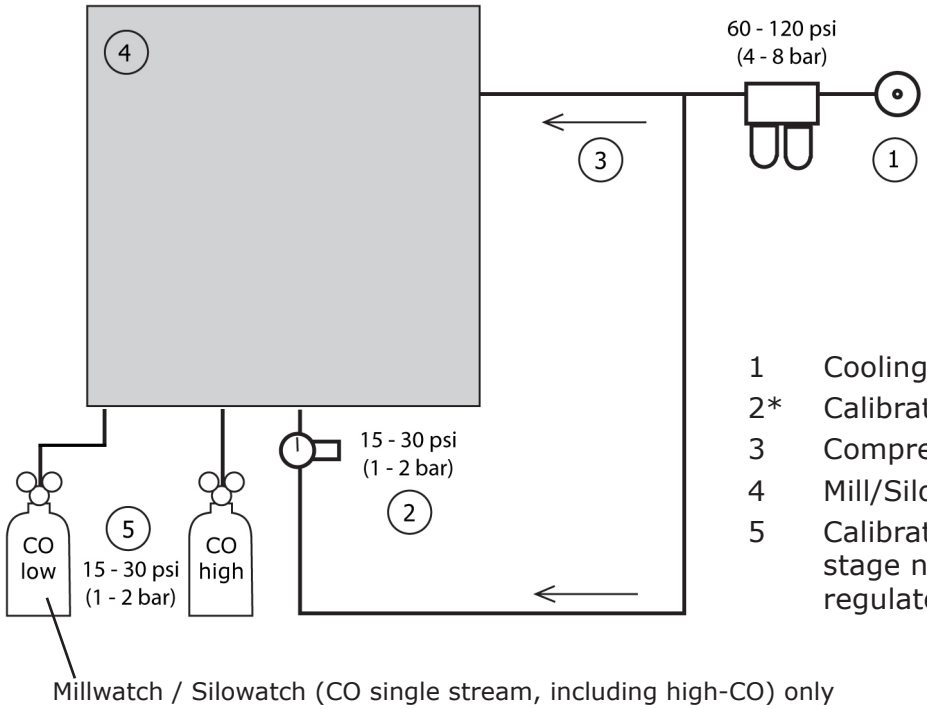
Part Nº	Probe length
704.424	500 mm
702.759	1000 mm

7 Recommended Installation for Probe

Position the analyser and probe below the blowback unit to allow any condensate to drain.



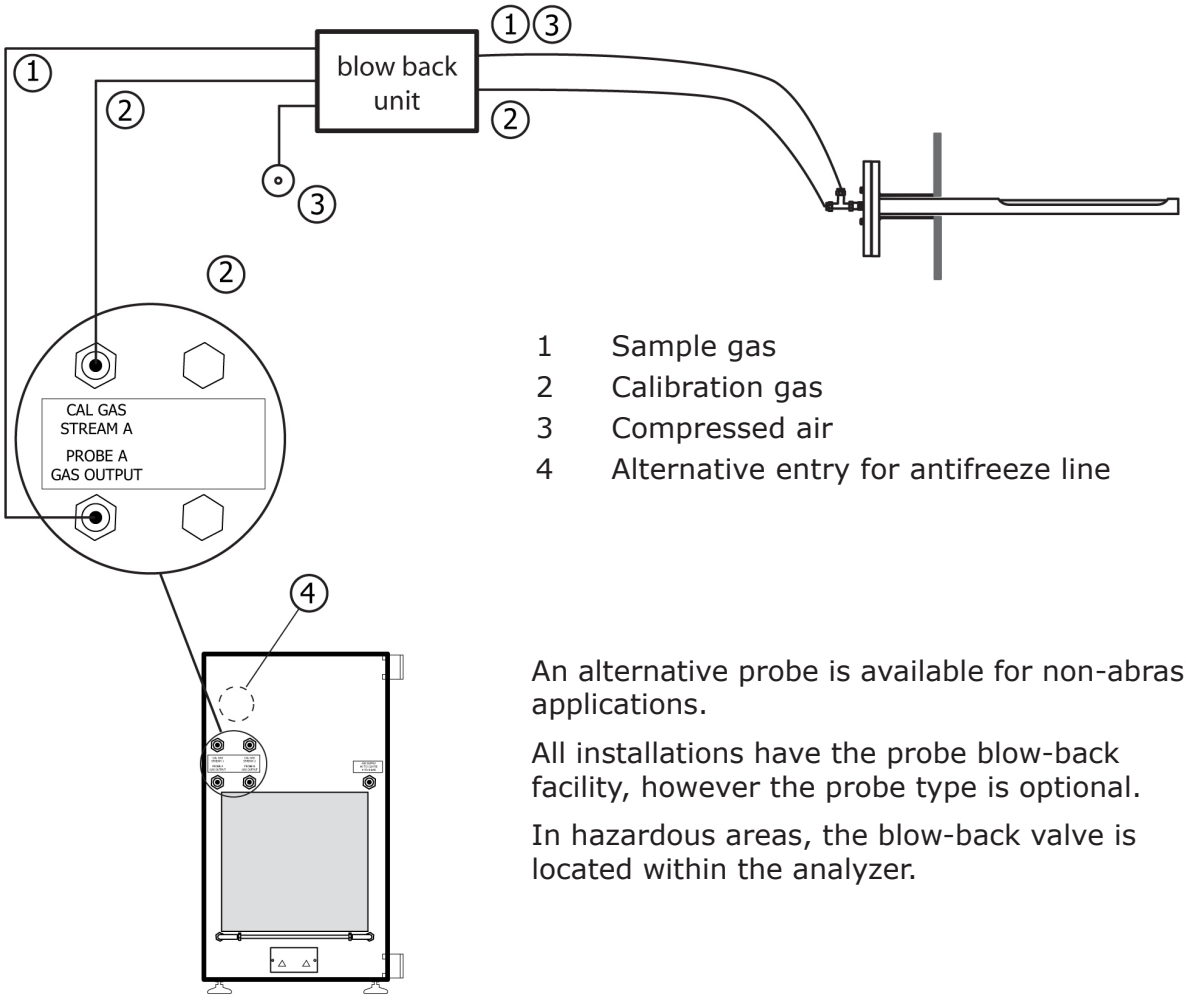
7.1 Recommendations for Installing the Instrument Air Supply and Calibration Gas



1 Cooling air supply
2* Calibration air supply
3 Compressed air supply
4 Mill/Silowatch Detector
5 Calibration gas (CO), 2 stage non-relieving pressure regulator

*A 30 psi pressure regulator is supplied in the spares kit with the monitor and must be fitted by the user. All other pressure regulators and pipework must be supplied by the customer.

7.2 Connecting the Probe



1 Sample gas
2 Calibration gas
3 Compressed air
4 Alternative entry for antifreeze line

An alternative probe is available for non-abrasive applications.

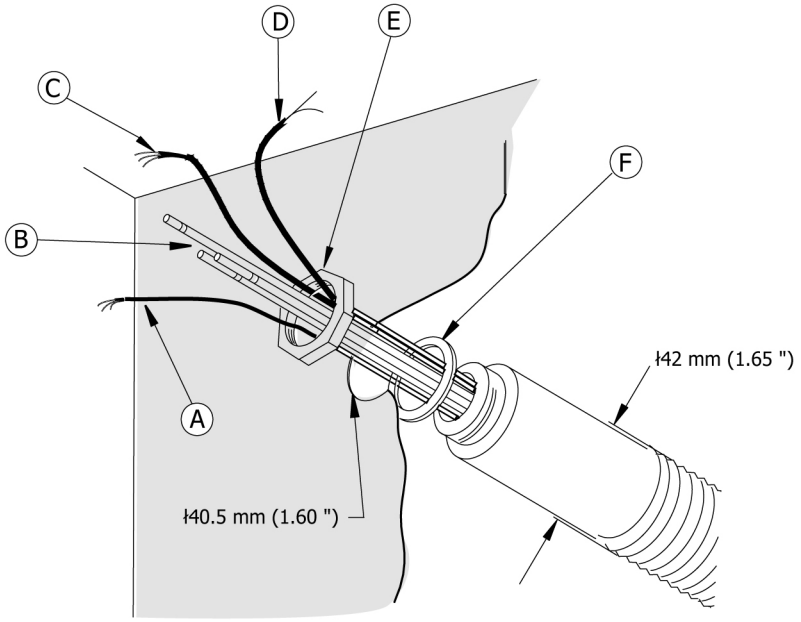
All installations have the probe blow-back facility, however the probe type is optional.

In hazardous areas, the blow-back valve is located within the analyzer.

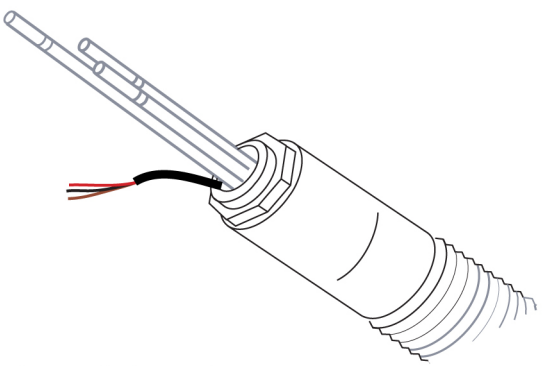
8 Installing the Antifreeze Line

Only two of the pipes in the antifreeze line are used. Make sure you identify these AT BOTH ENDS of the line.

