CAMBRIDGE SENSOTEC LTD

Rapidox 4100 Oxygen Analyser

Instruction Manual

Revision 2.2

Cambridge Sensotec Limited
Unit 8 Royce Court
Burrel Road
St Ives
CAMBS
PE27 3NE

Tel. +44 (0)1480 462142
Fax +44 (0)1480 466032
Mobile (07866) 624236
Sales@Cambridge-Sensotec.co.uk

Declaration of Conformity

Manufacturer: Cambridge Sensotec Limited
Unit 8 Royce Court
Burrel Road
St. Ives
CAMBS PE27 2NE
England

Product Names: Rapidox portable oxygen gas analyser

Model Numbers: RX4100

Conform to the following specifications:

EMC: EN 61326:1998

Electrical equipment for measurement, control and laboratory use

SAFETY: EN61010: 1993

This instrument complies with the European Low Voltage Directive 3/EEC, amended by 93/68/EECby the application of the safety standard. Installation and servicing should only be carried out by suitably qualified personnel.

ELECTROMAGNETIC COMPATIBILITY: EN50270:1999

This instrument meets the requirements of - .EMC . Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen.

Declaration

I declare that the above products conform to the applicable requirements of the LVD Directive 73/23/EEC and the EMC Directive 89/336/EEC and is CE marked accordingly.

Signature: M Swet

Name: Dr. Mark Swetnam

Title: Managing Director

Company: Cambridge Sensotec Limited

Date: 4th May 2007

WEEE Regulations 2006

Cambridge Sensotec takes its responsibilities under the WEEE Regulations extremely seriously and has taken steps to be compliant line with our corporate and social responsibilities. In the UK, Cambridge Sensotec has joined a registered compliance scheme "WeeeCare" (WeeeCare registration number WEE/MP3538PZ/SCH).

UK users only: If you have purchased any electronic or electrical product from Cambridge Sensotec since 2007 and would like to dispose of it correctly under the WEEE scheme, please contact us and we will be happy to either arrange the collection of the waste or have it returned to our offices for recycling. All our in-house manufactured products are scheme compliant and carry the WEEE label indicating that it is NOT allowed to be disposed of in a landfill site.

Contents

1. Introduction

The Rapidox 4100 oxygen analysers in this range are microprocessor controlled and provide a performance and a range of features without parallel for analysers of this type and cost. Fitted with a display that auto-ranges over a span of approximately 5 decades, (depending on the model) the alarm and analogue outputs are user programmable. Four sensor types are available to cover oxygen concentrations from 100% to low parts per million (ppm) in a variety of gas mixtures.

The Rapidox 4100 is a fully integral unit complete with a powerful yet quiet linear piston pump to provide gas sampling in the range 0.1 to 4 litres per minute. The analyser includes programmable alarm circuits and programmable analogue outputs (0-5V OR 4-20mA.

2. Features

- Bench mounted gas sampling electrochemical oxygen gas analyser
- Continuous gas sampling via powerful internally located linear piston pump
- Flow rate controlled by needle valve / flow gauge on front panel
- Fast measurement response (typically 3 seconds for a 90% response)
- Full measurement range available (0.1 ppm to 100% oxygen)
- Accuracy ± 1% of the full scale oxygen with a precision ± 0.5%
- Easy to calibrate by the user using ANY gas (air is usually chosen for convenience)
- Sensor life expectancy typically 2 – 5 years depending on type.
- 0-5V or 4-20mA current loop outputs (high range programmable)
- Programmable alarms (low and high condition) with outputs.

3. 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

- ***H cell model -*** Display range 1ppm to 10%. Resolution: 0.01% from 0.50% to 9.99%; 1ppm from 0ppm to 4999ppm. Suitable for hydrogen gases.

- ***L cell model -*** 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 reading per month, or 1ppm whichever is greater.

Cell life: E cell - up to 5 years. N, H and L cells - up to 2 years

Sample flow: Between 100ml.min^{-1} and 2L.min^{-1}

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 to +40 °C (non condensing)

Sample connections: Inlet and outlet: nipple fittings suitable for 0.25 inch (or 6mm) o/d tube

Speed of response: T90 is variable depending on sensor and concentration and is 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 10kohms) or 4 to 20mA (max. load 300ohms). The 20mA point oxygen value is user programmable over the following ranges.

