Instruction manual
MTL gas analysers & systems

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CROUSE-HINDS SERIES

KK650

MTL hydrogen and chlorine gas analyser

Powering Business Worldwide

DECLARATION OF CONFORMITY

A printed version of the Declaration of Conformity has been provided separately within the original shipment of goods. However, you can find a copy of the latest version at -

http://www.mtl-inst.com/certificates

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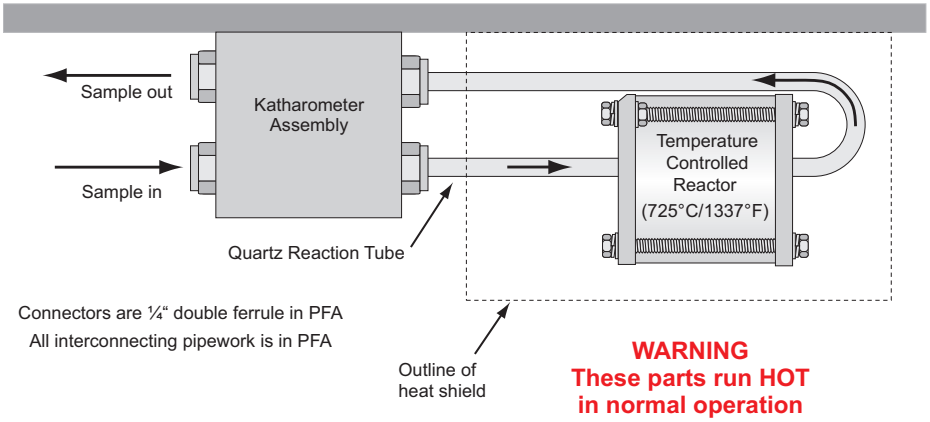
1 INTRODUCTION

The KK650 measures hydrogen in the ranges 0 to 5% or 0 to 10% (depending on the model), and also chlorine in the range 0 to 100%, when these gases are mixed with air. It is designed specifically for the chlor-alkali industry. Chlorine is usually manufactured by the electrolysis of brine (sodium chloride) or potassium chloride. This process also produces hydrogen and a small quantity is found in the chlorine stream. Larger quantities can indicate failure of a mercury cell, diaphragm or membrane and lead to potentially fatal explosive mixtures of hydrogen and chlorine!

The complete analyser comprises two separate parts, the sensor/reactor and the control/display electronics, which are linked by multi-core cables.

1.1 The katharometer sensor

This comprises two thermal conductivity measurement sensors and a sealed reference sensor. These are mounted together in one encapsulated assembly, which ensures that the sample gas comes into contact only with materials that are chemically inert. The katharometer assembly is mounted on a PVC panel along with its associated temperature controlled reactor.



1.2 The control/display electronics

These are housed in a separate IP66 enclosure containing the supply and signal processing for the katharometer, along with the power supply and controller for the reactor. Hydrogen and chlorine concentrations are displayed together with the reactor temperature and status. Analogue outputs and volt-free contacts are also provided, depending on the options chosen – see specification.

1.3 How it works

First, the thermal conductivity of the plant sample, as delivered, is measured. Next the sample is passed through a heated reactor tube where the hydrogen is reacted with the excess of chlorine (the hydrogen reacts preferentially with the chlorine and not with the oxygen within the sample). This mixture, now comprising chlorine, air and hydrogen chloride, is passed through the second sensor. The difference in thermal conductivity between the first and second measurement is a direct function of the hydrogen content, which the instrument calculates.

A measurement of thermal conductivity can only be used to interpret concentration where the change of only one component affects the sample's thermal conductivity, but measuring the hydrogen content in the way that we do means that the thermal conductivity measurement of the chlorine, hydrogen and air mix can be corrected for hydrogen content. This then enables the chlorine to air ratio to be calculated and hence the chlorine concentration.

The KK650 relies on the hydrogen reacting with chlorine or oxygen in order to measure it, consequently it is not able to measure hydrogen in any other type of gas mixture, e.g. hydrogen in nitrogen. However, other analysers are available for this type of duty.

Thermal conductivity measurements are not affected to a great extent by pressure fluctuations of a few centimetres (or inches) W.G. For optimum accuracy the process gas sample should be flowed at 350ml/min. (100ml/min = 0.212cuft/hr).

1.4 Manual symbols

The following methods are used in this manual to alert the user to important information:-

WARNING

Warnings are provided to ensure operator safety and MUST be followed.

CAUTION

A Caution is provided to prevent damage to the instrument.

NOTE

These are used to give general information to ensure correct operation

1.5 Information

Waste Electrical and Electronic Equipment directive (WEEE) 2002/96/EC

(RoHS) directive 2002/95/EC

WARNING

This equipment must only be used in accordance with the manufacturer's specification, instructions for installation, use and maintenance to ensure that the protection of the operator is not impaired. It is the responsibility of the installer to ensure the safety and EMC compliance of any particular installation.

2 SPECIFICATION

Two instrument range options are available. See below.

2.1 Ranges

		Ranges	Gas mix	Display resolution
Option 1	Range 1	0…5% max.	H_2 in Cl_2 and background gas	0.01%
	Range 2	0…100%	Cl_2 in H_2 and background gas	0.1%
Option 2	Range 1	0…10% max.	H_2 in Cl_2 and background gas	0.01%
	Range 2	0…100%	Cl_2 in H_2 and background gas	0.1%

2.2 Stability

Better than 1% f.s.d. over the operating temperature range

Better than 1% f.s.d./month

2.3 Accuracy

±1% f.s.d. or ±2% f.s.d. depending on calibration method

2.4 Repeatability

Better than 1% f.s.d.

2.5 Sample flow

Between 100 to 400 ml/min

2.6 Sample temperature range

0°C to +60°C (non-condensing)

2.7 Sample pressure

Atmospheric (nominally) - set by vent pressure

Maximum pressure - 1 barg

2.8 Ambient operating temperature range

Katharometer/Reactor: +5°C to +55°C

Electronics: +5°C to +45°C (0-90% R.H. non-condensing)

2.9 Storage temperature range

0°C to 55°C (0-90% R.H. non-condensing)

2.10 Displays

Instrument:4 line L.C.D.

Reactor controller:4 digit L.E.D.

2.11 Analogue outputs

4 to 20mA – programmable as follows:

	Range	Gas measured	Low End	High End
Option 1	Range 1	H_2	4mA equiv. to 0%	20mA equiv. to 1.00%…5.00% - user adjustable
	Range 2	Cl_2	4mA equiv. to 0%	20mA equiv. to 100% - fixed
Option 2	Range 1	H_2	4mA equiv. to 0%	20mA equiv. to 2.00%…10.00% - user adjustable
	Range 2	Cl_2	4mA equiv. to 0%	20mA equiv. to 100% - fixed

Maximum load resistance on outputs: 600 ohms

2.12 Fault indicator outputs

Two fault-indicating relay outputs are provided:

1. Instrument status
2. Reactor status ±10°C of set point.

Both are volt-free SPDT relay contacts rated at 30V AC or DC, 0.5A. The "no-fault" condition is NC - see Figure 6.

2.13 Concentration alarms

Two user-configurable Alarm outputs are provided:

1. Programmable alarm for Cl_2
2. Programmable alarm for H_2

Both are volt-free SPDT relay contacts rated at 30V AC or DC, 0.5A. The "no-alarm" condition is NC - see Figure 6.