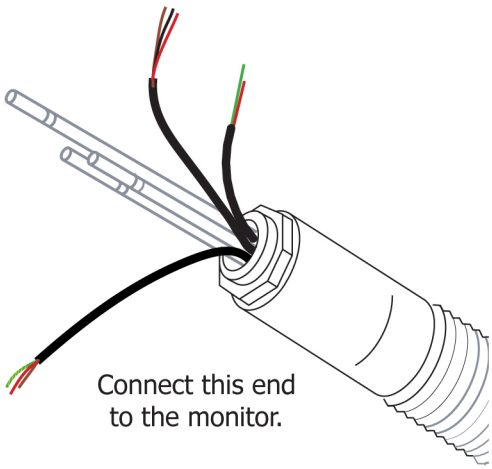
The power supply connects to the circuit breaker INSIDE the Mill/Silowatch Detector.



A Signal Cables (black, red, brown) use to connect blowback solenoid valve
B Sample and calibration gas lines (one is not used) identify lines at both ends
C Power Supply (brown, blue, green/yellow)
D Thermocouple NOT USED (make safe)
E Nut
F Washer



Connect this end to the blowback unit.



Connect this end to the monitor.

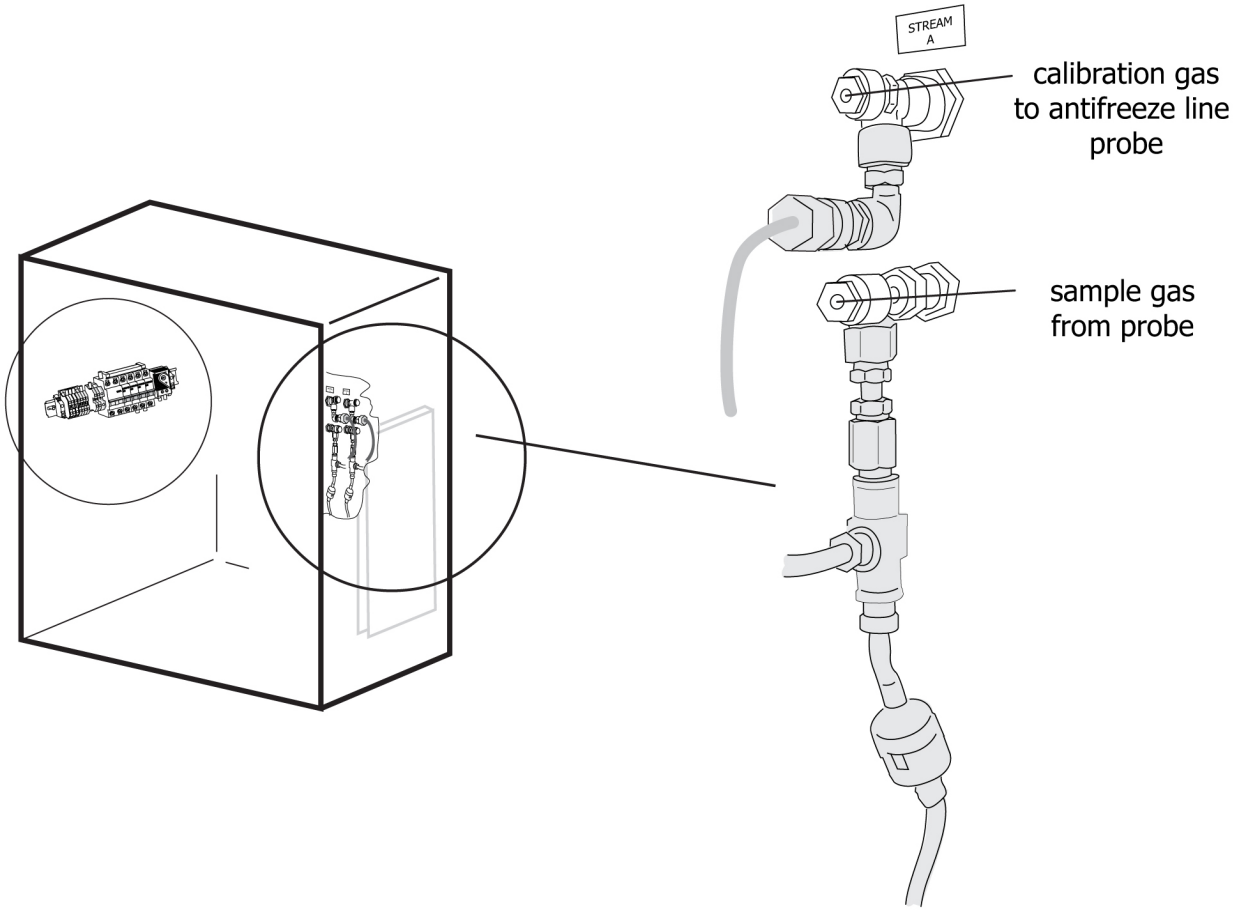
Part Nº	Description
323.512	Antifreeze sample line 230 V
323.513	Antifreeze sample line 110 V

Alternative sample line designs are used in the USA.

8.1 Connecting the Antifreeze Line

Connections viewed from the inside of the analyser.

Note: Plugs are fitted to the outside of the case when anti-freeze lines are used.

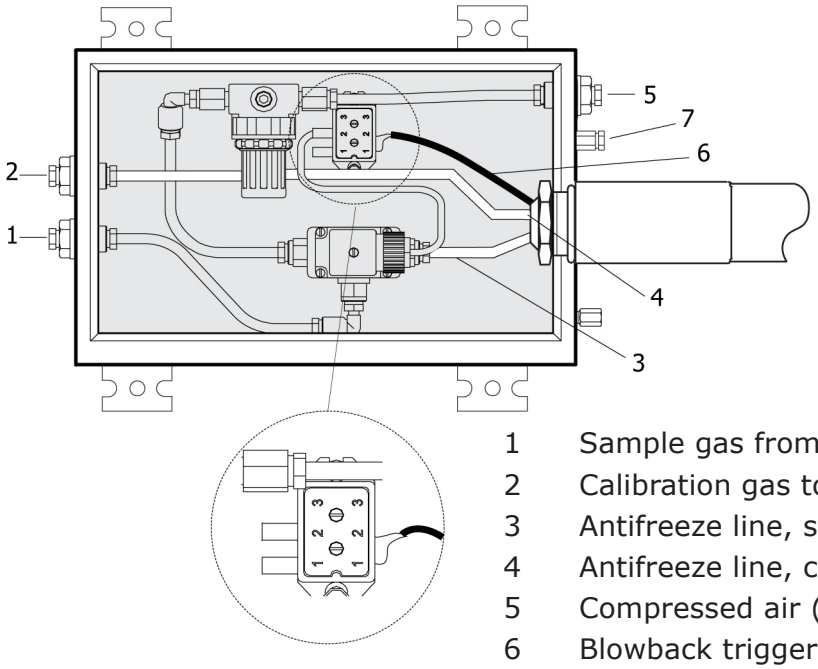


9 Blow-back Unit

In hazardous areas, the blowback valve is located within the analyzer.

9.1 Blow-back unit with antifreeze line

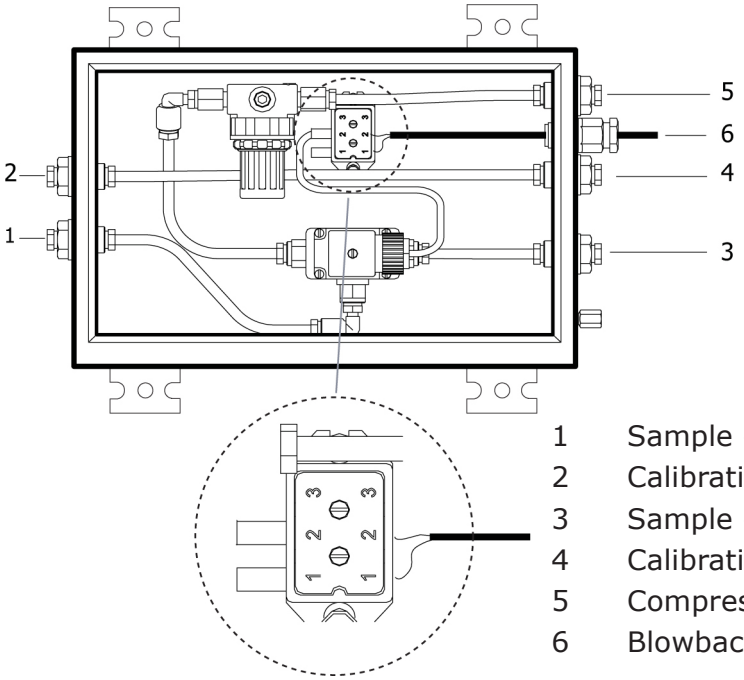
Do not adjust the regulator.



