

Z1920C

MTL Oxygen combustion analyser



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

NOTE

“Normal” as used to describe the process and instrument throughout this manual and on instrument data labels, assumes the following conditions: Oxygen concentration in the sample is within the range of the instrument; Catalyst Temperature is within the appropriate limits; Oxygen Sensor Temperature is at its correct operational level.

1.1 Applications

This range of analysers is designed to monitor the oxygen content of the products of combustion of a pre-mixed air/gas mixture.

1.2 General Description

The system comprises an electronic unit and a separate catalytic reactor/oxygen sensor unit.

Both the catalytic reactor and the oxygen sensor operate at elevated temperature.

The air/gas mixture is passed into the heated catalytic chamber where it combusts; the products of combustion then pass across a zirconia oxygen sensor. The oxygen sensor produces a signal proportional to the oxygen content of the gas, which is processed by the microprocessor control unit. The control unit also provides a digital display and a programmable analogue output (typically 4 to 20mA) linear with oxygen concentration; the default setting is 0 to 5%.

The catalytic reactor and the oxygen sensor are heated by separate control circuits also housed in the control unit. Their temperatures are controlled and monitored by two independent controllers mounted on the front panel of the instrument. A volt-free, relay contact is provided which opens when the sensor temperature or the catalyst temperature is in error.

The flow of gas through the catalytic chamber is indicated and controlled by a flow-meter with a built-in manual control valve.

1.3 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

1.4 Information

Waste Electrical and Electronic Equipment directive (WEEE) 2002/96/EC
(RoHS) directive 2002/95/EC

	<p style="text-align: center;">WARNING</p> <p>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.</p>
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2 SPECIFICATION

2.1 Materials

Sample pipe work from flowmeter:- Stainless steel

Electronic enclosure:- Stove enamelled steel for enclosed version.

2.2 Ambient Temperature

Sensor unit: 70°C Max

Electronics: 50°C Max.

2.3 Display

Multi-digit LCD- character height 12.7mm

2.4 Display ranges

Display range resolution: 0.1% from 10.0% to 100%; 0.01 % from 0.01 % to 9.99%

2.5 Analogue outputs - isolated

0 to 5 volts – minimum load 10k ohms. or

4 to 20mA – maximum load 300 ohms

Bottom scale is fixed at 0%, span is user programmable over the range of 5% to 100%

2.6 Alarm outputs

One volt-free normally closed relay contact to indicate correct sensor and catalyst temperature.

2.7 Accuracy

For newly calibrated instruments $\pm 2\%$ of reading. Stability better than 2% of reading per month. Repeatability better than 2% of reading.

2.8 Speed of Response

Typical T90 for combustion gas application is 5 seconds.

2.9 Power Requirements

110 or 240V ac 50/60 Hz at up to 200 VA.– voltage selector switch located on front panel of electronics unit.

2.10 Dimensions

See diagrams

3 INSTALLATION

3.1 Unpacking and Visual checking

Take all normal precautions when opening the packages. In particular, avoid the use of long bladed cutters. Check that all pipe connections have compression nuts and olives intact. Search packing if any are missing. Check for any sign of damage. Carefully remove any internal packing material.

THE SENSOR UNIT IN PARTICULAR SHOULD BE HANDLED WITH GREAT CARE SINCE THE MEASURING SENSOR IS MADE FROM FRAGILE CERAMIC MATERIAL.

3.2 Siting

3.2.1 Electronics

A site should be chosen that is not subjected to ambient temperature greater than 50°C. Care should be taken to mount the unit where it is not likely to receive heavy knocks or jolts. Diagram 1 below gives details of mounting dimensions. The enclosure should be mounted vertically, taking the standard precautions when installing equipment of this size and weight.