.E. Type cell: 5% to 100%
.N. Type cell: 50ppm to 50%
.L. & .H. Type cell: 50ppm to 10%

Setting resolution: 0.1% from 10.0% to 100% 0.01% from 0.50% to 10.0% 10ppm from 500ppm to 4999ppm 1ppm from 50ppm to 499ppm

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.

Ambient temperature: 0 to 40 ℃ – continuous -5 to + 50 ℃ – intermittent

Supply voltage: 110/120 v or 220/240 v 50/60 Hz, 24v DC, ±10% including ripple and noise. Max power consumption 6VA.

4. Installation

4.1 Precautions

Make sure you read and understand these instructions and keep them safe for later use. The unit should not be exposed to extreme temperatures < -5℃ or > 50℃. Normal operating temperature is 0-40℃. Avoid direct sunlight. Do not use liquid cleaners, aerosols or solvents to clean the case. Use a damp cloth for cleaning. Do not use this equipment near water. Avoid touching the LCD display as this may cause permanent damage. Make sure the rear ventilation slots are free of obstruction.

It is important that the sample being supplied to the analyser is clean and non-corrosive. Filters or chemical absorbers will be necessary for those samples that contain particulate matter or corrosive components. Additionally the dew-point of the sample should not be above the ambient temperature.

If site or process conditions require that the process is isolated from the analyser when the cell is changed, then shut-off valves should be fitted to the inlet and outlet of the measuring cell. The inclusion of a three way valve on the inlet side can also be used to allow easy connection of a standard gas for calibration checks.

There are no user serviceable parts in this unit. Do not attempt to repair yourself. Refer all servicing to qualified Cambridge Sensotec personnel.

4.2 Connections

It is particularly important that good pipe work connections are made when low levels of oxygen are being measured. For all parts per million (ppm) measurements the pipe work up to the inlet of the analyser, should be all metal or hard plastic such as Nylon 6, un-plasticised P.V.C. etc. PTFE, plasticised P.V.C. and other soft plastics ARE NOT SUITABLE. Standard 6mm or ¼" tubing is ideal.

The analyser must not be pressurised beyond 0.25 bar gauge or less than (-250mm water gauge. Rapid pressure changes could damage the cell, and pulsation will give an erratic display.

4.3 Cell Characteristics

4.3.1 E Cells

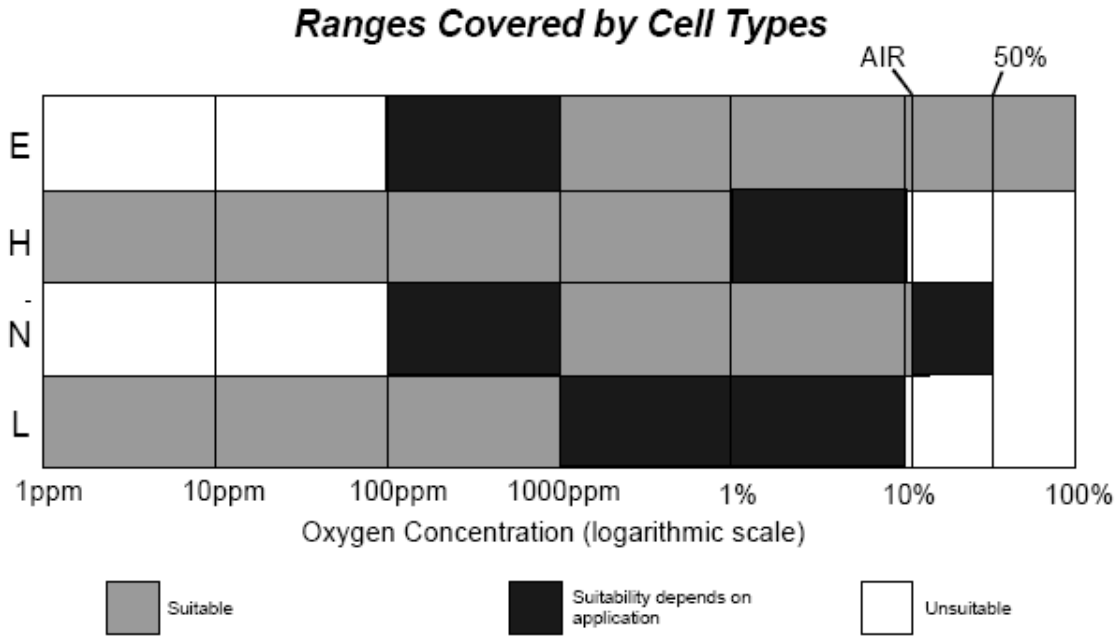
E cells are partial pressure cells and as such are affected by changes in atmospheric pressure. They are mainly used for high concentrations or lower concentrations when mildly acid gases are present and accuracy is not critical. They are not significantly affected the density of the sample or the presence of hydrogen. For best accuracy however it is best to calibrate with a mixture of gases similar to those in the process gas. The minimum resolution of E cell instruments is 0.01% (100ppm). For improved accuracy below 0.1% (1000ppm) the alternative cells would be better assuming other factors do not dictate otherwise. Suitable sample components for the E cell are: nitrogen, all inert gases, hydrogen, carbon dioxide, hydrogen sulphide, carbon monoxide, hydrocarbons up to C_4H_n.