2.14 Speed of response

T90: 30 seconds typical

2.15 Power requirements

Voltage: 99...132V or 198…264V AC, 50/60Hz

Power: 80VA

2.16 Electronics unit

Mounting:	Wall mounting case
Dimensions:	650mm (H) x 450mm (W) x 250mm (D) - without glands
Materials:	Polyester enclosure - (IP66 rating when door is closed and with suitable cable glands)
Net weight:	20 kg (nom.)

2.17 Katharometer/reactor unit

Mounting:	Wall mounting
Dimensions:	150mm (h) x 240mm (w) x 115mm (d) including heat shield
Katharometer Cable:	2 metre length provided - cable must not be extended or certification is affected.
Net weight:	3 kg (nom.)

3 INSTALLATION

WARNING

The weight of this equipment is in excess of 18kg, and the use of mechanical handling equipment or assistance from additional personnel is recommended when handling and mounting.

3.1 Unpacking and visual checking

Take all standard precautions when opening packages. In particular avoid the use of long bladed cutters. Search packing before discarding it and make sure that all of the components are removed. Check that all pipe connections have captive seal nuts.

3.2 Mounting

The analyser is supplied as two separate parts – the panel mounting katharometer/reactor assembly and the control electronics in its own environmental enclosure. The enclosure is un-drilled but is supplied with suitable cable glands. The user may therefore choose the cabling arrangement and drill holes in the enclosure to suit the application.

3.3 Electrical connections

Terminal blocks are provided in the lower part of the enclosure. See diagrams and labels for details.

WARNING

This instrument must be installed with a disconnecting switch close to it, within easy reach of the operator and compliant with the relevant parts of IEC 60947-1 and IEC 60947-3. It must be marked to indicate this function and show ON and OFF positions. Wiring should conform to local codes.
Only the live conductor has an internal equipment fuse. European regulations recommend that fuses be fitted in both the live and neutral of the mains supply to the instrument.

NOTE

The Relay operation and labelling 'Normal' relate to "process normal" and not the electrical rest position of the relays, In process normal the relays are energised.

3.4 Installation requirements for EMC

To ensure compliance with the European EMC directive certain installation precautions are necessary as follows:

3.4.1 Routing of wires

To minimise the pick-up of electrical noise all signal wiring should be shielded and routed away from power cables and sources of strong magnetic fields.

3.5 Sample conditioning

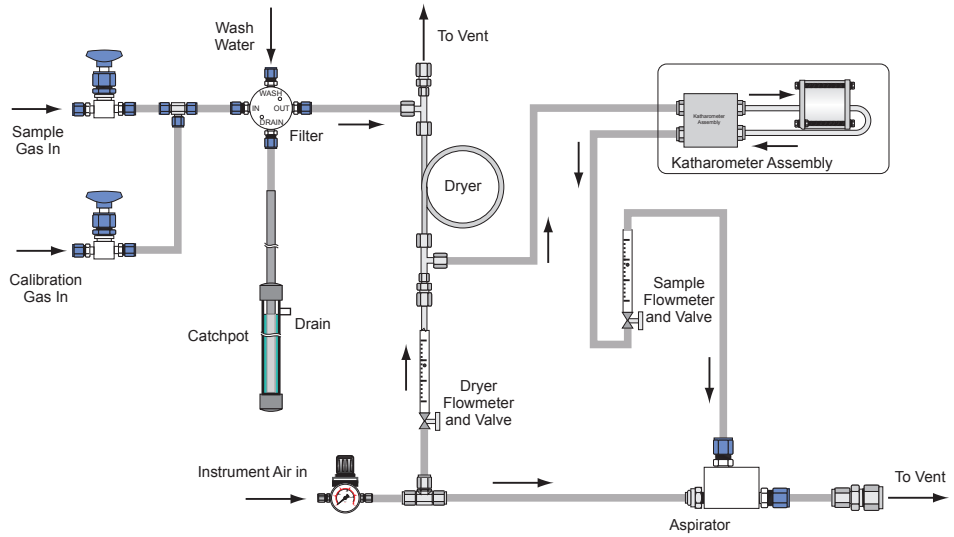
It is essential that the sample is dried to a water dew point of –10°C (14°F) or lower because water will react to some extent with the chlorine as the sample passes through the reactor. The reaction produces oxygen and hydrogen chloride and the effect of the oxygen appearing in second measurement sensor causes the hydrogen value to be reported lower than its true value. This is a slow reaction and its extent is dependent upon the sample flow rate and the reactor temperature.

NOTE

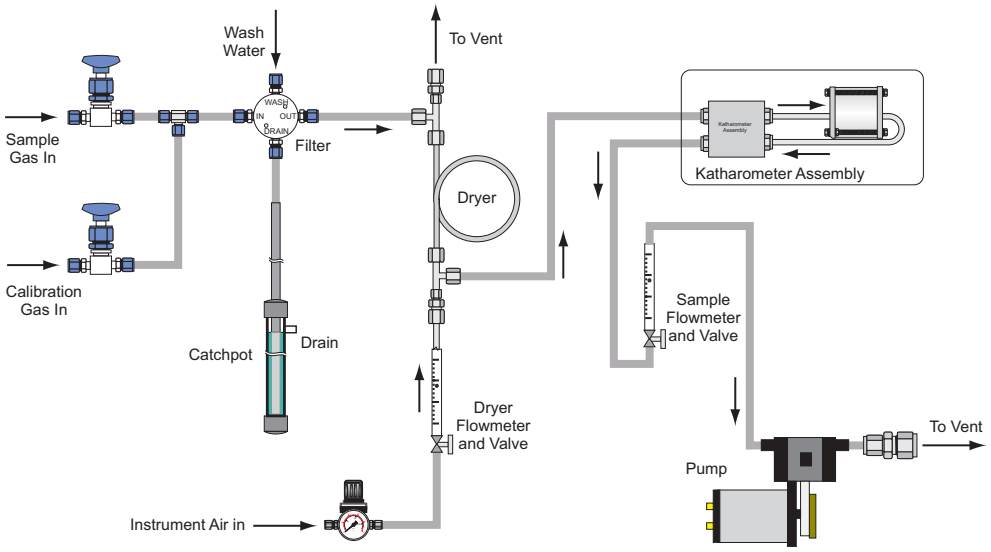
Care must be taken to ensure that the tubing etc, carrying the sample from the take-off point to the katharometer entry is completely obscured from any light, otherwise the analyser will report a lower hydrogen concentration for the sampled process gas. This fact would of course be true for any other thermal conductivity analyser performing this measurement.

Perma Pure dryers have been found to be very effective in drying the sample. Two optional configurations of these are shown below- a) aspirated or b) pumped. System designers and installers should consult Perma Pure for detailed advice before installing any system. (www.permapure.com)

a) Sample conditioning - Aspirated version



b) Sample conditioning - Pumped System



3.6 Katharometer/reactor assembly

This is shown below. It must be mounted upright as shown, in an ambient that is between 5°C and 55°C and not subjected to excessive vibration.

