Thank you for purchasing this CO$_2$ analyzer. Please read this manual thoroughly to familiarize yourself with the many unique features and exciting innovations we have built into your new equipment. Esco provides many other resources at our website, www.escoglobal.com, to complement this manual and help you enjoy many years of productive and safe use of your Esco products.

User and Service Manual

COA-2010-F
G100 Electronic CO$_2$ Analyzer

Copyright Information

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Warranty Terms and Conditions

Esco warrants that the product described in this manual will perform according to specifications for a period of 12 months from the date of purchase.

Esco's limited warranty covers defects in materials and workmanship. During the warranty period, Esco's liability shall be, at our option, to repair or replace any defective parts of the product, provided if proven to the satisfaction of Esco that these parts were defective at the time of being sold, and that all defective parts shall be returned, properly identified with a Return Authorization.

This limited warranty covers parts ONLY and not transportation / insurance charges.

This limited warranty does not cover:

- Freight or installation (inside delivery handling) damage. If your product was damaged in transit, you must file a claim directly with the freight carrier
- Products with missing or defaced serial numbers
- Products for which Esco has not received payment
- Problems that result from:
  o External causes such as accident, abuse, misuse, problems with electrical power, improper operating environmental conditions
  o Servicing not authorized by Esco
  o Usage that is not in accordance with product instructions
  o Failure to follow the product instructions
  o Failure to perform preventive maintenance
  o Problems caused by using accessories, parts, or components not supplied by Esco
  o Damage by fire, floods, or acts of God
  o Customer modifications to the product

Factory installed, customer specified equipment or accessories are warranted only to the extent guaranteed by the original manufacturer. The customer agrees that in relation to these products purchased through Esco, our limited warranty shall not apply and the original manufacturer's warranty shall be the sole warranty in respect of these products. The customer shall utilize that warranty for the support of such products and in any event not look to Esco for such warranty support.

Esco encourages user to register product online at www.escoglobal.com/warranty or complete the warranty registration form included with each product.

ALL EXPRESS AND IMPLIED WARRANTIES FOR THE PRODUCT, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES AND CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN TIME TO THE TERM OF THIS LIMITED WARRANTY. NO

Technical Support, Warranty Service Contacts
Toll-Free USA and Canada 877-479-3726
Singapore: +65 6542 0833
Global Email Helpdesk: support@escoglobal.com

Visit http://www.escoglobal.com/ to talk to a Live Support Representative
Distributors are encouraged to visit the Distributor Intranet for self-help materials.

Policy updated on 30th Jan 2007 *(This limited warranty policy does not apply to products purchased before 30th Jan 2007).*

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Introduction

1. Products Covered

Esco CO2 Incubator – Celculture - Accessories	
Type	Model
Electronic CO2 Analyzer	COA-2010-F

2. Safety Warning

- Anyone working with, on or around this equipment should read this manual. Failure to read, understand and follow the instructions given in this documentation may result in damage to the unit, injury to operating personnel, and / or poor equipment performance.

- Any internal adjustment, modification or maintenance to this equipment must be undertaken by qualified service personnel.

- The use of any hazardous materials in this equipment must be monitored by an industrial hygienist, safety officer or some other suitably qualified individual.

- Before you process, you should thoroughly understand the installation procedures and take note of the environmental / electrical requirements.

- In this manual, important safety related points will be marked with the s ⚠

- If the equipment is used in a manner not specified by this manual, the protection provided by this equipment may be impaired.

3. Limitation of Liability

The disposal and / or emission of substances used in connection with this equipment may be governed by various local regulations. Familiarization and compliance with any such regulations are the sole responsibility of the users. Esco's liability is limited with respect to user compliance with such regulations.

4. European Union Directive on WEEE and RoHS

The European Union has issued two directives:

• Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE)

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Esco sells products through distributors throughout Europe. Contact your local Esco distributor for recycling/disposal.

• Directive 2002/95/EC on Restriction on the use of Hazardous Substances (RoHS)

With respect to the directive on RoHS, please note that this hood falls under category 8 (medical devices) and category 9 (monitoring and control instruments) and is therefore exempted from requirement to comply with the provisions of this directive.