4.3.2 N, H & L Cells

These have an output that is not affect by changes in atmospheric pressure but is affected by changes in sample density. The default background gas is nitrogen and the reading changes approximately according to the following formula:

$$\sqrt{\frac{\text{Density of calibration gas}}{\text{Density of sample gas}}}$$

Example: if the calibration gas was oxygen in nitrogen and the sample applied had a density 1.5 higher, the oxygen reading on the process gas would be $\sqrt{1 \div 1.5} = 0.8$ lower than on the calibration gas. If the sample density changes significantly in normal use then some form of compensation or use of an E type cell should be considered. It important for best accuracy that instruments fitted with these cells are calibrated on a gas of similar composition to the process gas. Suitable sample components for N and L cells are: nitrogen, true inert or noble gases, Hydrocarbons up to C_4H_n.



5 Rapidox Operating Instructions

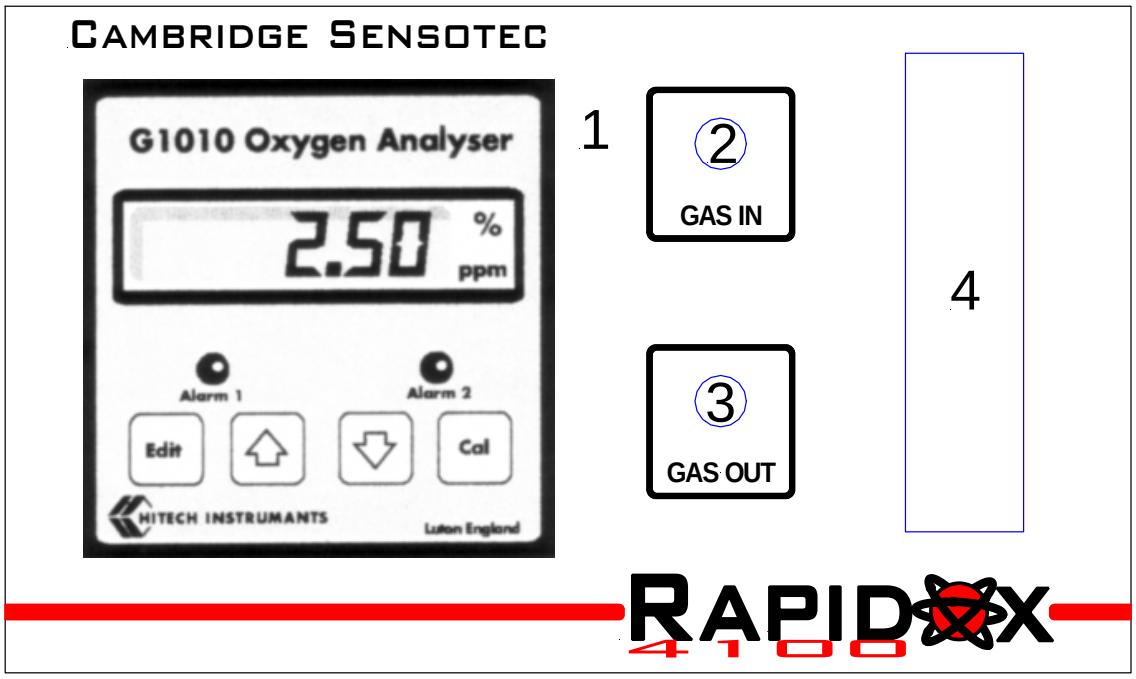


Figure 1: Rapidox 4100 front panel. The numbers refer to the instructions below.

