

G210
Oxygen Analyser
Instruction Manual

This Manual Contains Important Health & Safety Information.

OPERATING INSTRUCTIONS FOR THE G210 GAS ANALYSER

The G210 instrument is a gas analyser that can be used for measuring the concentration of oxygen in a variety of processes.

A microprocessor is used to control the instrument and its associated digital circuitry to provide a highly advanced, highly featured, user friendly gas analyser.

The instrument comprises the Hitech G1010 panel mounting analyser packaged in a free-standing enclosure that also contains sample flow control equipment. In its basic form it comprises a flow meter and valve. Various optional sampling systems are available including remote sensor versions.

1.0 SPECIFICATION

Display

Multi digit LCD - character height 12.7mm

Display ranges and resolution

E cell model - Display range 0.01% to 100.0%. Resolution: 0.1% from 10% to 100%; 0.01% below 10%. Suitable for samples containing mildly acidic gases. e.g. Carbon dioxide, hydrogen sulphide etc.

N cell model - Display range 1ppm to 50%. Resolution: 0.1% from 10% to 50%; 0.01% from 0.50% to 9.99%; 10ppm from 500ppm to 4999ppm; 1ppm from 0ppm to 499ppm

L and H cell models - Display range 0.1ppm to 10%. Resolution: 0.01% from 0.50% to 9.99%; 1ppm from 50ppm to 4999ppm; 0.1ppm from 0.0ppm to 49.9ppm

Stability

Better than 2% of full-scale per month

Cell life

E cell - up to 5 years

N, L and H cells - up to 18 months

Sample flow

Between 100 and 500 ml/min for optimum operation.

Sample pressure

The pressure applied to the cell is determined by the vent pressure which should be atmospheric for quoted accuracy. *Note: The sensor must not be subjected to rapid pressure changes.*

Sample temperature

(-)5°C to +40°C (non condensing)

Sample connections

Inlet and outlet: captive seal compression fittings suitable for 0.25 inch (or 6mm) o/d tube

Speed of response

T90 - variable depending on sensor and concentration. Approximately 3s at % levels and 20s at ppm levels. The ppm figure assumes that the sensor is purged down.

Analogue output

0 to 5 volts (min. load 10k Ω) standard, 4 to 20mA (max. load 300 Ω) option.

User programmable top-scale oxygen value between the following concentrations.

'E' type cell instruments 5% to 100% - Setting resolution: 0.1% from 10% to 100%; 0.01% below 10%.

'N' type cell instruments 50ppm to 50% - Setting resolution: 0.1% from 10% to 50%; 0.01% from 0.50% to 9.99%; 10ppm from 500ppm to 4999ppm; 1ppm from 50ppm to 499ppm

'L' and 'H' type cell instruments 50ppm to 10% - Setting resolution: 0.01% from 0.50% to 9.99%; 1ppm from 50ppm to 4999ppm

Alarm outputs

2 alarms each user programmable for: **Mode** - HIGH, LOW or OFF; **Level** - over full display range of instrument and **Hysteresis** - 0% to 10% of set point. **Volt free C/O contacts** rated at 48v ac or dc, 0.5A, normally energised. The resolution when setting the alarms is the same as for the analogue output except that the minimum setting is as the display range.

Ambient temperature

0 to 40 °C - continuous
-5 to + 50 °C - intermittent

Supply voltage

110/120 v or 220/240 v 50/60 Hz, Max power consumption 6VA

Mounting

Free standing

Dimensions

255 x 170 x 260 - excluding any fittings, filters etc.

Siting

The instrument should be sited where the ambient temperature is within its specification and where it will not be subjected to any excessive knocks, dust or water.

Electrical Connections.

Depending on the country, either a suitable mains lead is supplied or a plug that can be attached to a suitable lead that is compatible with the local electrical outlet system.

Sampling and Piping

The standard connections are captive seal compression fittings suitable for 0.25" (or 6mm) diameter tube on the sample inlet and sample outlet.