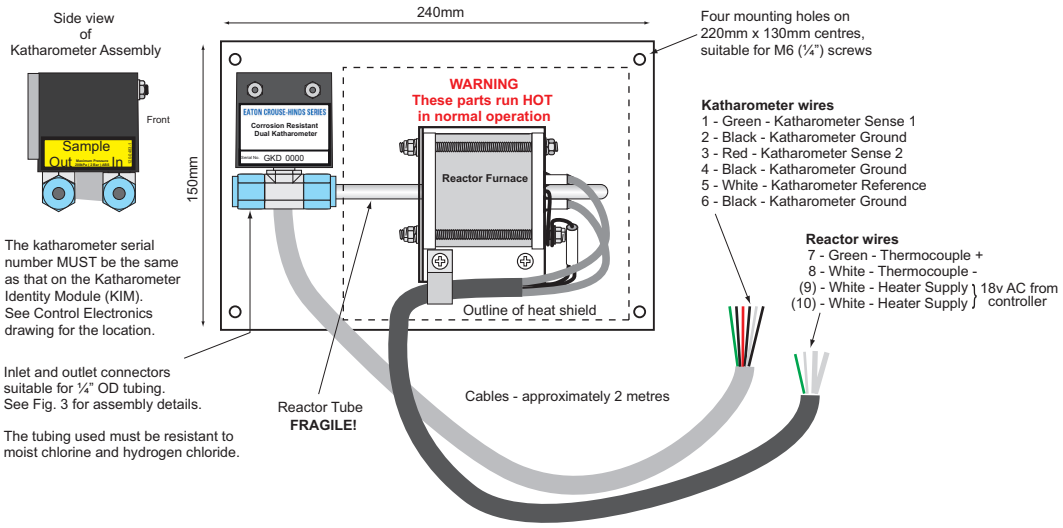


Figure 2

The katharometer's inlet and outlet connections are suitable for ¼" dia. tubing. Any tube attached to these must be capable of resisting moist chlorine and hydrogen chloride mixtures. If PFA tubing or similar is fitted then it should be grooved using the appropriate tool - obtainable from Swagelok (order code MS-GC-4) or from your local MTL Gas sales office. Grooving the tube is an enhancement and is not essential at the stipulated maximum pressure of the device. Note that to achieve an adequate seal the PFA (perfluoroalkoxy) coupling nuts must be tightened down to their end-stops, and then until the hexagons sides of the nut and fitting line up – See Fig. 3. Always support the body of the coupling with another tool when tightening.

If an alternative to PFA tubing is used in the compression fitting then it must be sufficiently rigid so as to prevent collapse when the nut is fully tightened. To prevent the possibility of 'flash backs' if exceptional hydrogen concentrations are experienced, it is advisable to fit flame traps at the sample inlet and outlet. Do not pressurise the katharometer assembly to greater than 1 barg (i.e. 1 bar gauge) i.e. no more than 0.1 MPa or 15 p.s.i.g.

When in measurement mode the internal katharometer pressure must be within ± 0.1 barg for measurement accuracy.

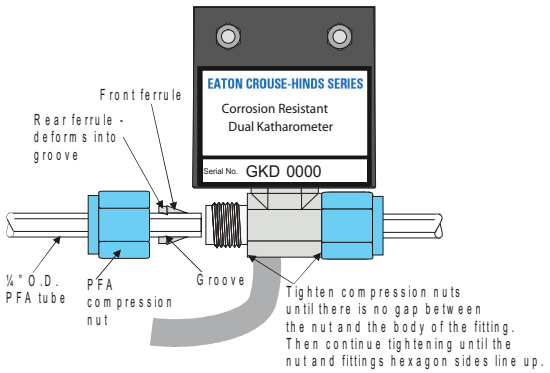


Figure 3

3.6.1 Control electronics

The control electronics are contained within the main enclosure together with the main display and reactor temperature readout. The enclosure must be mounted where the ambient temperature is maintained between 5°C and 45°C and where it will not be subjected to excessive vibration or direct sunlight, with subsequent heating.

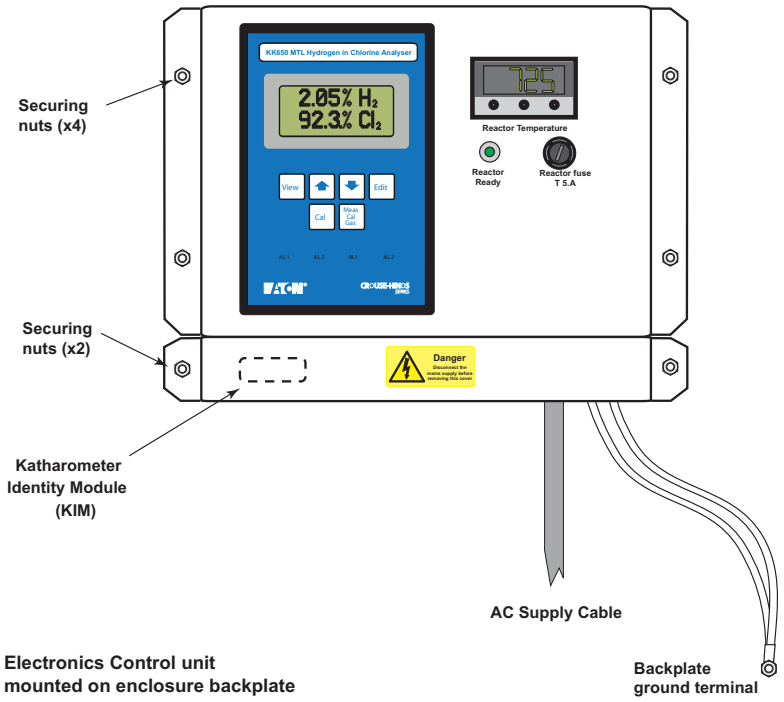


Figure 4

All electrical connections including the incoming AC power, are found in the lowest part of the enclosure, as can be seen in Figure 5 below.

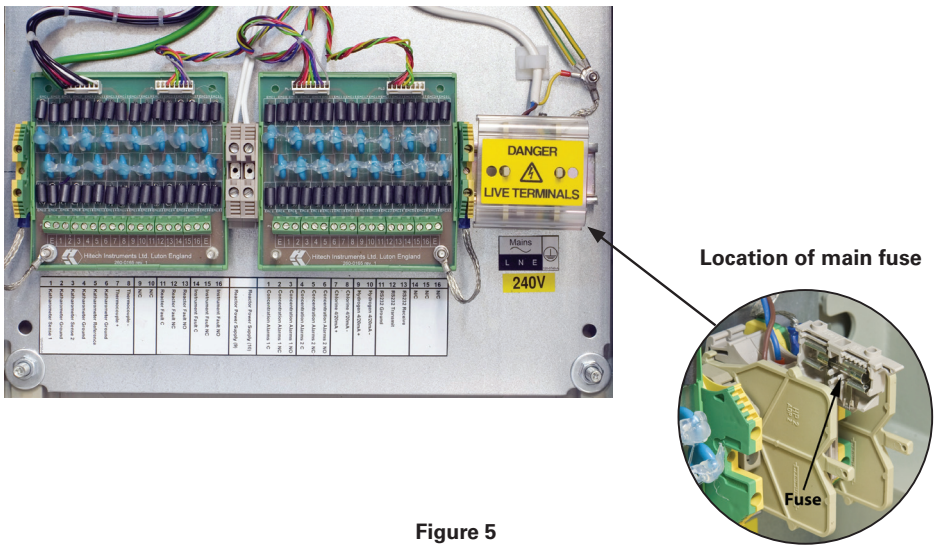


Figure 5

All low voltage connections are itemised on the white label below the connector terminals, see Figure 6 for details.