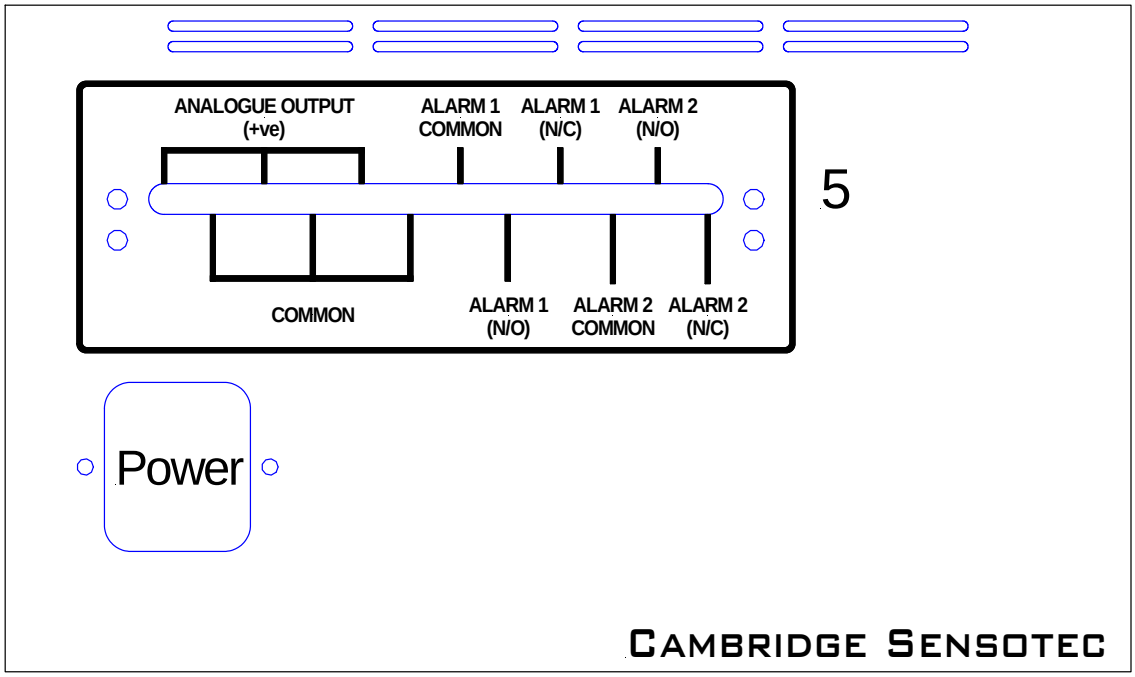


Figure 2: Rapidox 4100 rear panel. N/C= normally closed, N/O = normally open.

Ensure that the Rapidox analyser is located away from extreme heat and dirt environments. Plug the unit in to a suitable supply (noting the information on the serial sticker and using the power cable supplied). Connect your gas sampling tube (6mm OD 4mm ID) to the front gas inlet connector (2). If required a second tube can be connected to the gas outlet connector (3) and vented to the outside air. Turn the unit on using the power switch on the rear panel (located below the mains cable input). At this time the internal pump will energise and you can select the required gas flow by adjusting the flow valve (4).

When power is applied, the analyser briefly sets the alarms and analogue output to the fault condition: both alarms on and analogue output at approximately 115% (~5.6V or 22.5mA), and then automatically enters normal measurement mode. Depending on which cell is fitted, the analyser may initially indicate a high oxygen reading. After a few minutes the reading will settle to a level dependent on the sample being supplied to the cell. The analyser is calibrated prior to shipment and may be used immediately. To check the calibration see section 6.2.

Allow thirty minutes for the analyser to stabilise fully. This allows the components of the analyser to reach a stable working temperature. During this warm-up period it is common for the baseline oxygen to drift by a small amount, which may be corrected by re-calibrating.