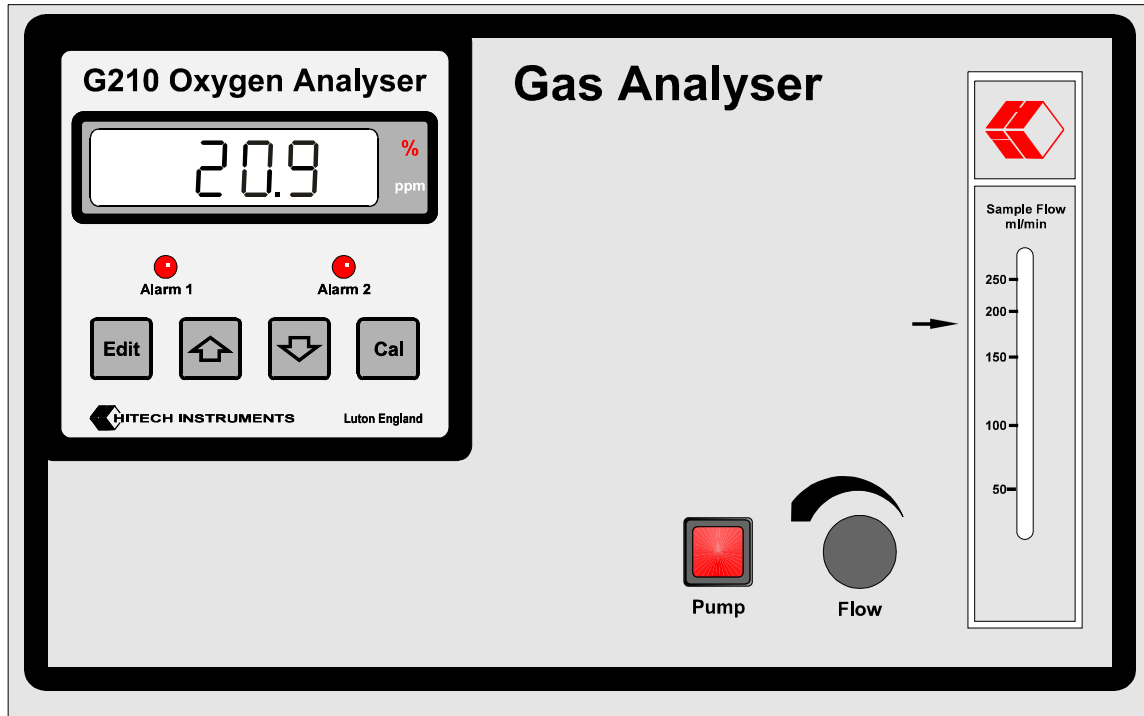
This instrument has been designed to meet the requirements of the EMC Directive 89/336/EEC and the requirements of the Low Voltage Directive 73/23/EEC, when installed in accordance with these instructions.

2.0 INSTALLATION

Unpacking and visual checking

Take all normal precautions when opening packages. In particular avoid the use of long bladed cutters. Check that all pipe connections have captive seal nuts. Search packing if any are missing.

Mounting



The G210 is a free standing instrument. A site should be chosen where the ambient temperature does not go above 40° C or below -5° C, and where the analyser will not be subjected to excessive vibration or knocks and jolts; it is not sensitive to tilting etc. in any attitude.

Service requirements

The supply voltage required depends upon the option fitted. Refer to the serial number plate, located on the rear of the instrument, for the exact option fitted. The options are 240V AC, or 110V AC or 24V DC.

Connections

The sensor, output signals and the supply should be connected as indicated below.

Terminal	1 + cell connection for remote cell versions or not used
"	2 - cell connection for remote cell versions or not used
"	3 + ve Analogue output

	"	4	-ve	"	"
	"	5	Alarm 1 common terminal		
	"	6	Alarm 1 normally closed terminal		
Terminal		7	Alarm 1 normally open terminal		
	"	8	Alarm 2 common terminal		
	"	9	Alarm 2 normally closed terminal		
	"	10	Alarm 2 normally open terminal		
	"	11	Not used		
	"	12	Not used		

Note that "normal" refers to the alarm status and not the electrical rest position of the relays which are energised in the process normal condition.

The mains connection is via the IEC connector located on the rear of the instrument. A mains connecting lead is supplied for instruments supplied within the U.K. and a suitable wirable plug for export instruments.

Sample connections

It is important that the sample being supplied to the analyser is clean and non-corrosive. It will be necessary for filters or chemical absorbers to be incorporated in the sample line of those samples that contain particulate matter or corrosive components.

Additionally, to avoid the risk of condensation within the sample line, the dew-point of the sample must not be above the ambient temperature.