16	N/C
15	N/C
14	N/C
13	RS232 Receive
12	RS232 Transmit
11	RS232 Ground
10	Hydrogen 4/20mA –
9	Hydrogen 4/20mA +
8	Chlorine 4/20mA –
7	Chlorine 4/20mA +
6	Concentration Alarm 2 NO
5	Concentration Alarm 2 NC
4	Concentration Alarm 2 C
3	Concentration Alarm 1 NO
2	Concentration Alarm 1 NC
1	Concentration Alarm 1 C
	Reactor Power Supply (10)
	Reactor Power Supply (9)
16	Instrument Fault NO
15	Instrument Fault NC
14	Instrument Fault C
13	Reactor Fault NO
12	Reactor Fault NC
11	Reactor Fault C
10	N/C
9	N/C
8	Thermocouple –
7	Thermocouple +
6	Katharometer Ground
5	Katharometer Reference
4	Katharometer Ground
3	Katharometer Sense 2
2	Katharometer Ground
1	Katharometer Sense 1

Figure 6

The cables from the katharometer/reactor unit are identified by number tags that correspond to the terminal numbers on the label. The two heavier wires (labelled 9 and 10) in the black cable from the katharometer should be connected to the DIN-rail mounted terminals between the two carriers.

NOTE

The cables supplied with the katherometer and reactor assembly must not be extended because they form part of the product certification.

AC supply wiring should be connected to the L, N and E terminals underneath the "Live Terminals" warning label.

WARNING

Take care to ensure that AC power is not present on the wiring before removing the protective cover. Ensure also that the protective cover is replaced before AC power is re-applied to the wiring.

IMPORTANT POINTS TO NOTE

- It may be necessary later to remove the katharometer if it should become contaminated. Its connecting cable should therefore be routed to assist in its removal.
- Allow sufficient space around the katharometer/reactor assembly for withdrawal of the quartz reactor tube to the right.
- The electronics and any intermediate electrical junction boxes etc. must be mounted in a well ventilated area so that any fugitive corrosive gases do not contaminate these items.
- It is essential that the katharometer and its corresponding identity module (KIM), which is mounted in the control electronics unit, ***have the same serial number.***

4 OPERATION

4.1 First checks

It is advisable to make a thorough check of all connections – particularly the pipe work – before applying any sample.

WARNING

Chlorine is a highly toxic and corrosive gas and it is of utmost importance that there are no leaks. In particular, ensure that all unions are fully tightened and that the fragile reactor tube is not damaged.

4.2 Flowing the sample

With these checks complete, power may be applied to the instrument. Following the initialisation screen, the display will indicate that it is waiting for the reactor to reach temperature. When the correct operating temperature is reached, the analyser will enter normal measurement mode automatically. The sample may now be applied. A sample flow of between 100 and 300 ml/min is suggested, although flows up to 400ml/min may be applied. (100ml/min = 0.212cuft/hr)

Once the sample pipelines have been purged the instrument display will show the hydrogen and chlorine concentrations. A warm-up time of approximately 15 minutes after the reactor has reached its operating temperature should be allowed in order to obtain the best accuracy. The instrument is supplied fully tested and calibrated and may be used immediately.

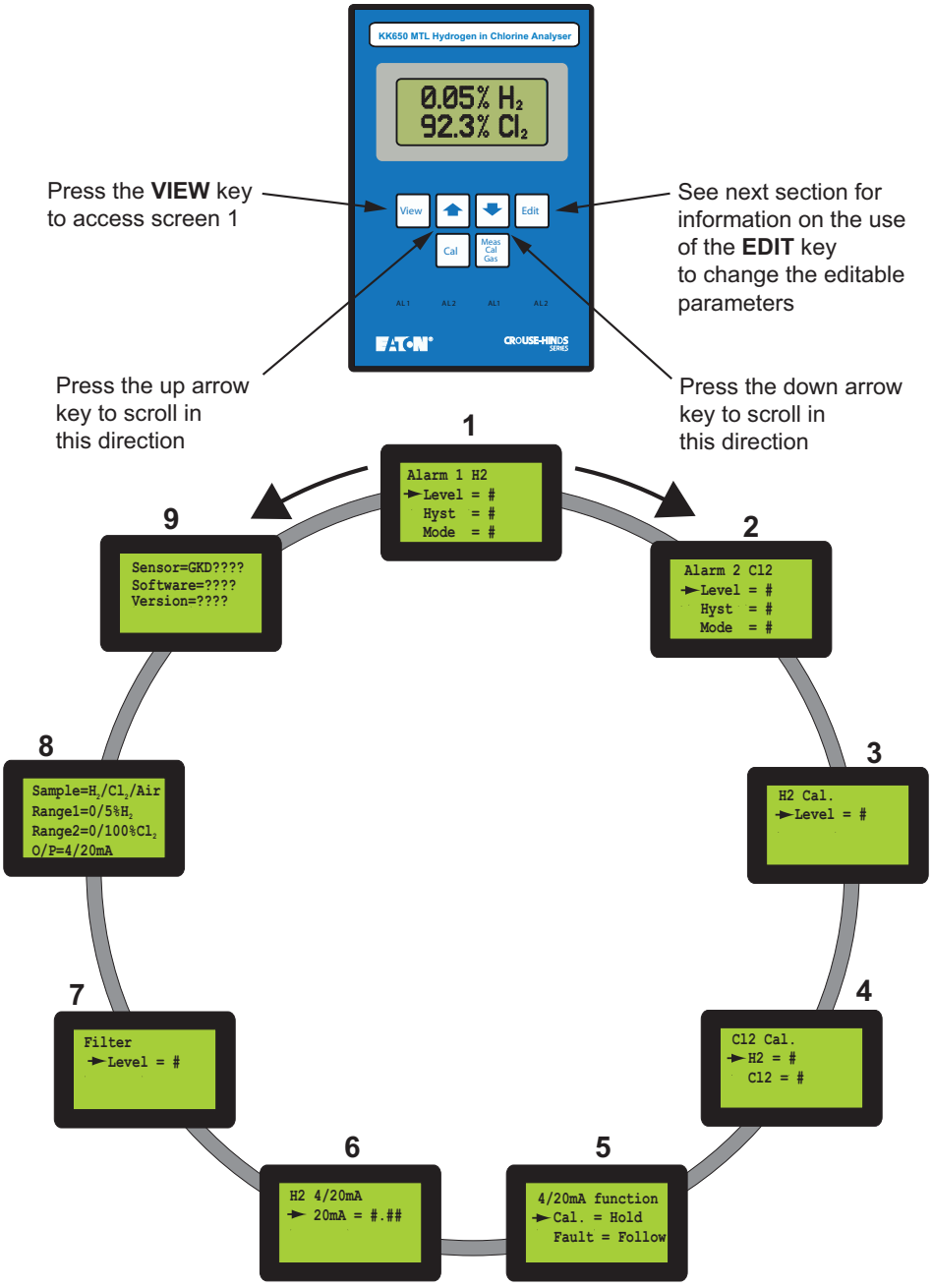
4.3 Configuring the analyser

This enables the user to step through a range of display screens and define (program) specific parameters, such as alarm levels, ranges, etc. The screens also provide data on the model and the software revision of the analyser. The following table describes the function and parameters available at each screen. There is also a diagram of the screen levels followed by a description of how to set the parameters.