1. Sample gas from probe
2. Calibration gas to probe
3. Antifreeze line, sample gas to monitor
4. Antifreeze line, calibration gas from monitor
5. Compressed air (60 to 120 psi, 4 to 8 bar)
6. Blowback trigger from monitor (it is possible to use the signal cable in the antifreeze line, as shown in diagram)
7. Cable gland (alternative connection for blow-back trigger from monitor)

9.2 Blow-back unit with standard line

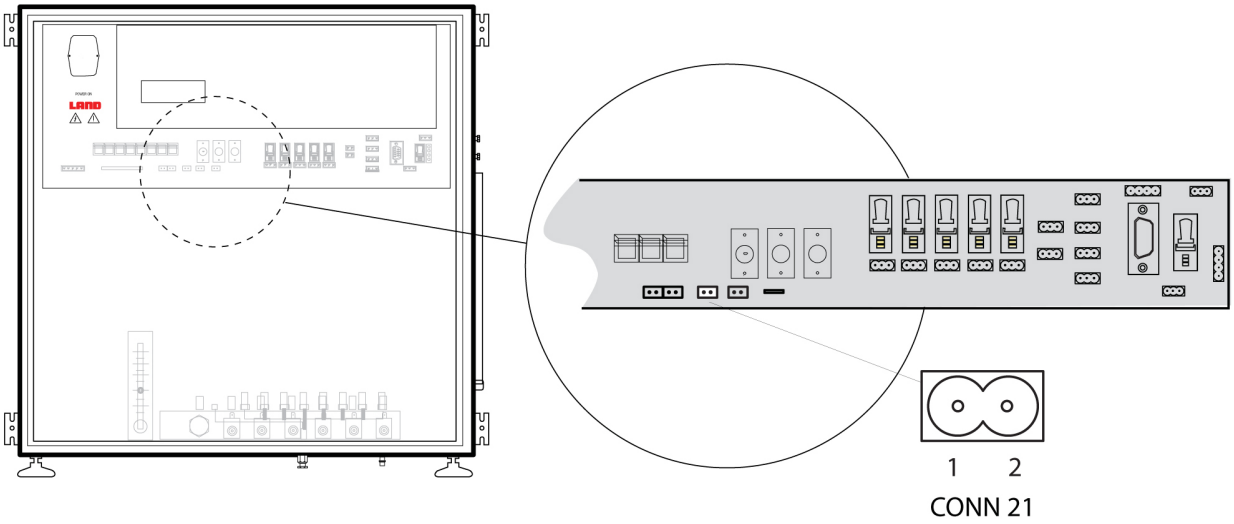
Do not adjust the regulator.



1. Sample gas from probe
2. Calibration gas to probe
3. Sample gas to monitor
4. Calibration gas from monitor
5. Compressed air (60 to 120 psi, 4 to 8 bar)
6. Blowback trigger from monitor

10 Connecting the Blow-back Trigger

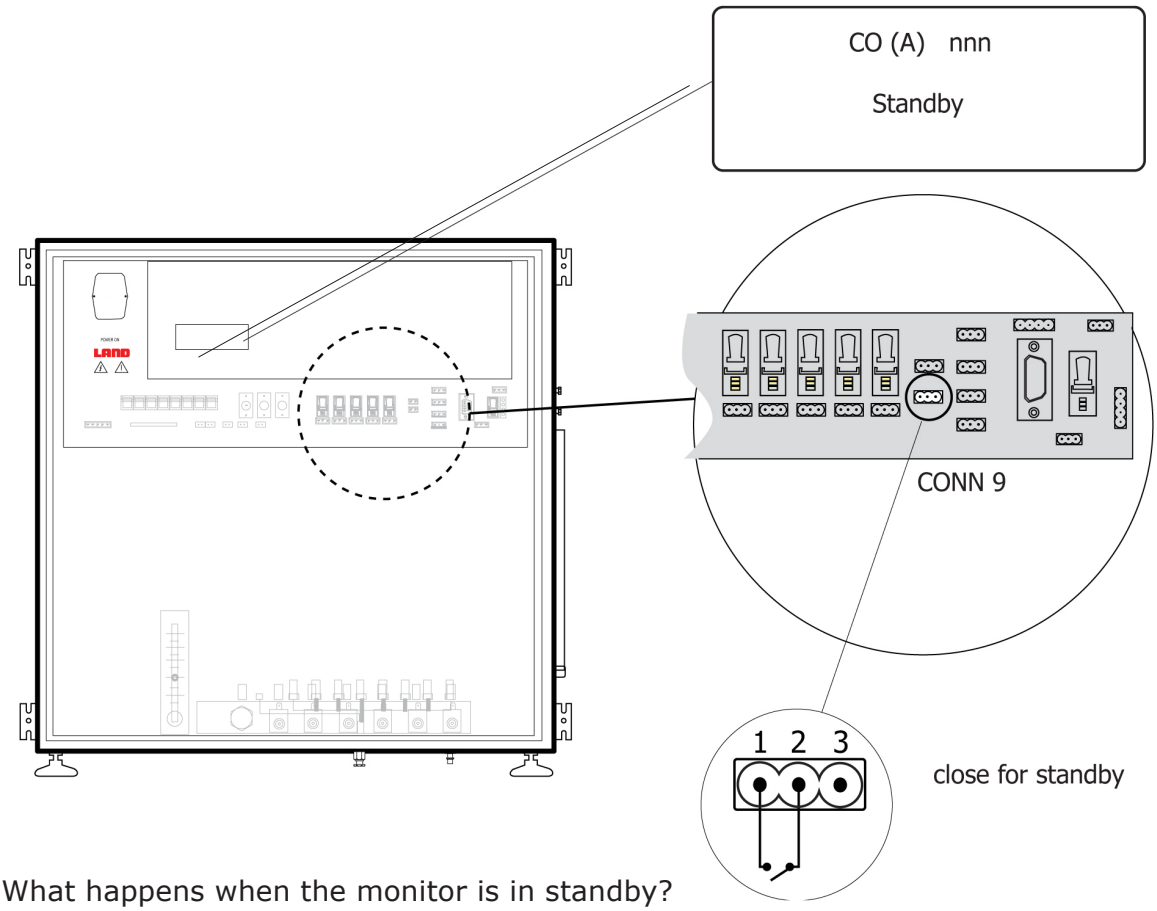
Connect the blow-back unit to Conn 21.



Service	Requirement	Size/Specification
1 Blow-back trigger	CONN 21 Pin 1 (0 V dc)	Blowback unit Pin 1
	CONN 21 Pin 2 (24 V dc)	Blowback unit Pin 2

11 Input Connection to Trigger Standby

The standby mode can be used to protect the analyser during abnormal modes of operation for example when a mill is being purged with steam or during periods where the plant is not operational.



What happens when the monitor is in standby?

- The maintenance relay is ON.
- Blowback operates constantly (the compressed air valve in the blowback unit remains open).
- AIR is passed through the gas sensors.
- Flow errors are ignored.
- The peristaltic pump operates normally.
- Timed blowback and calibration are disabled. Calibration will occur at the next due time.
- The analogue outputs track the readings from the gas sensors.

Item	Function	Connection	Size/Specification
1	Standby	CONN 9	Pin 1. Short Pins 1 and 2 for standby function Pin 2 Pin 3 Not used

12 Electrical and Signal Connections

All electrical work must be carried out by a competent person.

Power and signal cabling are the responsibility of the customer and should comply with local regulations.

Cables should be selected of a conductor size and insulation suitable for the purpose used.

The instrument and power leads should always be grounded/earthed.

Screened signal leads are recommended and a single ground termination made at one end only.

Description	Requirement	Size
Digital System OK Alarms (mid and high) Maintenance Calibration Trigger Standby input	8 core (1 or 2 cables depending on instrument)	7/0.2 core Diameter 7.5 to 10 mm
Current loop output 4 to 20mA DC sourcing Connect screen at monitor	3 core screened (1 or 2 cables depending on instrument)	7/0.2 core Diameter 7.5 to 10 mm
*Blow-back control signal to probe Stream A	1 core	7/0.2 core Diameter 7.5 to 10 mm

*Not required if using antifreeze lines.

12.1 Summary of Connections

Millwatch / Silowatch (CO single stream, including High-CO)

Item	From			To
High Alarm	Conn 13	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
Mid Alarm	Conn 15	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
System OK	Conn 11	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
Maintenance Relay	Conn 12	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
Blow-back signal to probe Stream A	Conn 21	0V dc 24V dc	Pin 1 Pin 2	Stream A Blow-back unit Pin 1 Stream B Blow-back unit Pin 2
Standby trigger to monitor	Conn 9		Pin 1 Pin 2	Short Pin 1 to Pin 2 for Standby
External trigger calibration (all streams)	J2		Pin 1 Pin 2	Short Pin 1 to Pin 2 for Calibration
Current loop 4 - 20mA output (powered internally by 24V)	Conn 23	+ve -ve GND	Pin 1 Pin 2 Pin 3	Customer's recording device

12.2 Summary of Connections

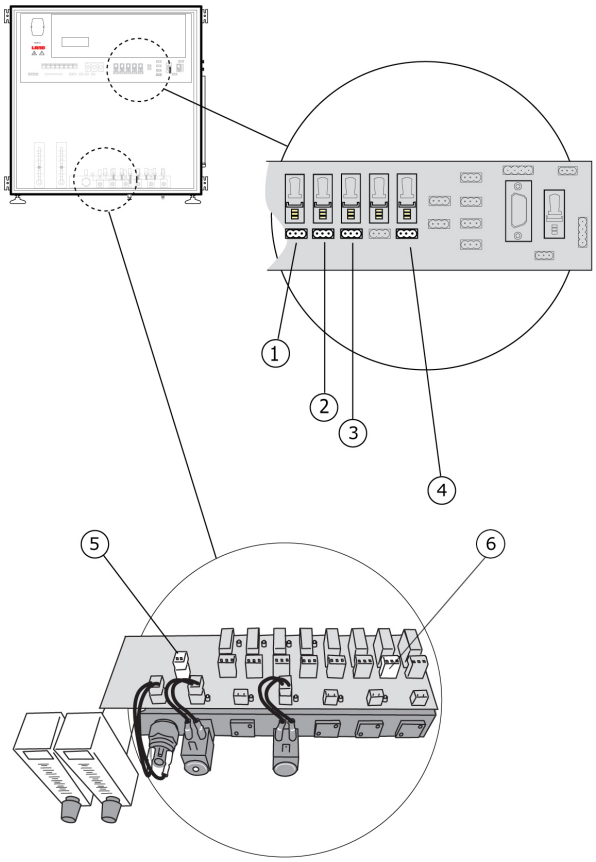
Silowatch (CO & O_2 single stream)