It is advisable to fit a valve or valves in the pipeline leading to, and possibly from, the analyser so that the analyser can be sealed from the process when the cell is changed or removed. The use of a three way valve on the inlet side is also useful in allowing easy connection of a standard gas for calibration checks. It is particularly important that good pipework connections are made when low levels of oxygen are being measured. **For all parts per million (ppm) measurements the pipework up to the inlet of the analyser should be all metal or hard plastic such as Nylon or rigid P.V.C. Soft plastics, P.T.F.E. or rubber must not be used since the diffusion of oxygen from the atmosphere across them will give significant errors.**

The cell should not be pressurised, nor should it be exposed to rapid pressure changes or a pulsating flow. Rapid pressure changes could damage the cell, pulsation will give an erratic display.

Alarm contacts

The contacts are rated for signal applications. Where AC voltages are to be switched, the use of suitable snubbers across the contacts is recommended to ensure reasonable contact life.

Typical values are 0.047 μ F to 0.22 μ F with 47 ohms to 100 ohms in series with the capacitors. Mains rated capacitors must be used.

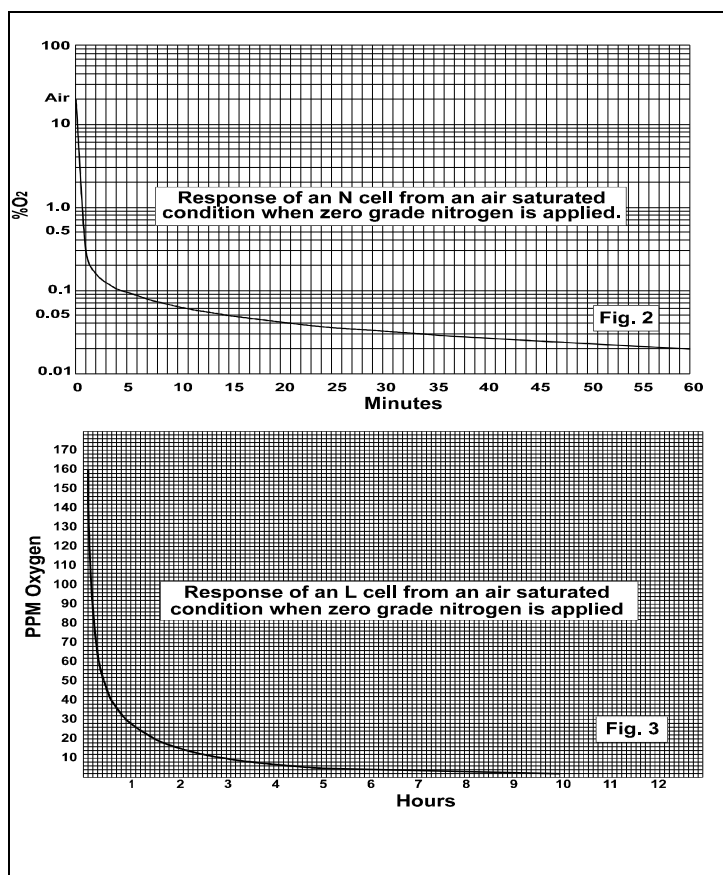
3.0 COMMISSIONING

Switching on

When the analyser is switched on the display will initially indicate a high oxygen reading. After a few minutes the meter reading will fall and will settle at the true oxygen content of the sample being

supplied to the cell. The speed of response depends on the type of cell fitted and the concentration being measured. Figs. 2&3 show the typical response of the N and L type cells. The E type cell has a similar response to the N type.

The instrument is calibrated prior to shipment and may be used immediately. If, however, you wish to check calibration go to



section 4.

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 (as turned on). Each subsequent momentary press of the **Edit** button scrolls the display through a sequence of adjustable parameters. 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.

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 Alarm 1 LED to 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 then the rate accelerates 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 in % 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

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. Neither alarm LED is flashing. Press the up/down arrow keys to change the value of oxygen concentration equivalent to the top scale value of the analogue output. The range of values depend on the particular model as shown below. Once the required value is selected, press the **Edit** button to store the value and return to measurement mode.