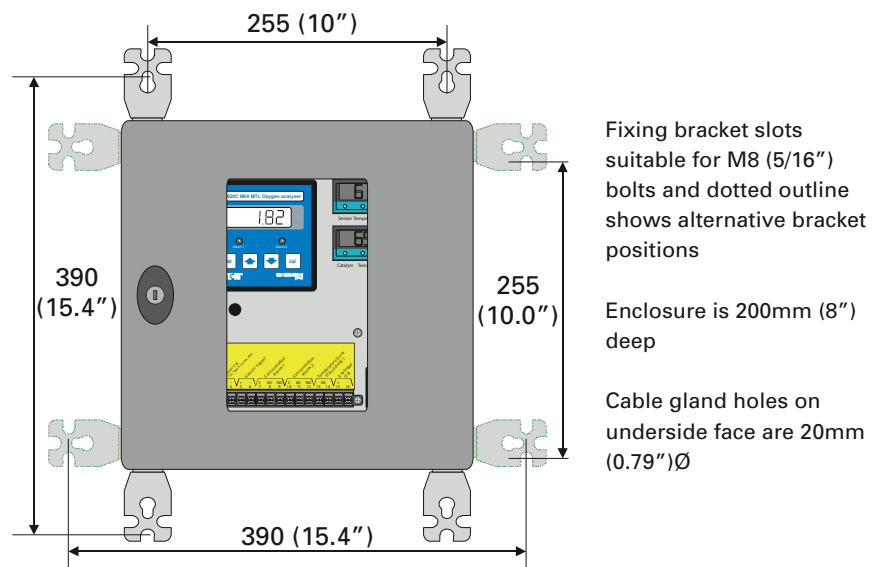


Diagram 1: Mounting dimension details

3.2.2 Catalytic Reactor and Sensor unit

Choose a site where the ambient temperature will not exceed 70°C. To enable the flowmeter to operate correctly the unit must be mounted vertically $\pm 2^\circ$.

Refer to the drawing on the following page for installation and dimensional details and observe the following points.



WARNING

Parts of the assembly behind the heat shield run at elevated temperatures. Care must be taken to ensure that they cannot be easily touched in normal operation.

CAUTION

All wiring from the catalytic reactor and the sensor unit must be routed so as to avoid touching any of the sensor unit's surfaces.



WARNING

Under normal conditions the gases emerging from the sample outlet are asphyxiating, and under fuel-rich conditions could contain poisonous carbon monoxide. These gases will also be hot, normally in excess of 100°C, and any extension tubing must be able to withstand this temperature and be of a diameter and length that will not cause a significant back pressure.