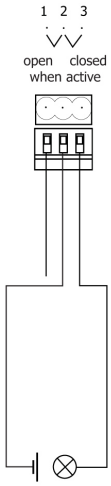
Item	From			To
High Alarm	Conn 13	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
Mid Alarm	Conn 15	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
System OK	Conn 11	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
High Oxygen	Conn 14	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
Maintenance Relay	Conn 12	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
Blow-back signal to probe	Conn 21	0V dc 24V dc	Pin 1 Pin 2	Stream A Blow-back unit Pin 1 Stream B Blow-back unit Pin 2
Standby trigger to monitor	Conn 9		Pin 1 Pin 2	Short Pin 1 to Pin 2 for Standby
External trigger calibration (all streams)	J2		Pin 1 Pin 2	Short Pin 1 to Pin 2 for Calibration
CO Current loop 4 - 20mA output (powered internally by 24V)	Conn 23	+ve -ve GND	Pin 1 Pin 2 Pin 3	Customer's recording device
O_2 Current loop 4 - 20mA output (powered internally by 24V)	Conn 10	+ve -ve GND	Pin 1 Pin 2 Pin 3	Customer's recording device

13 Digital Inputs and Outputs

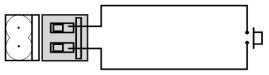
WARNING

Trigger Connections must be volt-free.





Alarm, maintenance and system OK relays

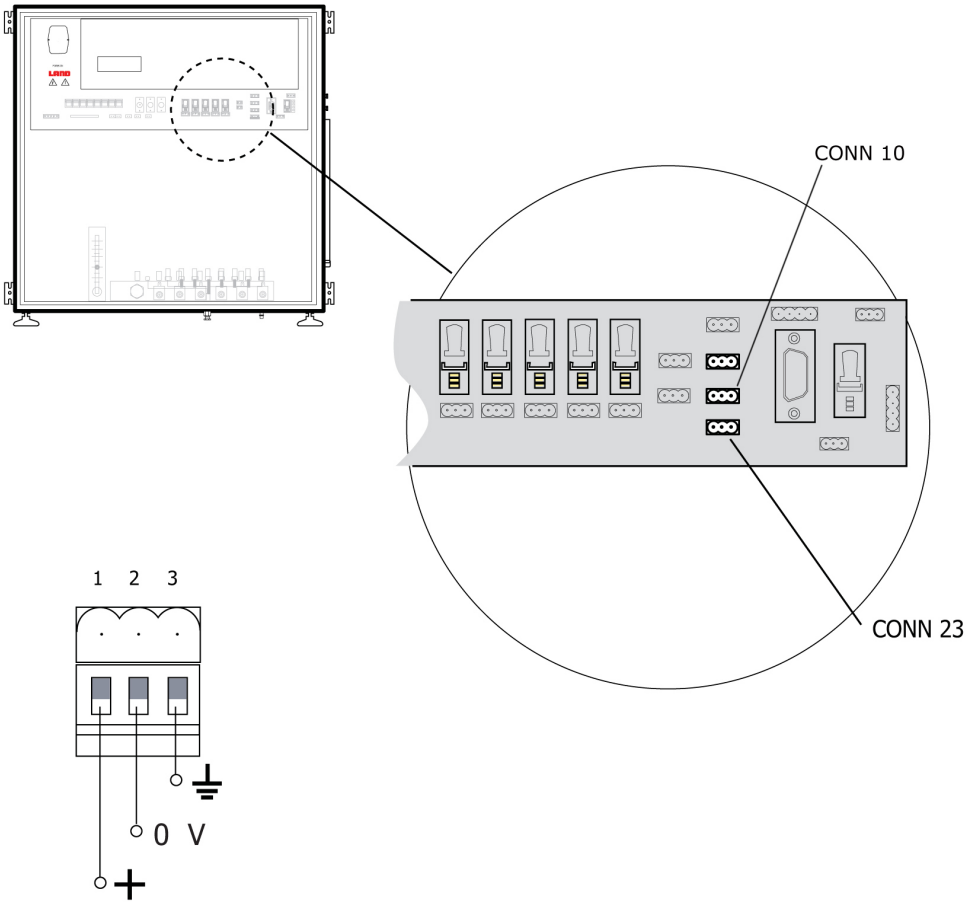


J2 External Calibration Trigger

Push-button or relay contacts must remain closed for more than 2 seconds. The calibration will not start until it opens again.

Item	Function	From			To
1	System OK	Conn 11	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
2	Maintenance/ Calibration Relay output	Conn 12	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
3	High Alarm CO	Conn 13	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
4	High Alarm Oxygen	Conn 14	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device
5	External trigger calibration	J2		Pin 1 Pin 2	Short Pin 1 to Pin 2 for Calibration
6	Mid Alarm CO	Conn 15	NO Common NC	Pin 1 Pin 2 Pin 3	Customer's recording device

14 Analogue Outputs



current loop connections
are electrically isolated

Item	Function	From			To
1	CO 4 - 20mA output	Conn 23	+ve -ve GND	Pin 1 Pin 2 Pin 3	Customer's connection
2*	O_2 4 - 20mA output	Conn 10	+ve -ve GND	Pin 1 Pin 2 Pin 3	Customer's connection

* Silowatch (CO & O_2 single stream)

The output can also be set to 0, 2 or 4 mA to 10 to 20 mA.

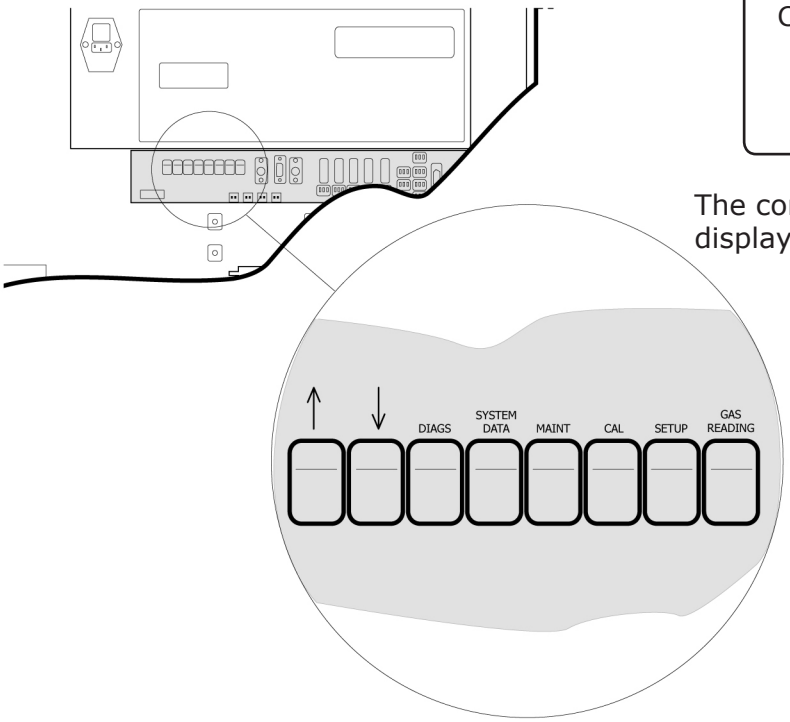
Example of setting analogue output

To set the minimum current for the output select SETUP > OP1 MIN > 0, 2 or 4.

To set the maximum current for the output select SETUP > OP1 MAX > 10 to 20.

To set the full scale value for the output select SET UP > OP1 SPAN > 20 to 4000 in steps of ten.

15 Description of the Control Panel

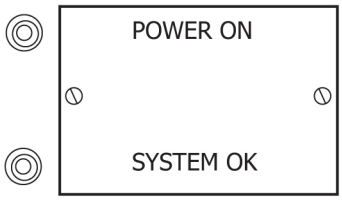


CO 000 ppm

SYSTEM OK

The composite gas reading is displayed by pressing GAS READING.

Arrows	Toggle ON/OFF or YES/NO options, change values, scroll lists
DIAGS	Diagnostics, shows number of faults. Press to list fault messages in turn
SYSTEM DATA	Sensor, cooling and flow data
MAINTENANCE	Switches the maintenance relay on or off
CALIBRATION	Calibration menus
SET UP	Change the operating parameters
GAS READING	Displays current gas readings on screen



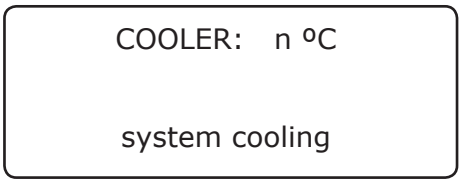
Panel Indicators

POWER ON	LED illuminates when power is on
SYSTEM OK	LED illuminates when the monitor is functioning correctly

16 Warm Up Routine

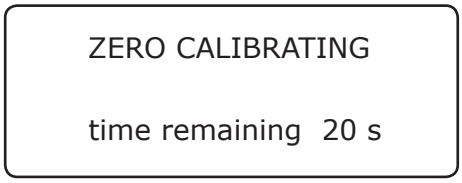
The warm up routine is started automatically when the monitor is switched on.

1) The sample gas chiller cools to its operating temperature.

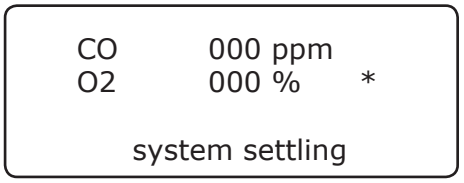


The default setting 4 ºC (39 ºF).
This can take up to 30 minutes.