E type cell instruments 5% to 100%

N type cell instruments 50ppm to 50%

L and H type cell instruments 50ppm to 10%

Cell failure detection

All types of cell used on the G210 fail to a low output or concentration reading. By setting one of the alarms to a “Low”

configuration and a concentration that the process could not reach in normal operation an effective cell failure alarm can be set up.

Turning on the sample (not applicable to remote cell analysers)

Establish a sample flow of between 100 and 300ml/min. The instrument should respond immediately and display the concentration of oxygen in the sample. The speed of response varies according to how far the oxygen concentration in the sample is from the gas in contact with the sensor at start up (usually air). Figs 2 & 3 show the typical response time from an air condition for N and L type cells. Once the cell is purged down, it responds in a few seconds to large changes of oxygen concentration within the instrument's span. Short time excursions to high levels of oxygen, such as may be experienced during calibration, are recovered from in a matter of a few minutes. **See Section 5 for advice on using N and L type cells on mixtures with background gases other than nitrogen.**

4.0 MAINTENANCE AND CALIBRATION CHECKS

CAUTION: VARIOUS PROCEDURES ASSOCIATED WITH MAINTENANCE AND CALIBRATION AFFECT THE OUTPUTS OF THE INSTRUMENT. ANY OF THESE OUTPUTS THAT ARE BEING USED FOR CONTROL, OR THE ASSOCIATED CONTROL LOOP SHOULD BE DISABLED BEFORE COMMENCING.

4.1 Cell life

The E cell has a life of 5 years in ideal conditions - (moist inert gas at 15°C). Typically 2 to 3 years can be expected as a minimum. The N cells have a life of 100,000 oxygen % hours or twelve months - whichever is the sooner; and the L type a life of 16,000 oxygen % hours or 12 months whichever is the sooner. Each cell is date labelled (see the Storage of the Measuring Cell section 6.2 for the code) when supplied and it is this date that should be used when establishing expiry date.

Cell failure modes

All known cell failure modes result in a loss or lowering of output. Thus applications that look for oxygen depletion are automatically fail safe and vice-versa.

4.2 Calibration interval

For instruments fitted with E cells it is recommended that the analyser's calibration is verified every two months. For those fitted with the N and L type cells the calibration should be verified every month. This frequency of verification is for typical industrial applications. When the application is critical, the frequency of verification should be increased in line with local safety standards.

4.3 Calibration gas level

See Section 5 for advice on using N, L and H type cells on mixtures with background gases other than nitrogen.

The level of oxygen in the calibration gas depends on the particular model - in particular the type of cell fitted. In general, for optimum accuracy, it best to calibrate with a gas with the same composition and oxygen concentration as the normal sample. Air (21% oxygen) is a very convenient and low cost option if it within the range of the instrument – see table below. However, the response time for the cell to stabilise back to its normal working level after being exposed to air should be taken into account. See Figs. 2 and 3 for details of the speed of response. Clean dry air contains 20.95% oxygen, moist air contains less oxygen. The table below shows the oxygen content of air at various temperatures and relative humidities (RH).

Temp °C	20% RH	40% RH	60% RH	80% RH	100% RH
0	20.9% O ₂	20.9% O ₂	20.9% O ₂	20.8% O ₂	20.8% O ₂
10	20.9% O ₂	20.8% O ₂	20.8% O ₂	20.7% O ₂	20.7 % O ₂
20	20.9% O ₂	20.8% O ₂	20.7% O ₂	20.6% O ₂	20.5% O ₂
30	20.8% O ₂	20.6% O ₂	20.4% O ₂	20.2% O ₂	20.1% O ₂
40	20.6% O ₂	20.3% O ₂	20.0% O ₂	19.7% O ₂	19.4% O ₂

4.4 Calibration of a percent range instrument (except remote ambient sensing cell) See section 4.5 for instruments scaled in PPM

Piping

The piping carrying the calibration gas must not have any leaks. Also, the pressure at the sample outlet must be the same as that when the analyser is measuring the sample. This avoids any errors due to the pressure at the cell.

Calibration method

The analyser must be isolated from the process gas and the calibration gas introduced to the analyser. Instruments fitted with an N type cell require only a single point calibration. A full calibration of instruments fitted with E and L types of cell requires two calibration points referred to as upper and lower, although the lower point can be omitted except when replacing a cell. Safeguards are built into the instrument to prevent the calibration being set outside of the cell's operational limits.