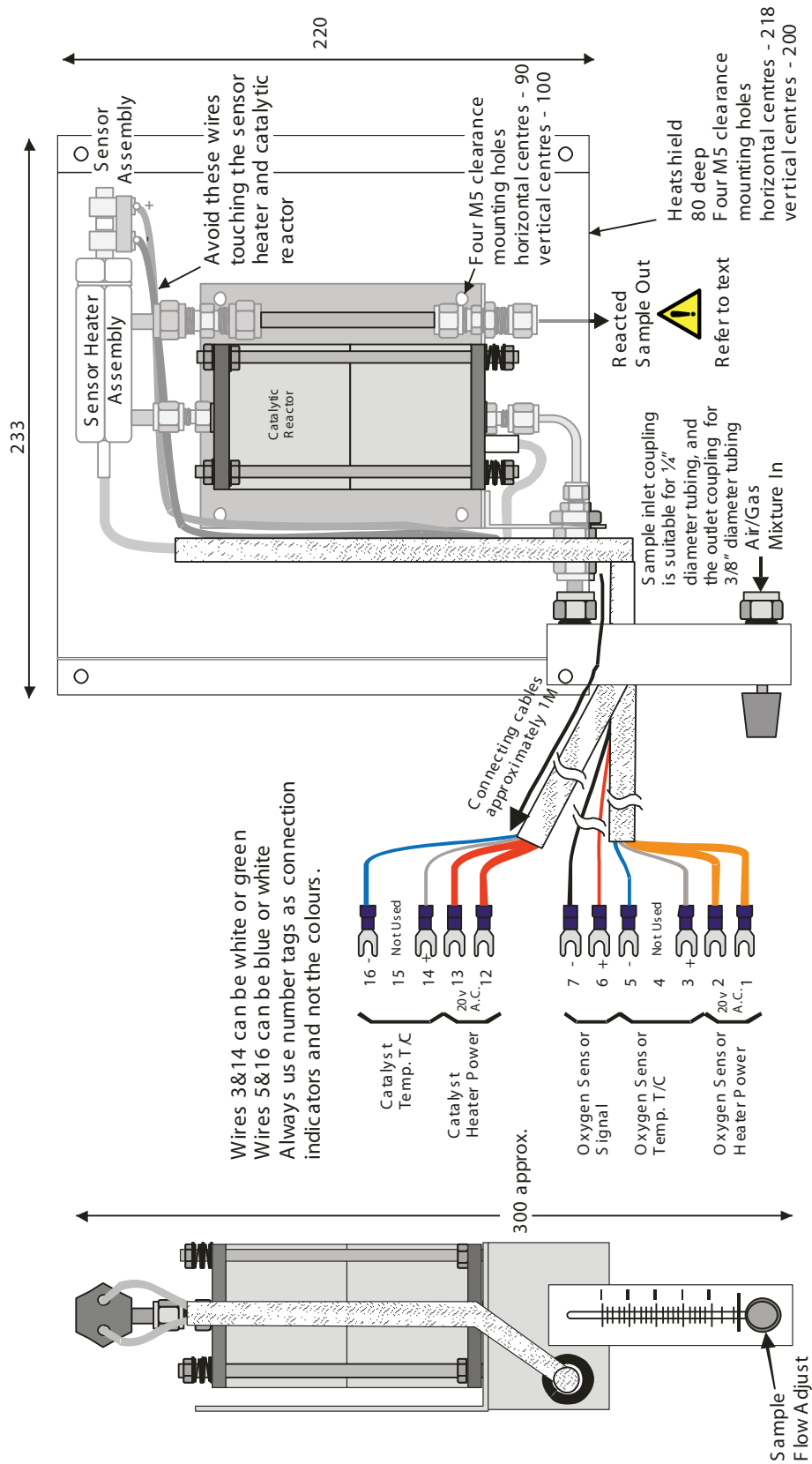
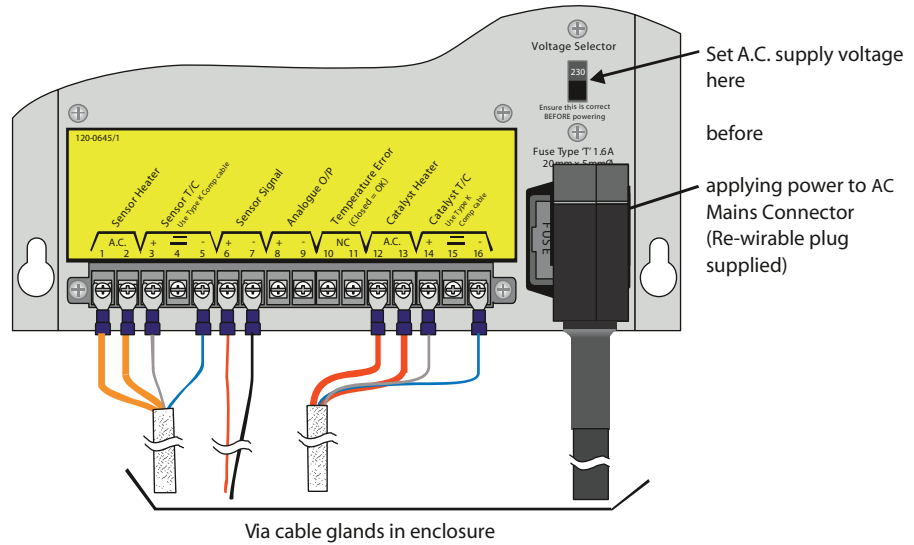



Diagram 2: Mounting details of catalytic reactor/sensor heater and heat shield

3.3 Electronic unit connections



The following points should be observed for the wiring between the sensor/reactor unit and the control/display electronics.

- The cables should avoid as much as possible tracking other high current cables.
- The signal outputs may be connected using standard instruments cable (e.g. 7/0.2). All signal outputs are short/open circuit proof.
- If the cables are extended only use wire of similar type and current carrying capacity. The thermocouple wire pairs 3&5 and 14&16 must use Type K thermocouple extension or compensating cable.