4.3.1 Parameters

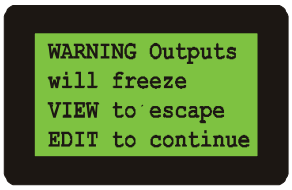
Screen	Function	Parameter	Description
1	Alarm 1 (Hydrogen Concentration)	Alarm Level	Adjustable from 0 to 5% or 0 to 10% (model dependant) in 0.01% steps
		Hysteresis	Adjustable from 0 to 2% of span in 0.01% steps
		Alarm Mode	Can be set to High, Low or Off
2	Alarm 2 (Chlorine Concentration)	Alarm Level	Adjustable from 0 to 100% in 0.1% steps
		Hysteresis	Adjustable from 0 to 20% of span in 0.01% steps
		Alarm Mode	Can be set to High, Low or Off
3	Hydrogen Span Calibration Level	Level	Concentration level adjustable from 1.50 to 2.00% in 0.01% steps
4	Chlorine Span Calibration Level	H_2 Cl_2	NOTE: The facility to set the hydrogen concentration in this screen is to facilitate calibration on a plant sample when the hydrogen concentration is known from other analysers. If pure chlorine OR pure argon (the surrogate for chlorine) is used for chlorine span calibration, the hydrogen level in this screen MUST BE SET TO ZERO.
5	4/20mA function	Cal. Fault	Define the action of the analogue output, when the analyser is in calibration or fault conditions. Set either to Follow (track) the display or Hold the last value immediately prior to the condition occurring.
6	H_2 4/20mA	20mA	Set top H_2 scale value. Adjustable from 1.00% to 5.00% in 0.01% steps, or 2.00% to 10.00% in 0.01% steps. (model dependant)
7	Filter	Level	A digital filter to 'smooth' rapid display changes. Set level between 0 and 9 (represents factor of 0.0 to 0.9). Displayed change = Actual change x (1 – factor) e.g. Change of 50% up to 70% with Level = 5 would result in 20% x (1 – 0.5) = 10%; hence next display is 50 + 10 = 60%
8	Samples, ranges and output	–	Displays analyser type, ranges measurable, and type of output
9	Sensor & software	–	Displays sensor serial number, software and version data.

View mode configuration screens



4.3.2 Edit mode

To edit a value, start by pressing the **View** button to enter the screen choice level. Use the arrow buttons to step through each screen and its options. At the chosen parameter, press the Edit button at which point the following screen is displayed.



This is to warn that all outputs will be stopped at their current value if the user goes further. Before continuing, the operator must be sure that no plant malfunction or safety problems will occur due to the 'freezing' of the analyser outputs.

When Edit mode is entered, a flashing cursor will appear on the first digit that may be altered. The keys increment or decrement the digit. Once a digit is correct the next digit is selected by pressing the Edit key, and so on, until the final digit. To skip a digit, press the Edit key twice. When the Edit key is pressed on the final digit the display will show "Storing Data" momentarily and then return to view mode, displaying the new parameters and un-freezing the outputs.

If no keys are pressed for any 30 second period while in Edit mode an automatic time-out takes the instrument back into measurement mode and displays a screen to this effect. Any changes made during Edit mode prior to this are ignored and lost.

NOTE

When setting alarms the maximum hysteresis that can be set is 20% of the span of the particular channel. It is important not to set the hysteresis to a level greater than the alarm point otherwise the alarm will never reset.

The following is a summary of the function of the keys when in View and Edit modes.

View mode (block cursor not displayed):-

⇧	return to the previous parameter or screen
⇩	advance to the next parameter or screen
View	exit View mode and return to Measurement mode
Edit	displays warning screen - press again for edit cursor. See below

Edit mode (block cursor displayed):-

⇧	increment the digit under the cursor
⇩	decrement the digit under the cursor
View	exit Edit mode - return to View mode
Edit	advance to the next digit - or store entry (if the last digit has been changed) and return to View mode

5 CALIBRATION

5.1 General notes

Provided the katharometer does not become contaminated, instruments can be expected to hold their calibration repeatability to better than 0.02% hydrogen for a lengthy period. Chlorine accuracy varies according to air and hydrogen concentrations. In the 90 to 100% range it is approximately 0.5% going out to about 1.5% at lower concentrations with high hydrogen. If the ratio of oxygen to nitrogen varies then a small error is introduced into the chlorine measurement. For every 1% oxygen variation the apparent chlorine concentration is changed by 0.07% (higher oxygen gives higher chlorine).

5.2 Gases required

To avoid the need to handle hazardous gases, calibration may be performed using benign surrogate gases. The surrogate gases used are; 1.5 - 2% hydrogen in air (50% LEL mixture) as a substitute for hydrogen in chlorine, and 100% argon in place of chlorine.

Another, even more convenient, way to calibrate the chlorine span of the analyser is to use the process sample gas - assuming its composition is reliably known from other forms of analysis. Configuration Screen 4 (see configuration diagram in section 3), allows both the chlorine and hydrogen concentrations (see following Note) to be set for the gas used for calibration. For example, if the process sample analysis was 96% chlorine and 0.3% hydrogen, this is what would need to be entered in Configuration Screen 4.

NOTE

The hydrogen concentration set in Configuration Screen 4 is to enable the analyser to compensate for its presence when calibrating the chlorine span on process sample – it is NOT a part of calibrating the hydrogen span. The latter is performed using hydrogen in air and specifying the hydrogen concentration in Configuration Screen 3. The hydrogen concentration set in Screen 4 must be zero if pure gases (i.e. 100% chlorine or 100% argon) are used to calibrate the chlorine span.

The calibration process must be performed in the order of

1. Zero calibration (air)
2. Hydrogen span (2% hydrogen in air)
3. Chlorine span (100% chlorine, or 100% argon or process gas if analysis is known)

Air is the ‘zero’ gas, and is common to both surrogate and non-surrogate calibration processes. It is possible to calibrate using both surrogate and non-surrogate gases. So it is possible to zero on air, set the hydrogen span using hydrogen in air, and then set the chlorine span using either pure chlorine or argon, or the process gas if its analysis is reliably known and the hydrogen and chlorine concentrations are entered as described above. For best accuracy, pure chlorine should be used for setting the chlorine span.

NOTE

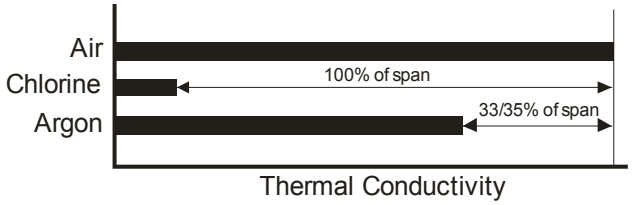
Hydrogen in chlorine mixtures can only be generated on-the-spot because they are unstable. Outside of the laboratory the practical difficulties of making these mixtures rule them out of being used.

continued on next page

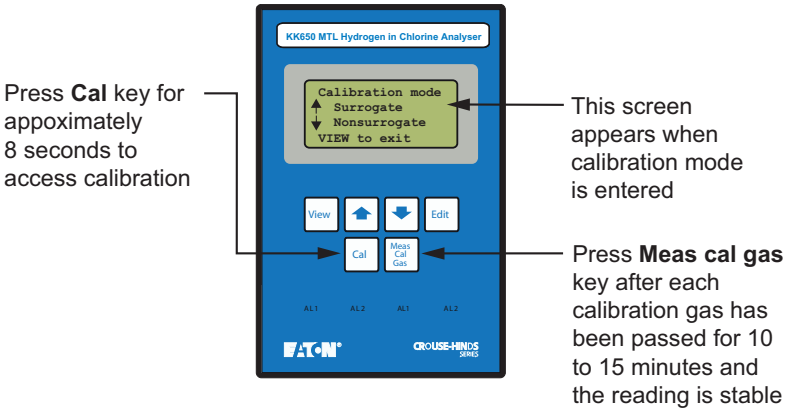
IMPORTANT NOTES

1. When calibrating, it is important to maintain a steady flow of calibration gas. For all gases, except the hydrogen in air mixture, flows of up to 400ml/min are acceptable. For hydrogen in air mixtures the flow must be limited to no more than 100ml/min (100ml/min = 0.212cuft/hr). This is because the reaction time of hydrogen with the oxygen in the air is somewhat slower than the reaction of hydrogen with the chlorine in the process gas. Its longer residence time in the reactor at the lower flow rate ensures complete reaction. Allow enough time for the sample system to be purged of each gas and for the instrument to stabilise between each gas by flowing each one for 10 to 15 minutes.