It should be noted that it will take time for the calibration gas to flush the previous gas out of any filters etc. upstream of the analyser. This means that the reading will take time to stabilise. Refer to the response graphs in this handbook for guidance on this.

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 that of the calibration gas, and then press the **Edit** button momentarily to reset the calibration. The display will now show "H xxxx", where xxxx is the correct concentration of the test gas. Unless a low level calibration is required, normally done only when a new cell is fitted, press the **Calibrate** button momentarily to return to measurement mode. To access the low calibration mode press and hold the **Calibrate** button for 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 calibration gas. Lower point calibration is performed in the same way as the high calibration, however it may be necessary to allow a longer time for the reading to stabilise.

4.5 Calibration of a ppm range instrument

Piping

The piping carrying the calibration gas must not have any leaks and should be metal with suitable fittings. If there are regulators in the gas stream they should have a low volume and a metal diaphragm. Most pressure gauges etc. contain cavities that trap air/oxygen and can take several hours to purge down, for this reason they should be avoided.

Calibration method

The analyser must be isolated from the process gas and the calibration gas introduced to the analyser. See Fig. 1 for suggested arrangement.

It should be noted that it will take time for the calibration gas to flush the previous gas out of any filters etc. upstream of the analyser, which will increase the time taken to stabilise.

Calibration gas level for L type cells

Ideally the calibration gas level should be as near to the normal working concentration as possible. However it is possible to use concentrations up to 5% oxygen in nitrogen. Beyond 5% the cell begins to deviate from its standard output equation. **Air may be used for convenience if nothing else is available. In this case, to correct for the deviation from the standard equation, the reading should be set to read 19.4% - NOT 20.9%.**

WARNING: Care must be taken not to expose an L type cell to ambient air for more than a few minutes while changing pipes etc. The time taken to purge the cell down to low ppm levels depends upon how much oxygen the cell has absorbed. Provided that the cell has only been exposed briefly to air, then the purge time will be quite short. If, however, the cell has been exposed to air for several hours then the purge time may become far longer. A graph of the response of an L cell from air to ppm levels is shown in Fig 3.

4.6 Cell replacement - overview

Before proceeding with changing a cell, identify which one is being replaced, then read and fully understand the appropriate procedure given in the sections that follow.

For best accuracy it is necessary to re-calibrate the instrument following a cell change. The calibration procedure depends on the type of cell fitted to the instrument. Read sections 4.3 to 4.5 for additional information on calibration before proceeding.

Each instrument is built to accept a particular type of cell and cannot be used with one of a different type.

For instruments fitted with L and E type cells it is necessary to reset the cell zero offset before replacing the cell as detailed in the following sections. For instruments fitted with an N type cell proceed to section 4.7.

4.6.1 Setting zero offset on instruments fitted with an E type cell

The label on the E cell is marked with the cell's offset at zero oxygen concentration. A short length of wire is also supplied with the cell, the use of which is described later. The offset figure is given in units of percent oxygen and is negative; for example (-)0.35%. To set the zero offset proceed as follows. Disconnect the signal leads of the old cell from terminals 1 and 2 of the instrument's terminal block and connect the short length of wire across the terminals so as to form a shorting link. Apply power to the instrument if it has been disconnected, and allow 30 seconds for the electronics to stabilise. Press the **Calibrate** button for approximately 8 seconds until the display shows "H xxxx". Release the button and then press it for another 8 seconds approximately until the display shows "L xxxx". "L" indicates that the lower concentration calibration is selected and xxxx is an oxygen concentration figure; note it probably will have a negative sign in front of it. Next use the up/down arrow buttons to set the display to read the cell oxygen concentration offset figure given on the new cell - note that this a negative figure and it is important that the display is set accordingly. When the correct figure has been set on the display, press the **Edit** button once for approximately 2 seconds and release. This puts the figure into the instrument's memory, the "L" will disappear and instrument will return to ordinary measurement mode. Remove the shorting link and discard it. Now refer to section 4.7 for details of how to replace and connect the cell.