5.1 The Rapidox Analyser - Menu System

All of the user-programmable functions are accessed via a menu system which is controlled using the front panel Keypad on the G1010 module (1). 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 the measurement mode.

5.2 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. The value changes slowly when the button is first pressed, enabling the least significant number to 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 memory. Simultaneously the display will change to show "E x" and the Alarm 1 LED will continue to flash.

5.3 Alarm 1 – Mode

The symbol displayed in the .x. position indicates the mode of the alarm as follows; O - 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 "EHxx" and the Alarm 1 LED will continue to flash.

5.4 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 the 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.

5.5 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 (5). 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 ranges 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%

5.6 Cell Failure Detection

All types of cell used on the 4100 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.

5.7 Applying a Sample

Establish a sample flow of between 100 ml.min^{-1} and 2l.min^{-1}. The analyser will respond immediately and move towards displaying 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). Figure 3 & Figure 4 show the typical response time from an air condition for N and L type cells. The E cell has a response rate similar to the N cell. The H cells response varies according to the hydrogen content and typically falls between the N and L cell. Once a 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.

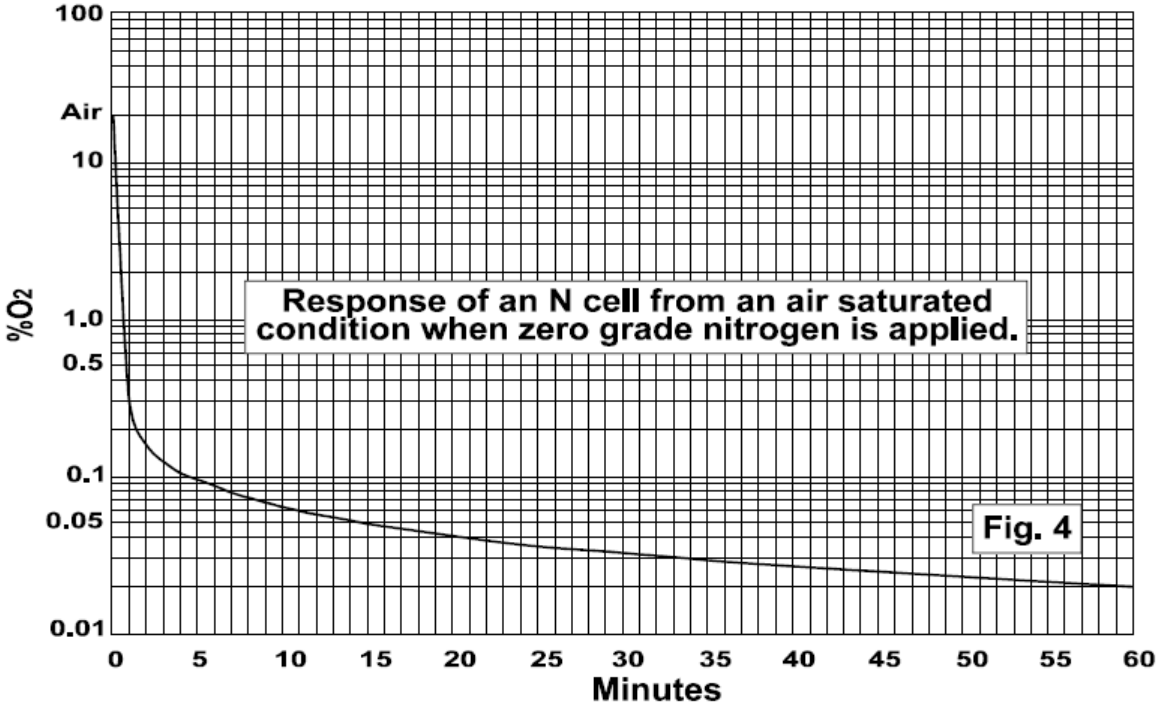


Figure 3: Response curve for E & N cell versions going from air to pure nitrogen

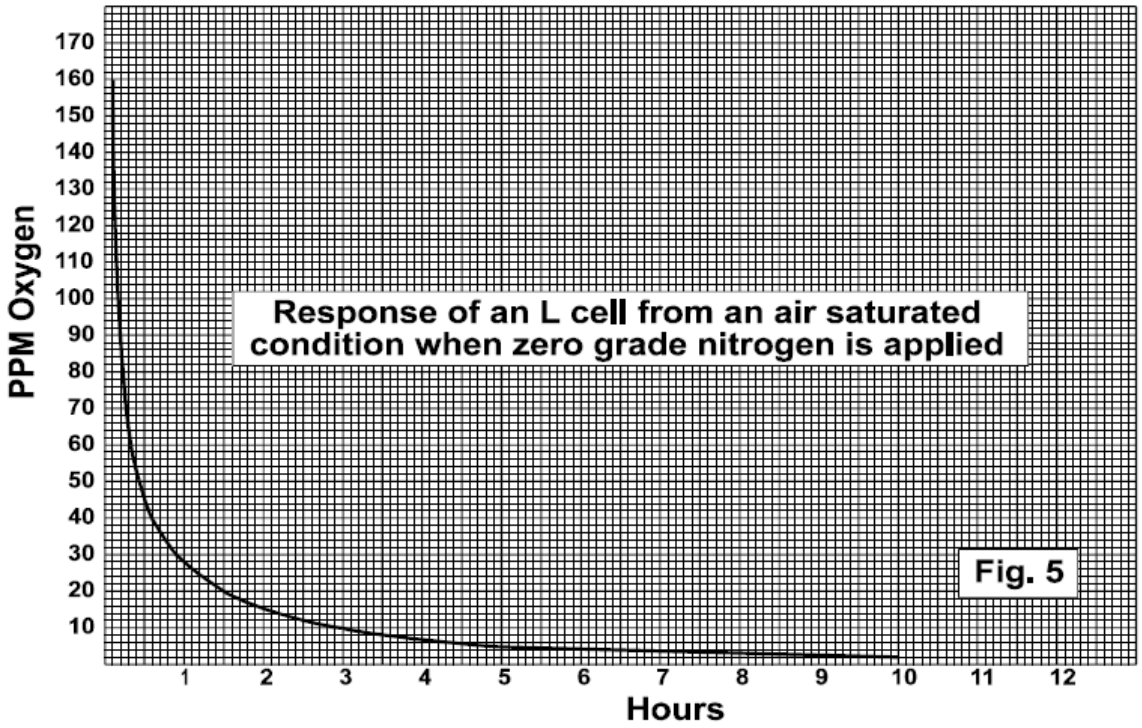


Figure 4: Response curve for L cell version going from air to pure nitrogen