2. When using argon to calibrate chlorine span the calibration screen displays % argon. When returning to normal Measurement Mode from Calibration Mode with argon still flowing, the chlorine concentration displayed will be the argon equivalent for that particular katharometer. This figure varies from 33% to 35%. The precise point varies slightly from one katharometer to another, and the exact figure is a part of the katharometer's characteristics that are contained in the Katharometer Identity Module (KIM). This figure is used by the software to set the 100% chlorine point from the 100% argon point. The following diagram illustrates this graphically in terms of the thermal conductivities of the three gases.

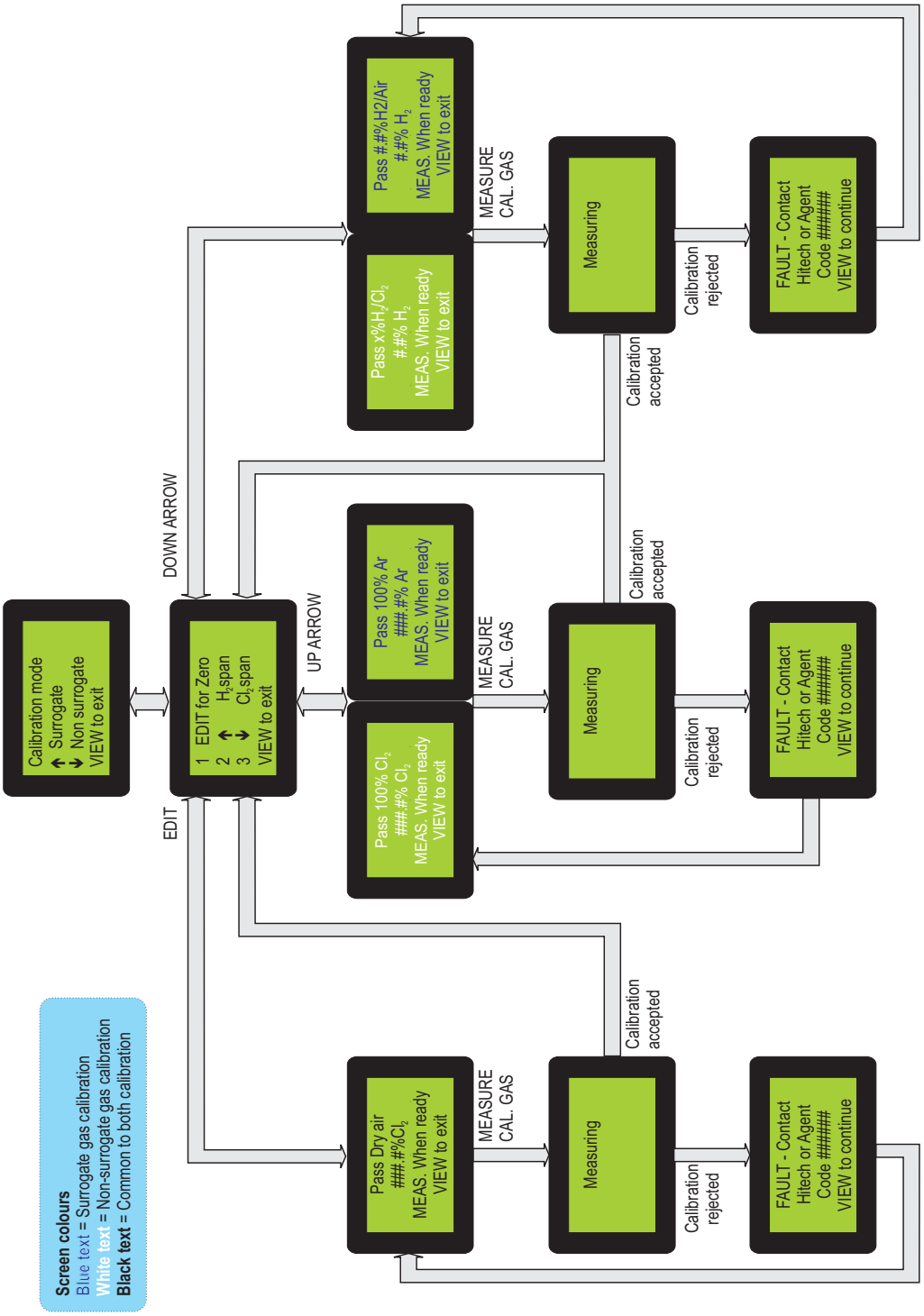


5.3 Calibration mode



Refer to calibration screen map on next page

Calibration screen map



6 SERVICE AND MAINTENANCE

6.1 General

In keeping with all of our products, the KK650 is a highly reliable analyser. If a fault is apparent on a new installation, the wiring, etc., should be checked thoroughly.

Similarly, if the instrument appears not to power up, ensure that a proper supply is in place and that the two fuses are intact. One fuse, for the reactor, is located on the front panel beneath the reactor temperature controller; and the other, for the entire instrument, is located behind the terminal cover plate.

WARNING

Take all necessary precautions when working on exposed A.C. mains terminals etc.

Only fuses of the type and rating shown here can be used to replace them.

Fuse	Rating	Type
Reactor fuse	5A, 48V minimum	Type 'T' (20mm x 5mm Ø)
Main instrument fuse	1.6A, 250V	

Apart from initial installation wiring errors etc., there are three potential causes of failure.

- Contamination of the katharometer through the breakdown of the sampling system.
- Contamination of the katharometer from accumulated carry-over after a prolonged period of operation.
- Incorrect calibration

The first two are normally picked up by the display of a fault code, the last is cured by a recalibration.

6.2 Fault codes

Fault code	Meaning
1	Vo1 has measured < (-)4093 A/D counts
2	Vo1 has measured > 4093 A/D counts
4	Vo2 has measured < (-)4093 A/D counts
8	Vo2 has measured > 4093 A/D counts
16	Vt has measured < -4093 A/D counts
32	Vt has measured > 4093 A/D counts
64	Vo1 offset is too low while performing zero calibration
128	Vo1 offset is too high while performing zero calibration
256	Vo2 offset is too low while performing zero calibration
512	Vo2 offset is too high while performing zero calibration
1024	Vo1 factor is too low while performing H2 span calibration
2048	Vo1 factor is too high while performing H2 span calibration
4096	Vo2 factor is too low while performing H2 span calibration
8192	Vo2 factor is too high while performing H2 span calibration
16384	Vo1 factor is too low while performing Cl2 span calibration
32768	Vo1 factor is too high while performing Cl2 span calibration
65536	Vo2 factor is too low while performing Cl2 span calibration
131072	Vo2 factor is too high while performing Cl2 span calibration
262144	Reactor temperature outside of ±10°C of set-point error band
524288	Cannot read the katharometer identity module

NOTE

The codes are additive. E.g. if a code of 5 was displayed it would mean that **Vo1** AD counts were less than (-)4093 and **Vo2** AD counts were less than (-)4093.