4.6.2 Setting zero offset on instruments fitted with an L cell

The label on the L cell is marked with the cell's offset at zero oxygen concentration. The offset figure is given in units of parts per million (PPM) oxygen and is negative; for example (-)3.5PPM. To set the zero offset proceed as follows. Disconnect the signal leads of the old cell from terminals 1 and 2 of the instrument's terminal block and leave the input open circuit, i.e. with nothing connected to terminals 1 and 2. Apply power to the instrument if it has been disconnected, and allow 2 minutes, or until the reading is steady, for the electronics to stabilise. Press the **Calibrate** button for approximately 8 seconds until the display shows "H xxxx". Release the button and then press it for another 8 seconds approximately until the display shows "L xxxx". "L" indicates that the lower concentration calibration is selected and xxxx is an oxygen concentration figure; note it probably will have a negative sign in front of it. Next use the up/down arrow buttons to set the display to read the cell oxygen concentration offset figure given on the new cell - note that this a negative figure and it is important that the display is set accordingly. When the correct figure has been set on the display, press the **Edit** button once for approximately 2 seconds and release. This puts the figure into the instrument's memory and the "L" will disappear and instrument will return to ordinary measurement mode. Now refer to section 4.7 for details of how to replace and connect the cell.

4.7 Replacing/Connecting the cell

Read section 4.6 before proceeding

Before replacing/connecting a cell ensure:

- a) That any leakage of sample that may occur will not create a hazard
- b) That any control loop using the outputs from the unit is disabled.
- c) Remove any power from the instrument **before** removing the cover of the instrument.

Replacing and connecting N, L and H type cells

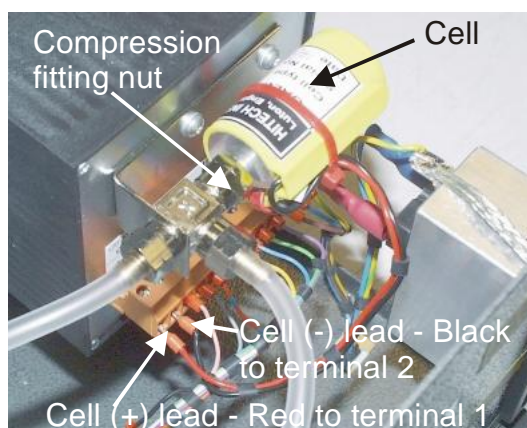
These are shipped with the leads shorted and the sample tube plugged with a rubber bung. This ensures that the cell is purged down to low levels and ready to be applied to the measurement of low levels of oxygen (less than 1000ppm) with the minimum of delay. The bung should be left in place until the system is ready for the cell to be fitted. If it is intended to apply the cell immediately to the measurement of low oxygen concentrations then the sample should be left flowing during the cell change operation. **The bung should be removed from the cell and the cell coupled to the holder as rapidly as possible. THIS ASSUMES THAT THE SAMPLE THAT WILL INEVITABLY ESCAPE WILL NOT CONSTITUTE ANY SORT OF HAZARD. IT IS THE RESPONSIBILITY OF THE USER TO ENSURE THIS.**

Replacing and connecting E cells

These are shipped with the sample port open and the leads insulated to prevent them touching. The insulation sleeve must be removed before the signal leads are connected to the input of the instrument.

General points when replacing a cell

First remove power from the instrument and remove its cover by removing the four screws attaching it to the base chassis. Refer to the illustration below.



View with cover removed

Disconnect the old cell's signal leads from terminals 1 and 2 of the connector on the rear of the instrument. Next slacken the compression nut on the cell sample tube and withdraw the old cell. **See foregoing warning regarding maintaining a sample flow during this operation.** Replacement is the reverse of removal; refer to the instructions given earlier in this section for N and L cell replacement.

Gas calibration following replacement

Refer to sections 4.3 to 4.5 for method of calibrating the cell at higher levels (span).

4.8 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.

5.0 TECHNICAL DESCRIPTION OF GALVANIC CELLS

5.1 How they work

The three types of galvanic oxygen sensor currently used by the G210 are designated N, L, H and E and they all operate on the same general principle, although the E has somewhat different “chemistry”, “physics” and “electrics” to the other two that enables it cover measurement applications that the others cannot.

The general electro-chemical mechanism of these cells is that of lead being oxidised by the oxygen in the sample and the current produced in the process being a measure of the oxygen concentration. They are in effect metal/oxygen batteries and as such eventually run out of the lead “fuel” when it is fully oxidised.