	<p>WARNING</p> <p>It is strongly recommended that the Temperature Error volt-free contacts (terminals 10 and 11) are used to activate a sample cut-off in the event that excessive sample flow (greater than 250ml/min) causes the catalyst to over heat. Typically the contacts would be used as a logic input to the overall burner controller. The controller would apply a delay to the burner shut-off command so as to avoid shutting the burner down in a transient temperature error situation.</p>
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4 OPERATION

4.1 First Checks

With the sensor and electronic unit connected up to each other and electrical supplies, the instrument is ready for use. Ensure that all the connections are correct and that the actual supply voltage is the same as that set at the voltage selector. Check all piping connections for tightness.

4.2 Start-up

With all the initial checks completed and found to be satisfactory, apply power to the instrument.

When power is applied the concentration read-out will display briefly its start-up messages and then, as the sensor heater warms up, the sensor temperature controller's display will alternate between indicating the rising sensor temperature and 'ALARM'. Once the temperature has reached its normal level, the controller display goes to a constant display of sensor temperature. During the warm up period the concentration meter read-out and signal output will be seen to go up and down the scale once or twice; this is quite normal.

CAUTION

Under no circumstances pass a combustible sample until both the catalyst and sensor are at their normal operating temperatures.

The instrument is calibrated prior to dispatch and is ready for immediate use, once warmed up. User quality assurance procedures may require that a calibration check is made before use. If this is the case then proceed to section 4.3, otherwise go to section 4.4.

4.3 Calibration check

The procedure requires two gases; one a standard gas with a known oxygen content of between 0.5% and 2% of oxygen in nitrogen, and air. It is important that these gases contain no combustible gas. The oxygen in nitrogen mixture may be obtained in cylinders from a number of gas suppliers. The cylinder will need to be fitted with a regulator. The calibration gases are introduced through the normal sample inlet. Either the sample will need to be disconnected, or a suitable manifold of valves will need to be arranged. Any source of the normal sample should be removed when performing a calibration check.

Firstly connect the air and adjust the flow to between 150 and 250 ml/min. Allow the system to stabilise for at least 60 seconds.


When the reading is stable, press and hold the **Calibrate** button for approximately 8 seconds. The display will go blank for a moment and then show "**H xxxx**"; where H indicates that the high calibration point is selected. Use the up/down arrow buttons to set the reading to 20.9%, and then press the **Edit** button momentarily to reset the calibration. The display will now show "**H 20.9**". Press and hold the **Calibrate** button for a further 8 seconds. The display will now show "**Lxxxx**" where "**L**" indicates that the low calibration point is selected and "**XXXX**" is the measured value of the gas passing across the sensor.

Now apply the 0.5 to 2% standard calibration gas and adjust the flow as before. Allow the reading to stabilise and use the up/down arrow buttons to set the reading to the correct concentration. Press the Edit button momentarily to reset the calibration and return to normal measurement mode.

4.4 Commissioning

If a calibration check has been conducted ensure the standard calibration gas connection is removed. The air gas mixture stream may now be applied. The flow control valve should be turned fully clockwise (closed) prior to applying the mixture to the analyser. This is to avoid passing high flow rates through the system.

Slowly open the flow valve beneath the flow meter until a flow of between 150 and 250 ml/min is flowing.

	<p style="text-align: center;">WARNING</p> <p>To avoid serious and dangerous damage to the catalyst and sensor the sample flow must not exceed 250ml/min (0.5cuft/hr).</p>
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The instrument will respond within a few seconds to show the oxygen concentration.

NOTE: Combustion of the sample generates heat and it is possible, when the sample is first applied, that the catalyst temperature may go higher than its normal control point before the controller is able to react. This will cause the controller to show error condition and the relay contacts to go a fault condition. Whether this occurs or not will depend on the sample composition and its flow rate. The results during this transient state are valid. It is suggested that any external equipment (PLC's etc) used to monitor the analyser are programmed so as to ignore this situation for approximately 60 seconds after the sample has been applied.

Before switching the analyser off following its use on combustible samples ALWAYS pass air through the analyser for a few minutes to purge out the moisture etc. formed when combusting the sample.

4.5 Programming

The user programmable features are accessed by pressing and holding the Edit button for approximately 8 seconds when the instrument is in normal measurement mode. Each subsequent momentary press of the Edit button scrolls the display through a sequence of adjustable parameters. The order of the sequence is as follows:

Alarm 1 Set point → Alarm 1 Mode → Alarm 1 Hysteresis → Alarm 2 Set point → Alarm 2 Mode → Alarm 2 Hysteresis → Analogue Output top scale value → Return to measurement mode.