Vt is the internal voltage signal that indicates the katharometer's temperature

Vo1 is the internal voltage signal that is a function of the difference between the two katharometer sense signals at terminals 1-2 and 3-4 in Figure 6. It is used to calculate the hydrogen content.

Vo2 is the internal voltage signal that is a function of the katharometer sense signal at terminals 3-4. It is used to calculate the chlorine content.

6.3 Trouble-shooting chart

NOTE

It is assumed that the instrument and its installation have been checked for power supply health, integrity and correctness of wiring and mechanical damage.

If there is any doubt regarding interpretation of these instructions or the corrective actions to be taken, contact your local MTL Gas sales office for clarification.

KIM = Katharometer Identity Module (see photograph on next page).

SYMPTOM	POSSIBLE CAUSE	TEST	ACTION
Instrument appears to be "dead".	1. No power.	1. Check power on supply terminal.	1. Reinstate if necessary.
	2. Fuse blown	2. Check main fuse in AC power terminal block - see Figure 5.	2. Replace if necessary, check supply voltage is correct. If fuse blows again see next symptom.
	3. Internal connection failure.	3. Disassemble and check all connections.	3. Replace KK650 electronics – see section 7.9
Instrument repeatedly blows fuses.	1. Wrong supply voltage.	1. Check actual voltage supply with that shown on the analyser data label.	1. Contact your local MTL Gas sales office.
	2. Wrong value or type of fuse.	2. Check instrument data label for correct fuse.	2. Replace as necessary.
Fault code between 1 and 32 is displayed - see manual sec 5.2	1. Unexpected gas applied; e.g. high hydrogen content more than 60% over instrument range.	1. Pass air through the analyser.	1. Check to see if faults still exist, if not, check cause 2 then 3.
	2. Sensor contaminated.	2. Clean sensor as per sections 7.5/7.6	2. Check fault status, if OK recalibrate instrument.
	3. Electronics failure.	3. Replace electronics as per section 7.9	3. Recalibrate instrument.
Fault codes 64 to 131072 will only occur during calibration.			
1. Following a sensor change	1. Sensor and KIM are not matched.	1. Check that serial numbers match – see Fig. 4 in manual for location of KIM	1. Replace/exchange as necessary.
2. If these fault codes are displayed when KIM and sensor are known to match	2. Calibration gas incorrect or not flowed for sufficiently long.	2. Check gas - replace as necessary - and flow for at least 10 minuets at the correct flow rate - refer to calibration section in manual	2. Try to recalibrate instrument.
3. Fault code remains	3. Memory corrupt		3. Reset factory settings – see section 7.10.2 and try to recalibrate.
4. Fault code remains.	4. Sensor contaminated.		4. Clean sensor as per sections 7.5/7.6 and recalibrate.
5. Fault code remains.	5. Electronics failure.		5. Replace electronics assembly as per section 7.9

continued

SYMPTOM	POSSIBLE CAUSE	TEST	ACTION
Fault code 262144.	1. Reactor temperature outside spec.	1. Examine display of temperature controller for fault status – As per section 7.8	1. Replace controller and re-tune if necessary - contact your local MTL Gas sales office for instructions.
Fault code 524288	1. Electronics unit has failed to read the KIM.	1. Remove KIM, check connections and replace.	1. Check for fault code.
Fault code remains	2. KIM has failed.	2. Replace sensor and KIM.	2. Check for fault code.
Fault code remains	3. Communication error.	3. Replace electronics unit as per section 7.9	3. Contact your local MTL Gas sales office representative if fault code remains.
Concentration alarm relay outputs are not as expected.	1. User programmable alarm settings are incorrect.	1. Refer to manual to check alarm settings.	1. Adjust alarm settings as required.
Not all functions operate e.g. keypad problems, display failure, LED failure, etc.	1. Electronics unit has corroded connections.	1. Check/ clean connections on the backplane and in the electronics.	1. Ensure Chlorine is kept out of the enclosure.
	2. Display failed	2. Replace electronics as per section 7.9	2. Return faulty unit to your local MTL Gas sales office.

Katharometer Identity Module (KIM)

6.4 Checking the katharometer

The simplest way to identify a possible katharometer fault is to measure the volts appearing across the measurement elements.

6.4.1 Checking the voltage across the elements

With the instrument powered up, the voltage across each terminal pair 1 & 2, 3 & 4, 5 & 6, should be somewhere between 2.5 and 4.5 volts. If this is the case, and a fault code indicates some excessive voltage (A/D counts <>4095) then faulty electronics are indicated.

6.4.2 Checking the resistance of the elements

If a katharometer fault is indicated, disconnect its wires from the electronics and check the resistance across each measuring element using a low voltage resistance tester – **DO NOT USE A HIGH VOLTAGE INSULATION RESISTANCE TESTER.**

The resistance across wire pairs 1 & 2, 3 & 4, 5 & 6, should be somewhere between 1000 ohms and 2500 ohms. If it is outside of these values, then it is unlikely to be repairable. If the resistances are within specification, but the voltages across the elements are outside of specification, it may be that the katharometer is contaminated, and may be recoverable through cleaning. The majority of likely contaminants of the measurement elements and reactor tube are water soluble, so irrigating them with water is usually sufficient to clean them. It is more convenient to do this in the workshop or laboratory, which means removing them from the katharometer/reactor assembly.

6.5 Removal of katharometer and reaction tube

Refer to fig 7 below

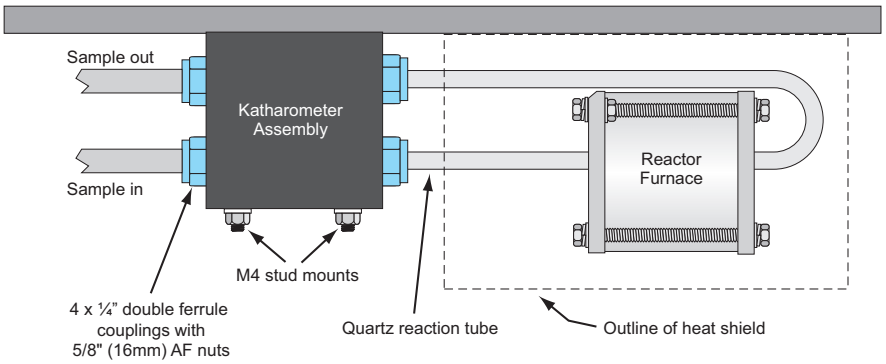


Figure 7

1. Ensure that the instrument is not powered up and that the reactor is cold.
2. Ensure that sample train is purged with air and that removing the sample connections will not cause the escape of any corrosive or poisonous gases.
3. Remove the heat shield by removing the four fixing screws
4. Slacken the two blue plastic (PFA) nuts that couple the reactor tube to the katharometer and carefully withdraw the reactor tube (FRAGILE!) to the right and put it to one side in a secure place.
5. Unscrew completely the blue plastic (PFA) coupling nuts of the sample inlet and outlet and pull the connecting pipes to one side. ENSURE THAT THE FRONT FERRULES (see fig. 3) ARE EITHER REMOVED AND PUT IN A SAFE PLACE, OR RETAINED ON THE PIPES IN SOME POSITIVE WAY.
6. Detach the katharometer connecting cable from the terminal block and release it from any trunking etc.
7. Remove the two nuts and washers on the stud mounts of the katharometer body and put them to one side in a secure place.
8. Withdraw the katharometer body from the mounting studs by gently pulling it squarely from the front.
9. Take the katharometer and reaction tube to the workshop or laboratory.