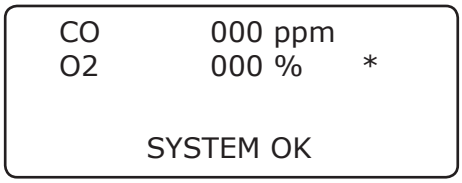
2) A timer is displayed. Zero calibration takes approximately five minutes (300 seconds).



3) The monitor begins to draw sample gas. The settling time is to allow the sample gas to reach the sensor unit and the sensors to stabilise.



4) The live CO reading is displayed.
If SYSTEM FAULT is displayed refer to the Diagnostics section of this manual.



* Silowatch (CO & O_2 single stream) only

17 Essential Setup Procedures

17.1 The Entry Code

1) Press SETUP on the control panel.
2) Use the arrow keys on the control panel to change the value displayed. If you change the code do not forget it.
3) Press SETUP again.

The entry code is factory set to 4.

17.2 Set the Time and Date

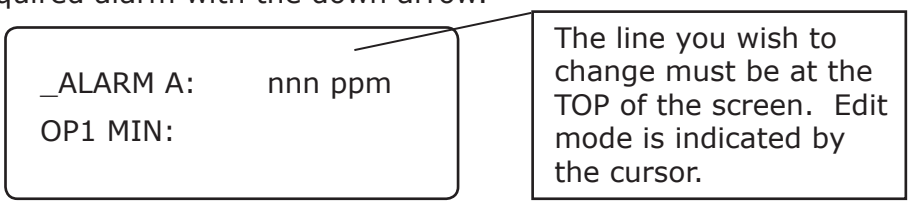
1) Use the down arrow until SET CLOCK is on the top line of the display.
2) Press SETUP. The cursor shows which line you will change.
3) Use the down arrow to change NO to YES.
4) Press SETUP.
5) Use the arrow keys to change the day.
6) Press SETUP to confirm.

   To change the time use the arrow keys and press SETUP to confirm. (A 24 hour clock is used.)

17.3 Set the Alarm Levels

ALARM A

1) Select the required alarm with the down arrow.



2) Press SETUP.
3) Use the arrows to change the value, zero to 4000 in steps of 10. Press SETUP to confirm.
4) Repeat for the midpoint alarms, MID AL A.

17.4 Selecting an appropriate alarm level.

There is no right or wrong level, each application must be considered in isolation. Use the monitor to assess normal operating levels and then set the alarm levels at an appropriate margin above normal levels so as not to cause false alarms whilst still providing adequate protection. The output signals from the monitor must be considered as data for evaluation by operating staff rather than simple go / no go alarms.

17.5 Select the Units of Measurement

ppm or mg/Nm^3
mg/Nm^3 = ppm 1.25
(STD = 0° C and 101.3 kPa)

1) Use the down arrow to UNITS.
2) Press SETUP.
3) Use the arrow keys to change the value and press SETUP to confirm.
4) To exit the SETUP menu press GAS READINGS.

17.6 Set the Automatic Calibration Times and Calibration Gas Concentrations

Checking and entering the calibration gas concentration is essential. The calibration gas concentration is shown on the certificate, which accompanies the calibration gas cylinder.

1) Press the CAL button.
2) Use the arrows to change the displayed value to the entry code.
3) Press CAL again.
4) Select AUTOCAL and press CAL.
   The calibration menu is now displayed.
5) To change the entries, press SETUP, change the value with the arrow keys and press SETUP again.

TYPE	MANUAL	See below
	TIMED TRIGGER	Calibration is set by TIME TO NEXT CAL and CAL INTERVAL values
	EXT TRIGGER	Use an external calibration switch
	OFF	Calibration is disabled
	AIR SOLENOID AND GAS1 SPAN for LAND use only	
CAL INTERVAL	The time between calibrations in hours (0 to 255 hours)	
SETTLE TIME	Time allowed for calibration gas to reach a steady state	
SPAN GAS	0 to 4000 ppm. Given on the calibration gas certificate	
REPORT DELAY	The time required for the report relay to remain closed in order for the recording or other device to acquire information. Default 20 seconds.	
CLOP	TRACK or HOLD (outputs during a calibration)	
CAL METHOD	2 POINT	
MAINT RELAY	CAL IN PROGRESS MAINTENANCE	
TIME OF NEXT CAL?	DAY hour:minute	
	Use the arrow keys to change the day and then press SETUP, repeat for hour and minute	

18 Diagnostics

18.1 Fault Messages

To check the fault messages press DIAGS.

The number of system faults is displayed. Press DIAGS again to list individual messages.

The diagnostics display has no affect on the operation of the monitor.

Fault	Possible Cause	Suggested Solution
ADC FAULT	Microprocessor failure may cause false readings	Contact LAND
*COOLER FAILURE	Cooler is less than 10% below ambient for more than 5 minutes	Check air supply to cooler
	Electronic fault, cooler fault	Contact LAND
	Ambient temperature is too high	
ZERO DRIFT	Gas sensor has failed	Replace sensor assembly
	New sensor is settling	Reset faults and recheck
	Sample gas is entering the monitor	Check for leaks
	Contaminated ambient air	May correct itself at next change over
SPAN COEFFICIENT OUT OF LIMITS	Sensor saturated, the sensor has been exposed to excessive amounts of CO. The sensor will recover if run on air	Reset the fault
	Sensor expired	Replace sensor assembly
	Calibration has failed	Check calibration gas concentration in setup menu matches calibration gas certificate
	Calibration gas is not reaching sensors	Check for leaks in sample path
FLOW RATE FAULT	Low sample gas flow	
	Sample pump failed	Replace pump
	Either gas stream probe, probe filter or sample line blocked	Remove probe and clean
	Sample chiller failed (frozen)	Replace sample chiller
*PERISTALTIC PUMP FAILURE	Faulty connection to pump	Check condensate pump is running? (does it turn when power on?)
	Pump failed	Replace pump
5V REF FAULT	Electronics fault	Contact LAND
FAIL IN CALIBRATION	This message is followed by one of the following	
CALIBRATION ABORTED	Calibration was stopped by an operator	Repeat calibration
NO CAL GAS	No calibration gas is available	Check calibration gas cylinder pressure gauge replace the calibration gas when gauge reads less than 20 bar (290 psi). Check that the calibration gas pressure regulator is switched on. Check the pipe work is connected correctly. Leak test the pipe work.
*EEPROM CHECKSUM ERROR	Electronic error	Contact LAND

*These errors will cause the monitor to shutdown. During this time all outputs will read zero. The monitor will automatically return to normal operation when the faults are rectified.

18.2 Clearing Faults

To manually trigger an automatic calibration, set TYPE to MANUAL and press CAL.

SETUP > CLEAR FAULTS > YES > SETUP

18.3 Key to Menu Items

SETUP

ENTRY CODE: 4

Any invalid entry code will allow values to be seen but not changed.

18.3.1 Menu options - Millwatch / Silowatch (CO single stream, including High-CO)

ALARM A	2000 ppm	CO alarm level 0 to 4000 in units of 10
O/P1 MIN	4 mA	Gas stream 1 minimum current of analogue output 0, 2 or 4 mA
O/P1 MAX	20 mA	Gas stream 1 maximum current of analogue output 0, 2 or 4 mA
O/P1 SPAN	500 ppm	Gas stream 1 CO full scale of analogue output 20 to 4000 in units of 10
Damper	1	Gas stream 1 current loop output response time seconds
A RED COEF 1		Gas stream A span calibration constant for red channel
A RED COEF 2	0	Gas stream A mid point calibration constant for red channel
A BLUE COEF 1		Gas stream A span calibration constant for blue channel
A BLUE COEF 2	0	Gas stream A mid point calibration constant for blue channel
PUMP INTERVAL	1 minute	Time between peristaltic pump operations - must be set to 1 minute
BLOW-BK INT	60 m	Time between blow-backs
UNITS	PPM	Units for gas concentration ppm mg/nm^3
WET ANALYSIS	NO	Wet analysis applied to gas calculation YES or NO
WATER	0.0%	H_2O water vapour concentration for wet analysis 0 to 25% in units of 0.01
SHOW NEGATIVE	NO	Permits negative readings to be displayed and output
ENTRY CODE	4	The password is factory-set to 4 (0 to 999)
BLOWBACK?	NO	Set to YES to manually purge the probe(s) (YES or NO)
SET CLOCK	NO	Set to YES to set the time and day
CLEAR FAULTS	NO	Set to YES to clear faults (persisting faults will not clear)
RESTORE CONST	NO	Set to YES to restore previous calibration constants
MID AL	200 ppm	Mid alarm point for gas stream A 0 to 4000 in units of 10