<p style="text-align: center;">NOTE</p> <p>Only the LED indicators are available for the concentration alarms. No relay output is provided on this model.</p>
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ALARM 1 - Set point

This is the first parameter to be displayed when the Edit button is pressed and held for eight seconds. The display will show "**E xxxx**", and the Alarm 1 LED will flash. "**xxxx**" is the value of the alarm set point and the flashing LED indicates that it is the set point of alarm 1. To the right of the display a % or ppm symbol is displayed to indicate the units of the value displayed. To change the value of the set point, press the up/down arrows until the display shows the required value. Observe the "%" and "ppm" symbols to ensure the correct setting. When the buttons are first pressed the value changes slowly and the least significant number can be changed by giving the buttons a short "**click**". If the button is kept depressed the rate accelerates rapidly to enable large changes in value to be achieved quickly. Once the required value is displayed, press the Edit button once to store the value in the analyser's memory. Simultaneously the display will change to show "**E x**" and the Alarm 1 LED will continue to flash.

ALARM 1 - Mode

The symbol displayed in the “x” position indicates the mode of the alarm as follows;

0- Alarm off; H- High; L- Low. Press the arrow buttons to change the mode and press the Edit button once to store the setting. The display will change to show “EH xx” and the Alarm 1 LED will continue to flash.

ALARM 1 - Hysteresis

The number displayed in the “xx” position indicates the value of the hysteresis for alarm 1. The value is given in percentage of the set-point or alarm level and is variable from zero to 10%. Press the arrow buttons to set the required value and then Edit button to store the value. The display will then change to repeat the above sequence for alarm 2; indicated by the alarm 2 LED flashing.

ANALOGUE OUTPUT - Top scale value

NOTE: This is factory set to 0 to 5% as the default for the Z1920C. It may be changed as required. When the EDIT button is pressed following alarm 2 hysteresis entry, the display will show “EPxxxx”, where “xxxx” is the oxygen concentration at which the analogue output (0 to 5v or 4 to 20mA) is at top scale. Press the up/down arrow keys to scroll the display to show the required setting. See Specification section for the limits of this value. When the required value is displayed, press the Edit button to store the value and return to measurement mode.

5 MAINTENANCE

NOTE

The internals of the sensor unit operate at elevated temperatures. Take great care when working on an analyser that has power applied or has only recently been turned off.

5.1 General

5.1.1 Electronics

The electronics unit is virtually maintenance free. Faults in modern electronics equipment normally show up in the first six months of continuous operation. Tests show that following this period, the life is virtually infinite, (10 years or more) assuming that the instrument has not been subjected to use beyond its specification.

All the electronic modules require specialist test equipment and any adjustments, other than those available on the front panel should be avoided.

5.1.2 Sensor Unit

Following commissioning it is advisable to check the calibration as described in section 4.3 after one week of continuous operation. Following this check, monthly checks should be adequate. When carrying out the calibration check, it is useful to observe the response rate of the SENSOR. With the air off or the sample valve shut the response to the calibration gas, assuming the line is purged up to the inlet connector, should be virtually instantaneous. The reading of sample oxygen should be fully stabilised in 5 to 10 seconds.

If it is suspected that the SENSOR is faulty a check on its electrical resistance is a good indication of failure. See section 6.1

5.1.3 Catalytic Combustion Unit

Provided that no samples containing significant levels of sulphur, phosphorus, heavy metals, silicon or halogen compounds, have been through the analyser, the catalyst should last indefinitely. Running the system for long periods with fuel rich mixtures should also be avoided.

6 FAULT FINDING AND SERVICING



WARNING

The internals of the sensor unit operate at elevated temperatures. Take great care when working on an analyser that has power applied or has only recently been turned off.

NOTE

For those instruments supplied as separate electronics and sensor units, to be inter-wired on site, always check the interconnecting wiring first. Tests are mostly described as being performed from the electronics end. If an open circuit condition is found, it is advisable to repeat the tests at the sensor head before drawing a firm conclusion.