6.6 Cleaning the katharometer and reaction tube

1. The reaction tube may be immersed in water and gently agitated. Any deposit that is not removed may be left in place. Rinse with distilled or de-ionised water and dry it by standing or heating it in an oven (e.g. 55°C for 12 hours).

2. Remove the two reactor coupling nuts and the ferrules and place them in a secure place. **Do not immerse the katharometer in water.** Instead, flow water through each sensor by either holding it under a running tap with the stream directed to the each of the couplings, or connecting a suitably sized tube to them. Tilt the katharometer as shown so that the water irrigates the sensor element. Five minutes of flowing tap water should suffice.

3. After the tap water wash, shake out as much water as possible and rinse several times with distilled or de-ionised water.

4. To dry the katharometer stand it upright in a warm ventilated place overnight and remount.

5. Alternatively follow section 7.7 up to the end of paragraph 2. Arrange a means of passing clean dry air, nitrogen or argon through between the sample inlet and outlet and the reverse. Pass the drying gas first one way and then the other for about 1 to 2 hours, in both directions, at flow of about 500ml/min.
   Then proceed as paragraph 3 in section 7.7.

NOTE

If flushing with water, as described here, has not removed the deposits, a suitable solvent may be tried, depending upon the type of contamination.

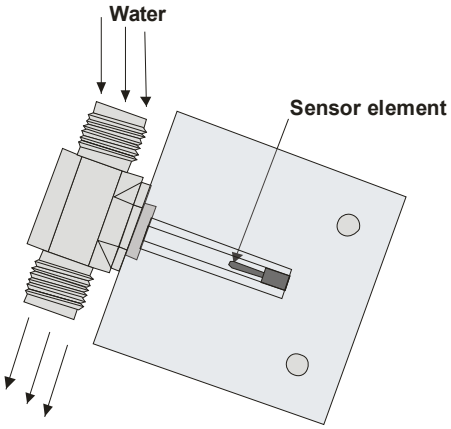


Figure 8

6.7 Re-mounting the katharometer and reaction tube

Re-mounting is the reversal of removal. Always make sure that all ferrules are undamaged and put in place correctly – Figure 3 illustrates this.

Re-make all the electrical connections and then apply power to the analyser.

Check that the voltages on the elements are correct – refer to 7.4.1; if they are not, either the elements need more drying, or another fault is indicated – refer it to your local MTL Gas sales office.

If everything is satisfactory, double check all couplings and reconnect to the normal sampling system. Verify calibration and re-apply the plant sample.

6.8 Checking reactor

If the control thermocouple fails, the controller displays alternately 'InPt' and 'FAIL'. Check for any loose connections – terminals 7 & 8. If these look satisfactory, then the reactor assembly will need replacing.

If the controller continues to display a low temperature after power up (typically ambient), check the reactor power connections. If these look satisfactory, check the voltage on terminals 9 &10 which should be in the order of 18V AC_{rms} .

If the voltage is correct, disconnect the reactor power wires from terminal 9 &10 and check the resistance across the ends of the cable. This should be in the order of 4 ohms. If it is substantially higher then the reactor assembly will need replacing.

If the voltage is at or near zero, check the reactor fuse. If this is intact, then a failure within the electronic module is indicated - refer it to your local MTL Gas sales office. If the fuse is open circuit, disconnect the reactor power wires from terminal 9 &10 and check the resistance across the ends of the cable. This should be in the order of 4 ohms. If it is substantially lower then a fault in the wiring or the reactor assembly is indicated. If any intermediate wiring is known to be correct the reactor will need replacing - refer to your local MTL Gas sales office.

6.9 Changing the electronics control unit

SAFETY NOTES

Changing the electronics unit requires the power to be disconnected from the instrument. This will cause any alarm contacts to failsafe to the alarm condition and the analogue output to drop to zero. Ensure that the control of the plant will not be compromised by these signals going to alarm conditions.

CAUTION

Record all user programmable settings before carrying out this procedure.Settings include alarms, analogue output span (some instruments), calibration gas concentration, actions under calibration or faults conditions and the digital filter value.

6.9.1 Tools required

M4 nut spinner recommended.

6.9.2 Removal and replacement

The power supply to the instrument must be completely disconnected.

The stainless steel electronics unit mounts to the backplate of the enclosure on four captive studs, two each side, and is secured to each with a nut, a locking washer and a plain washer - see Figure 4 (page 8) for details.

1. Remove the nut on the backplate grounding stud so that the earth wire connected to the steel casing of the control unit can be detached easily at the end of the next step.
2. Support the control unit while removing the nuts and washers from the studs. The electronics unit can then be detached from the connectors at the rear together with its earth wire.

Replacement is the reversal of removal. Before fitting the replacement electronics ensure that it is configured for the same supply voltage as the one it is replacing, this can be determined from the label on the side of the electronics unit. If in doubt, contact your local MTL Gas sales office who will require the serial numbers of both the old and the new units to check the details.

1. Thread the earth wire behind the lower cover then carefully align the new module into position on the mounting studs. Carefully press the module into position to fully engage the rear connectors.
2. While supporting the unit in place, fit a plain washer and a locking washer over one of the top studs and spin a nut onto it until finger-tight. Do the same on the other top stud to secure the unit. Fit the lower washers and nuts in a similar manner then tighten all four nuts to a suitable torque value.
3. Refit the earth wire, with the others, on the backplate grounding stud and replace the securing washer and nut. Tighten to a suitable torque value.

The instrument will now need to be calibrated and any user configuration settings will need to be re-entered. See sections 5.3 and 6 for details.

6.10 Restoring factory defaults

This procedure may be used where mis-calibration is producing unacceptable errors and re-calibration is not possible – e.g. no gas available.

This procedure should be carried out by qualified service personnel only, and only as indicated by the fault finding requirements set out in the trouble-shooting chart in section 7.3.

6.10.1 Tools required

None

6.10.2 Instructions

Disconnect the instrument from its power supply and leave for 30 seconds. Whilst keeping the **Cal** button depressed, apply power to the instrument. Continue to hold the **Cal** button until a 'Calibration data lost' message appears on the display.

Connect a dry air source to the instrument and flow air at approx 200 ml /min through the sensor and check the chlorine and hydrogen zero accuracy against the table below. If the readings are outside the limits shown, it is likely that the katharometer sensor is contaminated and will need cleaning. See section 7.6 for the cleaning procedure. Should the cleaning not restore operation to within limits shown below, the sensor and its KIM should be replaced.

If the results are within the limits shown here, recalibrate the analyser and restore the customer settings from the noted values above.

6.10.3 Acceptable limits

Reading	Error - %Absolute
Chlorine	± 8%
Hydrogen	± 1%

These limits refer to the zero reading accuracy at room temperature after restoring factory settings but before performing a gas calibration.

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