To exit this menu press GAS READINGS

18.3.2 Menu options - Silowatch (CO & O2 single stream)

ALARM A	2000 ppm	CO alarm level 0 to 4000 in units of 10
O/P1 MIN	4 mA	CO minimum current of analogue output 0, 2 or 4 mA
O/P1 MAX	20 mA	CO maximum current of analogue output 0, 2 or 4 mA
O/P1 SPAN	500 ppm	CO full scale of analogue output 20 to 4000 in units of 10
O/P1 Damper	1	CO current loop output response time seconds
O/P2 MIN	4 mA	O_2 minimum current of analogue output 0, 2 or 4 mA
O/P2 MAX	20 mA	O_2 maximum current of analogue output 0, 2 or 4 mA
O/P2 SPAN	25	O_2 full scale of analogue output 0 to 25 in units of 1%
O/P2 Damper	1	O_2 current loop output response time seconds
A RED COEF 1		CO span calibration constant for red channel
A RED COEF 2	0	CO mid point calibration constant for red channel
A BLUE COEF 1		CO span calibration constant for blue channel
A BLUE COEF 2	0	CO mid point calibration constant for blue channel
A RED COEF 1		O_2 span calibration constant for red channel
A RED COEF 2	0	O_2 mid point calibration constant for red channel
A BLUE COEF 1		O_2 span calibration constant for blue channel
A BLUE COEF 2	0	O_2 mid point calibration constant for blue channel
PUMP INTERVAL	1 minute	Time between peristaltic pump operations - must be set to 1 minute
BLOW-BK INT	60 m	Time between blow-backs
UNITS	PPM	Units for gas concentration ppm mg/nm^3
WET ANALYSIS	NO	Wet analysis applied to gas calculation YES or NO
WATER	0.0%	H_2O water vapour concentration for wet analysis 0 to 25% in units of 0.01
SHOW NEGATIVE	NO	Permits negative readings to be displayed and output
ENTRY CODE	4	The password is factory-set to 4 (0 to 999)
BLOWBACK?	NO	Set to YES to manually purge the probe(s) (YES or NO)
SET CLOCK	NO	Set to YES to set the time and day
CLEAR FAULTS	NO	Set to YES to clear faults (persisting faults will not clear)
RESTORE CONST	NO	Set to YES to restore previous calibration constants
MID AL	200 ppm	Mid alarm point for gas stream A 0 to 4000 in units of 10

To exit this menu press GAS READINGS

19 Technical Specification

Coal Mill Probe

Probe material	Hardened mild steel
Probe filter	Stainless steel
Weight	3.5 kg (7.7 lb)
Flue gas temperature	200 ºC maximum

Analyser

Ambient Temperature	0 ºC to 45 ºC (32 ºC to 113 ºF), -20 ºC to 45 ºC (-4 ºF to 113 ºF) with optional case heater 0 ºC to 50 ºC (32 ºF to 122 ºF) with optional cooler
Weight	53 kg (117 lb)
Power consumption	300 W 800 W with case heater 225 W with antifreeze line
Voltage	83 to 132 V ac or 165 to 264 V ac 50 to 60 Hz
Calibration	Automatic, 2-point calibration span and zero, microprocessor controlled.
Indicators	2 LEDS on door panel; power on and system OK

Environmental

System enclosure:	Painted steel, sealed to IP65/NEMA 4

Compliance

EMC:	Conforms to EN-50 081 and EN-50 082
Electrical Safety:	Conforms to EN-61010-1

Measurement Ranges

Low CO sensor*	0 to 100 up to 4000 ppm in 50 ppm steps or 0 to 100 up to 5000 mg/m3 in steps of 50 mg/m^3
O_2 sensor*	0 to 5% up to 25%
High CO sensor*	0 to 100000 ppm or 0 to 125000mg/m^3
Composite output*	0 to 100000 ppm or 0 to 125000mg/m^3
Resolution	1 ppm / 1 mg/m^3
Linearity	< 2 % of range
Zero drift	< 2 % of range per month
Span drift	< 2 % of range per month

Input and Output Connections

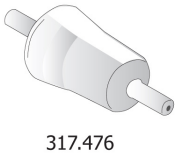
Analogue Outputs	*4 x isolated current loops: Low CO, O_2, High CO and Composite CO level **One isolated current loops for CO level 0, 2 or 4 mA to 10 to 20 mA
Relay outputs	CO level alarms: *Low CO Sensor mid point and high *High CO sensor mid point and high *O_2 sensor high point **CO level alarms: mid point and high, O_2 high System OK Calibration/Maintenance Isolated change over SP 1 A at 240 V a.c.

* Millwatch / Silowatch (CO single stream, including High-CO)
**Silowatch (CO + O_2 single stream

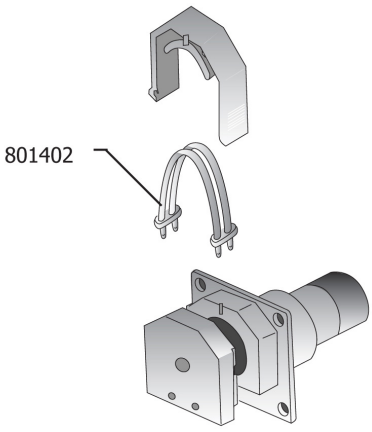
20 Spare Parts

Part Number	Description	Quantity
802769	**Two Year Spares Kit - Single Stream Millwatch/Silowatch**	
317.476	Gas filter	6
801346	Membrane Disc Filter	3
801402	Twin Autoprene Tube Assembly	3
317.553	Replacement Pump Head	3
317.552	Replacement Viton Diaphragm	1
801387	Air Pump (Linear)	1
807478	**Fuse and Fittings Kit - Millwatch/Silowatch**	
404.516	Fuse 2A Fast blow	2
404.535	Fuse 5A Anti-Surge (T)	2
404.541	Fuse 2.5A Anti-Surge (T)	2
317.007	Tubing Nut 1/4 in Tube	5
317.009	Tubing Sleeve 1/4 in Tube	5
318.280	1/4 in Stainless Steel Nut (Swagelok)	2
318.281	1/4 in Front Ferrule (Swagelok)	2
318.282	1/4 in Back Ferrule (Swagelok)	2

801691	Blow-back unit (for standard line)
801692	Blow-back unit (for antifreeze line)
801387	Air pump
801373	Cooler assembly
801401	Peristaltic pump
317.476	Disposable Filter
801854	Gas pump assembly
801399	Flow sensor PCB assembly
703.630	Gas pump assembly
099.392	Sample probe assembly
321.005	Anti-abrasion shield
321.006	Tubular stainless steel probe filter
809926	Spare gasket kit for Sample Probe 099.
306.047	Nylon sample tube
702.818	Dual CO detector cell unit (Low CO)
808 415*	Dual CO detector cell unit (High CO)
702.502*	Dual O2 detector cell unit
703.630	Pump assembly
805093	Main PCB
810163	Microprocessor board
805097	Current loop output module
317.101	Pressure switch
317.473	Flow meter
702.424	Sample probe 500 mm
702.759	Sample probe 1500 mm

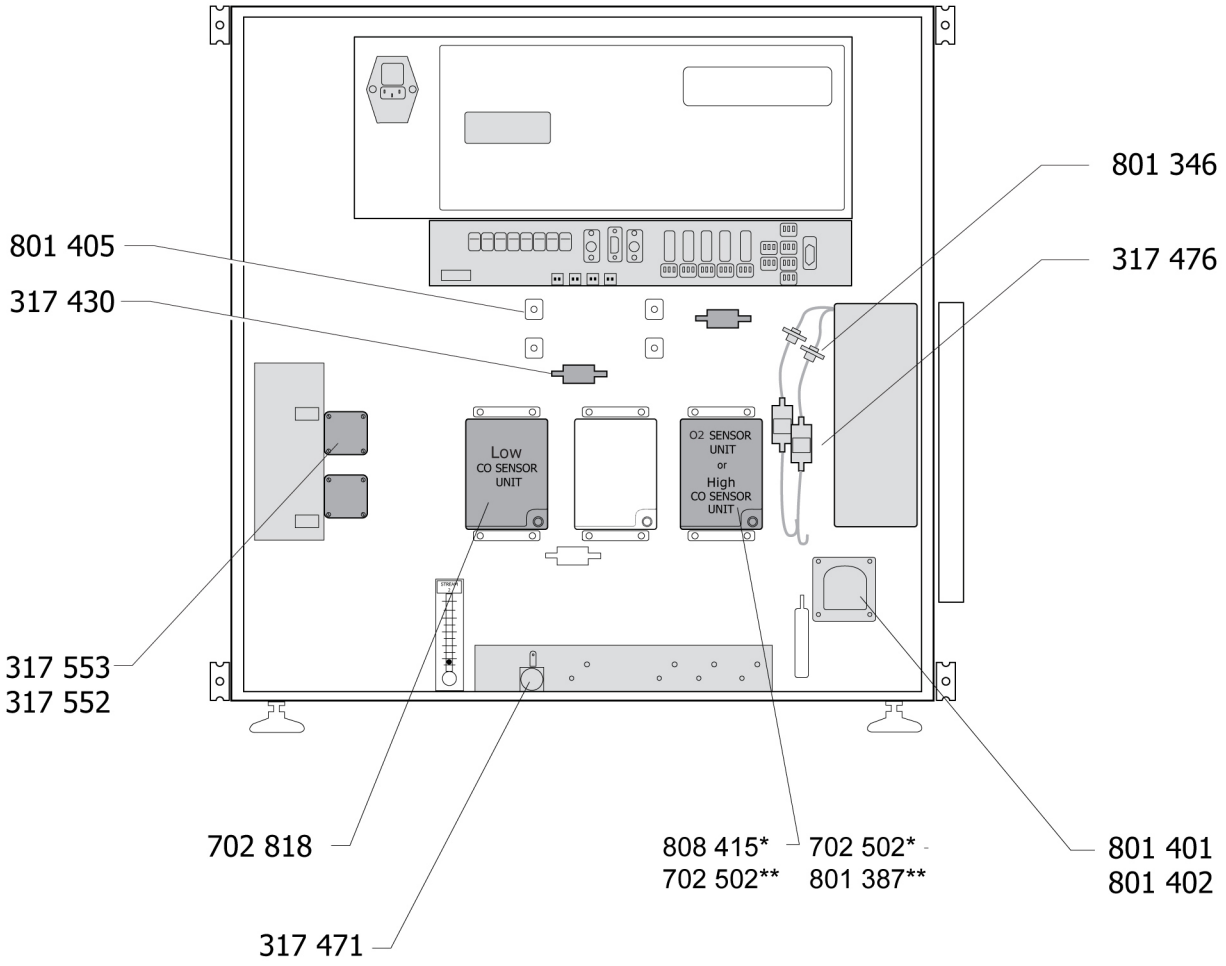


317.476



* Millwatch / Silowatch (CO single stream, including High-CO)