5.8 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 unit 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 unit 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 Maintenance and Calibration

CAUTION: Disable all analyser-dependent plant control functions before commencing calibration and maintenance procedures. Some of the procedures described when replacing/connecting a cell assume that the escape of the sample into the atmosphere will not constitute any sort of hazard such as asphyxiation, flammability etc. It is the responsibility of the user/operator to ensure this. If a hazard will result then the method should be modified accordingly. Consult Cambridge Sensotec for advice if in doubt.

6.1 Typical Cell Life

E Type: 5 years in ideal conditions - (moist inert gas at 15°C). 2 to 3 years can be expected as a minimum.

N Type: 100,000 oxygen % hours or 2 years, whichever is the sooner

H Type: 80,000 oxygen % hours on nitrogen and 25,000 oxygen % hours in hydrogen or 2 years, whichever is the sooner.

L Type: 16,000 oxygen % hours or 2 years, whichever is the sooner.

All known cell failure modes result in a loss or lowering of output.

6.2 Calibration

The calibration routines detailed below all assume that the cell zero offset has been entered as detailed in detailed in 6.9 for E cells or in 6.11 for N,H & L cells. Instruments as delivered and fitted with their original cell will have had this offset entered. When installing a replacement cell it is important to follow these procedures. It is recommended that the calibration is 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.

6.3 Calibration of N & E cell Analysers

For optimum accuracy it is best to calibrate with a gas of the same composition and oxygen concentration as the normal sample. Refer to section 0 if calibrating an
“N” type instrument AND the density of the calibration gas and sample gas are significantly different. If calibrating on ambient air, take into account the dilution effect of its humidity using the table below.