Types N, L and H

These cells produce an inverse logarithmic output signal that in theory goes to infinity at 100% oxygen concentration and hence they cannot be used at high concentrations. Because of the “physics” of the cell their output is a function of the mean molecular weight of the sample, see future section, and they are immune to changes in sample pressure over quite a wide range; i.e. they are measure the proportion of oxygen not its partial pressure. The electrolyte used is alkaline which means they cannot be used with samples contain high concentrations of mildly acidic gases such as carbon dioxide, hydrogen sulphide, sulphur dioxide etc.

Type E

The ‘E’ type cell operates in a slightly different way. The cell output is affected by the pressure applied to the cell, but they are produce a linear signal that is not a function of the mean molecular weight of the sample. The electrolyte used is mildly acidic and hence they can be used measure samples containing mildly acidic gases such as carbon dioxide, hydrogen sulphide, sulphur dioxide etc.

Application

N cells are used as a general purpose cell operating over the range from 25% down to 500ppm (0.05%) although they can be used effectively to beyond 50% and down to 100ppm. Their output is very reproducible over the operating range, allowing convenient single point calibration. This combined with their immunity to pressure changes makes them the ideal choice for many processes. They cannot be used with samples containing significant amounts of hydrogen.

L cells are used to monitor oxygen concentrations between 1 and 1000ppm. They can be used reliably up to 10% but because of their higher output and hence shorter life they are typically restricted to the lower concentration measurements. They are used in preference to the N type when measuring above 100ppm when speed of response in

purging down from higher concentrations is important. They cannot be used with samples containing significant amounts of hydrogen.

H cells are used to monitor oxygen concentrations between 1ppm and 1% in hydrogen bearing gases. They can be used reliably up to 10% but are typically restricted to the lower concentration measurements. They are used in preference to the E type when measuring above 1000ppm when accuracy and immunity to atmospheric pressure variations are important.

E cells are used typically for high concentrations or lower concentrations when acid gases are present and accuracy below 1% is not critical. Although it is possible to use the cells for comparative results below 0.5%, they are not as precise as the other cells in this region. They are also used when the mean molecular weight of the gas varies significantly.

Effects of sample composition

Molecular weight

The N, L and H types have outputs which are a function of the mean molecular weight of the sample. Instruments are normally calibrated with nitrogen as the background gas unless otherwise stated. When other gases are present that significantly affect the mean molecular weight of the gas then this needs to be taken into account. The following formula is used to calculate the cell output under these conditions.

$$\text{Reading} = \text{Reading for an O}_2 \text{ in N}_2 \text{ sample} \times \sqrt{\frac{\text{Mean mol. wt. O}_2 + \text{N}_2}{\text{Mean mol. wt. of sample}}}$$

Example

If an instrument was reading 10% oxygen on a oxygen/nitrogen sample and the nitrogen was replaced by argon.

$$\text{mean mol. wt. of O}_2/\text{N}_2 = 0.1 \times 32 \text{ (mol. wt O}_2\text{)} + 0.9 \times 28 \text{ (mol. wt. N}_2\text{)} = 28.4$$

$$\text{mean mol. wt. of O}_2/\text{Ar} = 0.1 \times 32 + 0.9 \times 39 \text{ (mol. wt. Ar)} = 38.3$$

$$\text{So reading of instrument would be } 10 \times \sqrt{28.4/38.3} = 8.61\%$$

The E type cell does not have this characteristic and its output is not dependent on the molecular weight of the sample.

6.0 SPARES AND REPAIRS

6.1 Ordering parts

The only part that is user serviceable is the replacement cell. All other parts are designed for a MTBF of 100,000 hours. Should any failure occur, then the instrument should be returned to Hitech Instruments Ltd or their local agents for repair. When ordering spare cells or raising queries on the instrument, it is important that the serial number or job number, are quoted. These numbers may be found on the data label on the right-hand side of the instrument.

6.2 Storage of measuring cell

The E cells have a maximum useful life of 5 years including any storage time. The oxygen cells types N and L have a maximum storage life of 6 months if the full usable life is to be realised. Each cell is dated in manufacture and "storage" starts from that time. The first two digits give the month and the second two the year. i.e. 1086 is October 1986. Ideally the cell should be stored in a refrigerator and the seal over the sample connector should be intact and undamaged. It is advisable, when the replacement date is predictable, to order a new cell from Hitech or their agents one month prior to this date. This ensures that a fresh cell is available at replacement time.

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