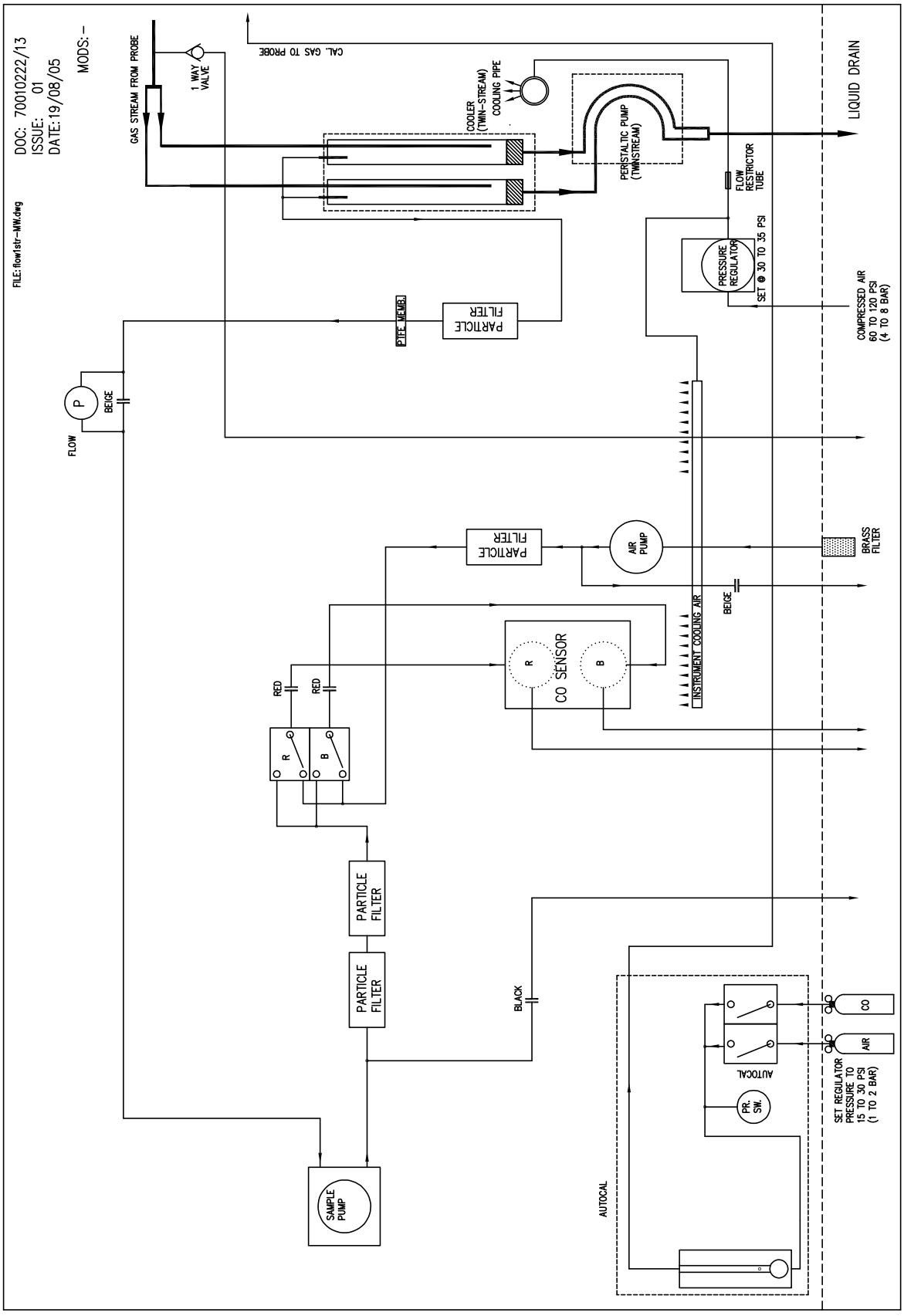
20.1 Location of Spares



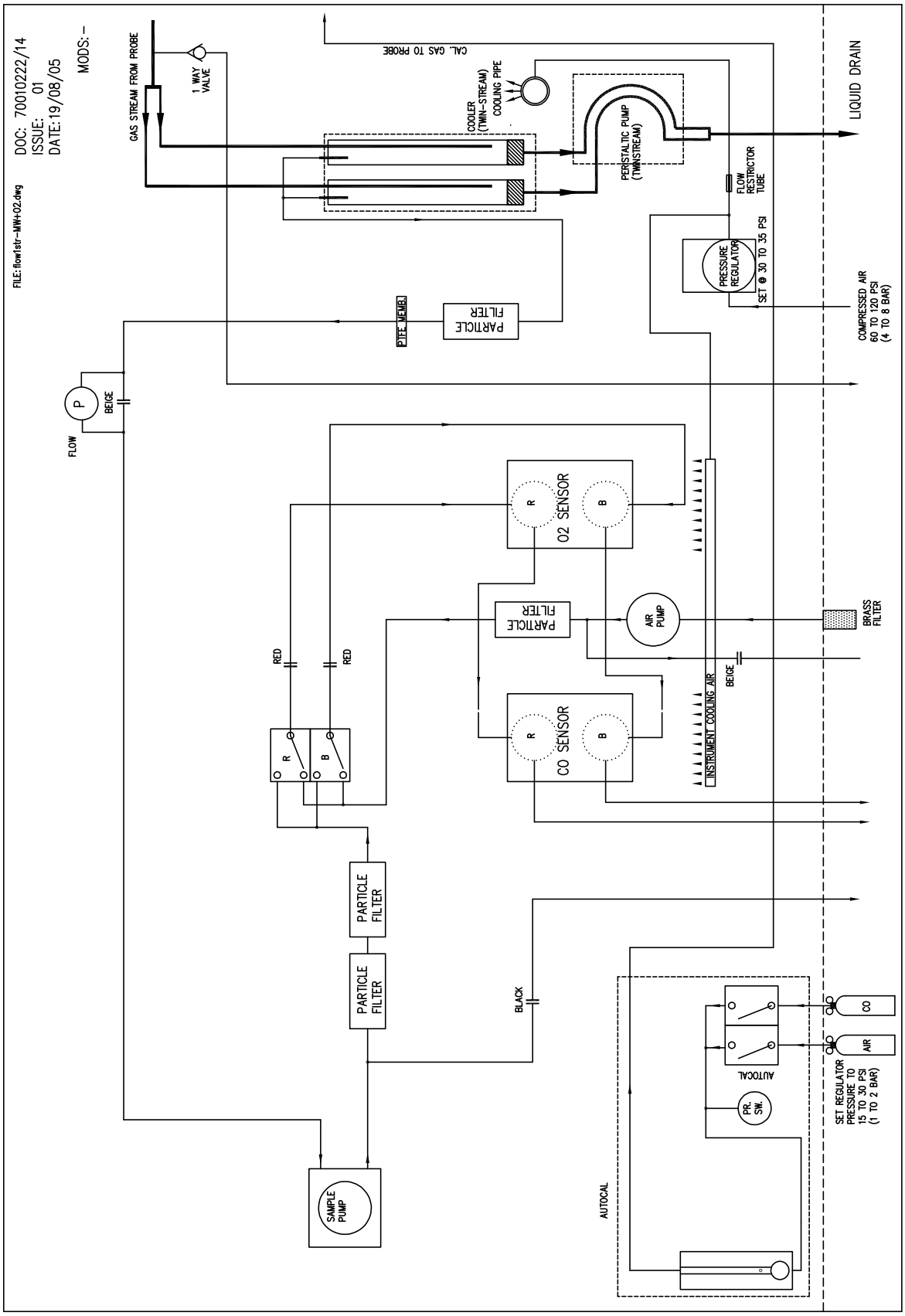
* Millwatch / Silowatch (CO single stream, including High-CO)
**Silowatch (CO + O2 single stream)

20.2 System Flow Diagrams

20.2.1 Millwatch / Silowatch (CO single stream, including High-CO)



20.2.2 Silowatch (CO + O_2 single stream)



21 Calibration

Regular calibration is essential to maintain the accuracy of the CO measurement, and also to demonstrate that the sensor is functioning correctly. The choice of calibration interval needs to balance a number of factors:

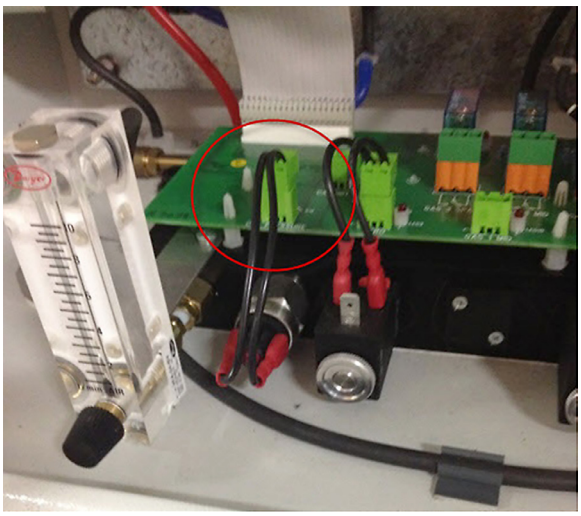
- Frequent calibration gives the best accuracy and reliability:
- The analyzer is not measuring sample during calibration, so it is unable to perform its early warning function. Therefore frequent calibration reduces the safety coverage offered by the Millwatch or Silowatch analyzer;
- Calibration gas is expensive and frequent calibrations consume a significant amount of gas;
- If the calibration gas is not permanently connected to the instrument, an operator must go to the instrument and connect the gas cylinder.