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

Flow the calibration gas through the analyser and wait for the reading to become stable. If the reading is the same as the concentration of the calibration gas, no adjustment is necessary, and the analyser may be put back in normal service. Otherwise, press and hold the Cal button until the display shows “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 confirm the calibration. The display will now show “H xxxx”, where “xxxx” is the correct concentration of the test gas. Press the Cal button momentarily to return to measurement mode. This completes the calibration and the analyser is ready for use. Re-enable any disabled control functions.

6.4 Calibration of L & H cell Analysers

Typically, these instruments will be measuring parts per million (ppm) concentrations of oxygen, and care must be taken not to expose “H” and “L” type cells to ambient air for more than a few minutes while changing pipes etc. This is because the time taken to purge the cell down to low ppm levels depends on how much oxygen the cell has absorbed. If the cell has only been exposed briefly to air, the purge time will be quite short. If, however, the cell has been exposed to air for several hours, the purge time may become far longer. See Figure 4 for details. Refer to section 0 if calibrating an “L” or “H” type instrument and the density of the calibration gas and sample gas are significantly different. The method used to calibrate ppm analysers depends on the concentration to be measured during normal service.

6.5 Calibration of L & H cell Analysers > 50ppm oxygen

Ideally use a standard gas with a concentration of oxygen approximately that of the typical in-service concentration. However it is possible to use concentrations up to 10% oxygen. Flow the calibration gas through the analyser and wait for the reading to stabilize. If the reading is the same as the concentration of the calibration gas, no adjustment is necessary, and the analyser may be put back in normal service. Otherwise, press and hold the Cal button until the display shows “H xxxx”; where “H” indicates that the high calibration point is selected and “xxxx” is the measured concentration. Use the up/down arrow buttons to set the reading to that of the calibration gas, and then press the Edit button momentarily to confirm the calibration. The display will now show “H xxxx”, where “xxxx” is the correct concentration of the test gas. Next, press the Cal button momentarily to return to measurement mode. This completes the calibration and the analyser is ready for use. Re-enable any disabled control functions.

6.6 Calibration of L & H cell Analysers < 50ppm oxygen

For these analysers, the "zero" or low point of the analyser should be set using a gas of similar concentration to the typical in-service concentration. Flow the calibration gas through the analyser and wait for the reading to stabilize. If the reading is the same as the concentration of the calibration gas, no adjustment is necessary, and the analyser may be put back in normal service. Otherwise, press and hold the Cal button until the display then shows "H xxxx"; where "H" indicates that the high calibration point is selected. Next, press and hold the Cal button again until the display show "L xxxx", indicating that the low/zero calibration point is selected. Now 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 and return to measurement mode. The display will now display the concentration of the test gas. The next stage is optional, and for analysers typically measuring less than 20ppm. It is not recommended except for the first calibration following the fitting of a replacement sensor. Flow the calibration gas, which should have a concentration of at least 100ppm oxygen, through the analyser until the reading is stable. If the reading is the same as the concentration of the calibration gas, no adjustment is necessary, and the analyser may be put back in normal service. Otherwise, press and hold the Cal button until the display shows "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. Next, press the Cal button momentarily to return to measurement mode. This completes the calibration and the analyser is ready for use. Re-enable any disabled control functions.

6.7 Replacing the Cell

Before proceeding identify which cell is to be replaced, then read and fully understand the following sections for the appropriate procedure. 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. See sections below 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. Replacement cells have their zero offset value written on the data label. It is necessary enter this value into analyser when fitting the new cell. The procedure used depends on the type of cell.

The cell is located on the inside of the machine towards the rear of the Rapidox instrument. To access the cell disconnect the analyser from the mains and remove the four corner screws from the rear panel. Carefully lift up the rear panel from the bottom noting that there are cables attached. With the rear panel partly removed you will be able to see the cell in front of you.

Disconnect the +ve (red) and –ve (black) wires from the orange terminal block by pulling the terminal block away from the rear of the G1010 module. This will allow access to the screw terminals with a small screwdriver. Slacken the compression nut on the cell sample tube and withdraw the old cell. Replacement is the reverse of removal; refer to the following sections for details of each type of cell.

6.8 Additional Notes for Replacing E cells

E cells 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 following the setting of the cells zero offset.