NOTE

Some tests described assume that the repairer is familiar and comfortable with electrical apparatus and simple test equipment. Apart from standard small tools, other items required to perform the tests described are a) digital multi meter - hand held 3½ digit type capable of resolving 0.1mv dc, 0.1ma dc and up to 30v ac. b) potentiometer trim tool. The most convenient way of repairing the instrument is to carry a full set of spares and substituting known good modules for those identified as faulty using the tests described here.

6.1 Error 'HELP' Messages

If a data error is detected by the microprocessor it is reported by displaying 'HELP' followed by a number. The meaning of these messages is as follows.

- HELP 1-** After finding user calibration data corrupt the backup was found to be corrupt too. Return to factory.
- HELP 2-** Will not be seen. Factory calibration data is corrupt. If the backup is OK it will be silently restored.
- HELP 3-** After finding factory setup data corrupt the backup was found to be corrupt too. Return to factory.
- HELP 4-** User calibration and/or setup data is corrupt. Press the UP () key to recover. Factory default values are loaded for alarms, output range, cell calibration etc. After a few seconds the instrument will automatically go into the EDIT menu. After working through the edit screens (alarm settings and output range) in the normal way, the instrument goes automatically into the CALIBRATE mode. After calibrating at the high and low points, the instrument reverts to normal operation.

6.2 Oxygen Sensor Resistance Checking

The sensor temperature must be at normal operating temperature when this test is carried out. Note also that the full working temperature of the sensor is not reached until the instrument has been on for about 10 minutes. Pass air across the sensor via the calibration connection or the sample inlet and check the resistance of the sensor across terminals 6 and 7 using a digital multi-meter set to read at least 1000 ohms. If the resistance of the sensor is more than 1000 ohms and its response is sluggish, it is likely that it is faulty.

6.3 Checking the Temperature Controller and Heater Circuit of the Oxygen Sensor

Switch the analyser off and allow the sensor to cool down. Using a multi-meter set to read resistance check that the resistance across terminals 3 and 5 (the thermocouple) is between 1 and 6 Ω . Next check the heater resistance as follows. Remove the heater power connection from terminal 1 to disconnect it from the power transformer, and use the multi-meter to measure the resistance across heater wires 1 and 2. This should be 4 $\Omega \pm 10\%$. If either test produces abnormal readings then the sensor heater/thermocouple assembly will need to be replaced-proceed to section 6.4 for instructions on how to remove the module.

6.4 Checking the Temperature Controller and Heater Circuit of the Catalytic Reactor

Switch the analyser off and allow the sensor to cool down. Using a multi-meter set to read resistance check that the resistance across terminals 14 and 16 (the thermocouple) is between 1 and 6 Ω . Next check the heater resistance as follows. Remove the heater power connection from terminal 12 to disconnect it from the power transformer, and use the multi-meter to measure the resistance across heater wires 12 and 13. This should be 4 $\Omega \pm 10\%$. If either test produces abnormal readings then the catalytic reactor assembly will need to be replaced -proceed to section 6.5 for instructions on how to remove the catalytic reactor.

6.5 Sensor Removal and Replacement

CAUTION

Remove power from the analyser and allow the reactor/sensor assembly to cool to ambient temperature before proceeding. Also take great care when working with the fragile ceramic of the sensor.

Remove the sensor signal connector and lead by carefully unclipping it from the ceramic sensor. Unscrew the sensor and withdraw it from the heater body. Replacement is the reversal of removal.

ENSURE THAT THE ELECTRICAL LEADS ARE SEPARATED FROM ALL HOT SURFACES BY AT LEAST 12mm AND NOT PLACED VERTICALLY ABOVE THEM.

6.6 Catalytic Reactor/Sensor Heater

The sensor heater and catalytic reactor are supplied as two separate assemblies.

Replacement is by substitution of either assembly.

ENSURE THAT THE ELECTRICAL LEADS ARE SEPARATED FROM ALL HOT SURFACES BY AT LEAST 12mm AND NOT PLACED VERTICALLY ABOVE THEM.

After replacement the analyser must be recalibrated as described in section 4.3

6.7 Spares & Service

Contact your local MTL Gas sales office for all spares and service.

WHENEVER SPARE PARTS ARE ORDERED IT IS IMPORTANT TO PROVIDE THE INSTRUMENT SERIAL NUMBER.

For electronic cards, specify full input and output requirements if different from original equipment.

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