In most cases, a calibration interval between 1 day and 7 days gives good results.

21.1 Automatic Calibration - Quick Start

Although a number of detailed calibration options can be selected, the following procedure is sufficient for most calibration requirements.

1) Check the display does not show "Zero calibrating" or "System Settling". You must wait until those have been completed before calibrating.
2) Press CAL
3) Set entry code 4 then press CAL
4) Check cursor is on the top line (AUTO CAL)
5) Press CAL
6) In the next screen, press "SETUP" to change the value on the top line and press SETUP again to save it. Set the following parameters:
   a) Type: Manual
   b) GAS1 SETTLE: 300
   c) GAS1 SPAN: Cal gas concentration for first cal gas
   d) GAS3 SPAN may also be required
   e) CAL METHOD: 2 POINT
7) Press CAL to begin calibration
8) Display should show AUTO CALIBRATING on the bottom line
9) If the system aborts the calibration after a few seconds, check the cal gas pressure. If the pressure switch on the calibration module is not active, the instrument will abort the calibration. As a diagnostic, in case the pressure switch is not functioning, place a jumper wire across the terminals (circled).



22 Preventative Maintenance

22.1 Maintenance Relay

Before starting work switch on the maintenance relay.

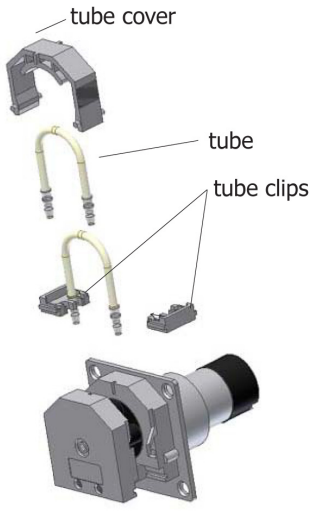
MAINT > ON.

Procedure	6 Months	2 Years	3 Years	Part Nº
Inspect the monitor for damage or corrosion	✓			
Check air and gas pressure flows	✓			
Open the door and check for signs of corrosion or leaks	✓			
MILL PROBE				
Check the probe filter. Clean or replace if necessary	✓			321.006
Check the probe abrasion shield. Replace if necessary	✓			321.005
Check the sample probe gaskets. Replace if necessary	✓			809926
Change sample and air filter	✓			317.476
Change PTFE membranes	✓			801346
Check the sensor co-efficients. If greater than 15,000 replace he sensor	✓			
Change peristaltic pump tube	✓			801402
Change sample pump head	✓			317.553
Change sample pump diaphragm		✓		317.552
Replace the peristaltic pump			✓	801401
Replace air pump		✓		801387

22.2 Changing the Peristaltic Pump Tube

1) Isolate the power supply.
2) Remove the tube cover.
3) Slide out the tube clips and remove the tubes.
4) Insert the new tubes into the clips.
5) Slide in the clips and replace the cover.

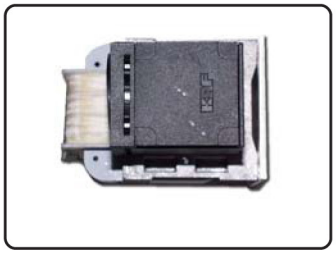
Make sure the cover clips back into the correct position and ensure the pump operates in the correct direction.

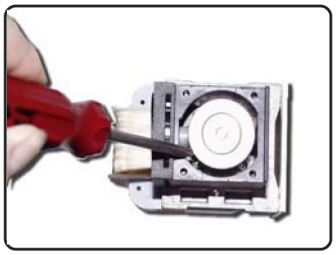


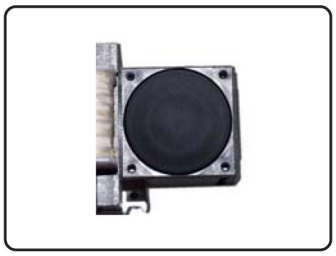
Part number 317.553

22.3 Replacing the Pump Head

1) Isolate the monitor.
2) Remove the gas sample pipes.
3) Remove the screws from the pump head assembly.
4) The pump head is replaced as one unit.







Part number 317.552.

22.4 Replacing the pump diaphragm 317.552

1) Isolate the monitor.
2) Remove the sample gas pipes.
3) Remove the pump head.
4) Use a flat bladed screwdriver to remove the cover.
5) Retain the gasket.
6) Push the cam wheel to the position where the diaphragm begins to work free from the housing.
7) Secure the wheel with a screwdriver.
8) Slowly unscrew the diaphragm from the assembly. Ensure all of the washers are retained.
9) Fit the washers to the replacement diaphragm.
10) Screw the replacement diaphragm into place.
11) Refit the protective pump cover, the pump head assembly and the gas sample pipes.
12) Switch on and check that pumps operate, and that air is being expelled through both bleed ports in the bottom of the enclosure.
13) Switch on the monitor and check that the pumps operate. Air is being expelled through both bleed ports in the bottom of the enclosure.

22.5 Changing a Sensor Unit

1) Isolate the power supply to the monitor.
2) Uncouple the sensor electrical input connector (on the electronics panel).
3) Remove the tubing for the air and gas feed pipes (on the sensor unit).
4) Remove the 4 nylon securing pillars.
5) Remove the sensor unit from its mounting.
6) Lift out the old sensor unit.
7) Mount the new sensor unit.
8) Refit the 4 nylon pillars.
9) Refit the air and gas pipes.
10) Reconnect the sensor unit electrical input.
11) Calibrate the monitor.

Appendix 1 Parameter Record Sheets

Use the tables below to record your parameter settings.

Unit			
Parameter	**Actual Setting**	**Units**	**Description**
ALARM 1		ppm	Sensor 1 alarm level.
ALARM 2		Percent	O2 alarm level.
O/P 1 MIN		mA	Minimum current for sensor 1 gas current loop O/P.
O/P 1 MAX		mA	Maximum cureent for sensor 1 gas current loop O/P.
O/P 1 SPAN		ppm	Sensor 1 gas full scale O/P.
O/P 1 DAMPER		6 secs	Sensor 1 gas current loop O/P response time.
O/P 2 MIN		mA	Minimum current for O2 current loop O/P.
O/P 2 MAX		mA	Maximum cureent for O2 current loop O/P.
O/P 2 SPAN		Percent	O2 full scale O/P.
O/P 2 DAMPER		6 secs	O2 current loop O/P response time.
O/P 4 MIN		mA	Minimum current for NOx current loop O/P.
O/P 4 MAX		mA	Maximum current for Nox current loop O/P.
1 RED COEFF 1			Span calibration constant for sensor 1 on red channel.
1 RED COEFF 2			Mid-Point calibration constant for sensor 1 on red channel
1 BLUE COEFF 1			Span calibration constant for sensor 1 on blue channel.
1 BLUE COEFF 2			Mid-Point calibration constant for sensor 1 on blue channel
PUMP INTERVAL		minutes	Minutes between drain pump operations.
BLOW BACK INTERVAL		minutes	Minutes between purge intervals.
FUEL			Fuel type selection.
EFF. O/P			Selects output for O/P 4 as efficiency loss.
FUEL 1 k1			Calculation constant (k1) for Fuel Type 1.
FUEL 1 k2			Calculation constant (k2) for Fuel Type 1.
FUEL 1 CO MAX			Stoichometric value of Fuel Type 1.
FUEL 2 k1			Calculation constant (k1) for Fuel Type 2.

Unit			
Parameter	**Actual Setting**	**Units**	**Description**
FUEL 2 k2			Calculation constant (k2) for Fuel Type 2.
FUEL 2 CO MAX			Stoichometric value of Fuel Type 2.
FT MIN		DegC	Minimum value for the flue temperature CLIP.
FT MAX		DegC	Maximum value for the flue temperature CLIP.
FT ZERO		mA	Minimum current for the flue temperature CLIP.
AMB MIN		DegC	Minimum value for ambient temperature CLIP.
AMB MAX		DegC	Maximum value for the ambient temperature CLIP.
AMB ZERO		mA	Minimum current for ambient temperature CLIP.
UNITS			Units used for gas concentrations.
O2 NORM			O2 normalisation applied.
O2 REF			O2 reference value for normalisation.
WET ANALYSIS			Wet analysis applied to gas concentrations.
WATER			Water vapour concentrations for wet analysis.
CO2 COMP			CO2 factor for O2 compensation.
SHOW NEGATIVE			Allows display and output of negative values.
ENTRY CODE			Allows new code to be entered.
BLOW BACK			Manually purge the probe.
SET CLOCK	N/A		Allows system clock to be set.
CLEAR FAULTS	N/A		Clears fault flags (Ongoing faults remain flagged).
RESTORE CONST.	N/A		Restores the previous calibration constant settings.
OUTPUT CO2			Allows CO2 to be output on current loop O/P 4.
The following information is found under "System Data". CO Span Constants can be changed in the Setup.			
CO Span Constants			
	RED CELL		BLUE CELL
O2 Span Constants			
O2 Span Constants can only be changed with a calibration.			