6.9 Setting the Zero Offset for E cells

The label on the E cell is marked with the cell offset at zero oxygen concentration. The offset figure is given in units of percent oxygen and is negative; e.g.(-)0.35%. A short length of wire is also supplied with the cell, the use of which is described later. To set the zero offset proceed as follows:

Remove any cell leads connected to terminals 1 and 2 of the instruments terminal block and connect the short length of wire across the terminals so as to form a shorting link. Replace the rear panel temporarily and apply power to the instrument if it has been disconnected, and allow 30 seconds for the electronics to stabilise.

Press and hold the Cal button until the display shows “H xxxx”. Release the button and then press and hold it again 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 two seconds and release. This puts the figure into the instrument memory, the “L” will disappear and instrument will return to ordinary measurement mode. Disconnect power and remove the shorting link and discard it. Connect the cell leads. The instrument is now ready for use. Re-enable any disabled control functions.

6.10 Additional Notes for Replacing N, L & H cells

These cells 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 the cell is to be immediately applied to the

measurement of low oxygen concentrations, 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 quickly as possible.

6.11 Setting Zero Offset for N, L & H cells

The label on the cell is marked with the cell 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 terminal block and leave the input open circuit, i.e. with nothing connected to terminals 1 and 2. Close the rear lid and 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 and hold the Cal button until the display shows “H xxxx”. Release the button and then press and hold it again 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 two seconds and release. This puts the figure into the instruments memory and the “L” will disappear and instrument will return to ordinary measurement mode. Connect the cell leads. The instrument is now ready for use. Re-enable any disabled control functions.

6.12 Safety and Disposal of Depleted Cells

The cells contain a 4-molar potassium acetate solution which is corrosive. Normally the solution only leaks out as a result of mechanical damage (crushing or piercing), or by electrical misuse; e.g. by attempting to input an electrical charge. The cells also contain small amounts of lead, lead oxide, platinum, silver, carbon and antimony, some of which are toxic and/or mutagenic. If the contents of the cells come into contact with the skin or other parts of the body, the affected area should be washed with copious amounts of water and medical advice sought. As the cells contain some toxic compounds, they must be disposed of according to local waste management requirements and environmental legislation, irrespective of their physical condition. They must not be burnt as they will evolve toxic fumes.

7 Spares and Repairs

The replacement cell is the only user serviceable part. All other parts are designed for a MTBF of 100,000 hours. If any failure occurs, the instrument should be returned to Cambridge Sensotec for repair. When ordering spare cells or raising

queries on the instrument, it is important that the serial number or job number, is quoted. These numbers are found on the data label on the right-hand side of the instrument.

The E cells have a maximum useful life of five years including any storage time. The oxygen cells type N and L have a maximum storage life of six 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 with any sealing bungs etc. intact and undamaged. It is advisable, when the projected replacement date can be anticipated, to order a new cell from Cambridge Sensotec one month in advance.

8 Warranty

The Rapidox 4100 analyser has been carefully tested and inspected before shipment and is guaranteed to be free from defective materials and workmanship for a period of twelve months from date of purchase. The sensor is replaceable and has a life expectancy of up to five years depending on type (see section 6.1). However, if the analysis gas contains corrosive gases or large quantities of particulates, sensor life may be shortened. In the case of the latter, it is normally possible to insert a filter prior to the sensor head to remove the particulate material.

8.1 Conditions of Warranty:

1) This warranty is in addition to and does not affect any statutory rights of consumer purchasers. This warranty is valid worldwide on a back to base basis.

2) This warranty covers breakdowns due to design or manufacturing faults; it does not apply to damage, however caused, wear and tear, neglect, unauthorised adjustment or repair, or any items of limited natural life.

3) In the event of failure, please contact the Cambridge Sensotec service and repair centre at the address given on the cover of the manual.

4) The warranty period applicable shall be 12 months from the date of purchase.

Rapidox CERTIFICATE of CALIBRATION

Date: …….

Rapidox Serial number: …….

G1010 Module Serial number: …….

Cell Serial number: …….

Calibration Gas 1: ……. Rapidox Display: …….

Calibration Gas 2: ……. Rapidox Display: …….

Calibrated by: …….

Signed: …….

Cambridge Sensotec Rapidox 4100 Oxygen Analyser Instruction Manual