Declaration of Conformation

In accordance to EN ISO/IEC 17050-1:2004

$C\mkern-8mu\epsilon$
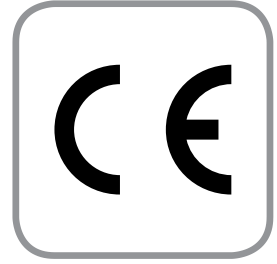
We,   Esco Micro Pte. Ltd.
of   21 Changi South Street 1
        Singapore, 486777
        Tel: +65 6542 0833
        Fax: +65 6542 6920

declare on our sole responsibility that the product:

        Category   **: Electronic CO_2 Analyzer**
        Model   **: COA-2010-F Electronic CO_2 Analyzer**

in accordance with the following directives:

        2006/95/EEC   **: The Low Voltage Directive and its amending directives**
        89/336/EEC   **: The Electromagnetic Compatibility Directive and its amending**
                              directives

has been designed to comply with the requirement of the following Harmonized Standard:

        Low Voltage   **: EN 61010-1:2001**
        EMC   **: EN 61326-1:2006 Class B**

More information may be obtained from Esco's authorized distributors located within the European Union. A list of these parties and their contact information is available on request from Esco.

_____

Lin Xiang Qian
Vice President of Engineering Division

Chapter 1 – Product Information

1.1 Instrument Panel

A – Main Read Screen – Start and end screen when using the instrument.

B – Soft Keys – The function of the three 'soft-keys' on the front of the instrument panel are determined by menu options taken. Functions vary from screen to screen.

C – On/Off Key – Press the 'On/Off' key briefly to switch the instrument on and off.

D – Pump Key – Press the 'Pump' key to start or stop the pump.

E – Scroll Left Key/Key 4 – Enables the operator to scroll left to display more information.

F – Scroll Down Key/Key 8 – Enables the operator to scroll down to display more information.

G – Menu Key – Press the 'Menu' key to go to the 'Main' menu. Enables the operator to pre-set values and settings. Select options from the 'Main' menu to also view data and readings stored or held.

H – Enter Key – The 'Enter' key accepts/confirms choices made by the operator to various functions and operations. Also, required to confirm numeric data entry.

I – Scroll Up Key/Key 2 – Enables the operator to scroll up to display more information.

J – Scroll Right Key/Key 6 – Enables the operator to scroll right to display more information.

K – Moisture Removal Tube – Removes the moisture from the sample gas.

L – Serial Number – Unique Identification for the instrument. Verification of the serial number will be required if Technical Support

M – Instrument Stand – Instrument stand

Note:
- *Do NOT attempt to remove the cover off the back of the analyzer which houses the moisture removal tube.*
- *Do NOT cover the moisture removal tube with your hand when holding the analyzer to take readings.*

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1.2 Connectors

A – Temperature 1 – Temperature 1 connector measures differential temperature – incubator and ambient temperatures.

B – Temperature 2 – Temperature 2 connector measures differential temperature – incubator and ambient temperatures.

C – Humidity Probe (Optional) – Humidity probe attachment point.

D – Gas Outlet – Gas outlet port used to exhaust the gas.

E – Gas Inlet – Gas inlet point used to attach the sample tube and filter in order to take the gas reading.

F – USB Cable Attachment Point – Used to connect the analyzer to a PC via a USB cable to download data.

G – Mains Battery Charger Point – Used to attach the mains charger to the analyzer for charging.

 5V $\;\overline{\cdots}\;$ ± 0.5V(max 1000mA)
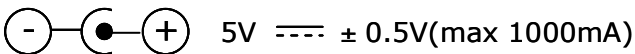
Note:
Temperature connectors are fitted with snap rivets to prevent dust ingress, remove before use. Grip back cap and pull upwards to release. Refit when not in use.

Chapter 2 – General Operational Instructions

2.1 Switching the Instrument On
- To switch on the instrument, press the 'On/Off' key briefly. There will be a short beep and a slight pause followed by the company logo.
- The power on self-test will then commence (approximately 15 seconds) including warm-up time.
- Assuming there are no warnings to display the instrument will continue to the 'Main Read Screen'.

2.2 Switching the Instrument Off
- Purge with fresh air. Run the pump for approximately 30 seconds or until the readings have returned to normal levels.

  Note:

  Before the instrument is switched off a clean air purge should be performed. This ensures that the instrument is free from gas and ready for the next measurement. This final purge is especially important for the oxygen sensor as it may degrade if stored when contaminated with gas.

- To switch off the instrument, press the 'On/Off' key briefly.

  Note:

  If the 'Auto Off' utilities setting is set to 'Yes', the analyzer will switch off automatically after 10 minutes if not in use.

2.3 Instrument Main Read Screen
After the analyzer has been switched on and the warm-up self-tests completed the analyzer will display the 'Main Read Screen'.

Soft-Keys:

Peak - Enables the operator to display the peak reading.

Store - Enables the operator to store the displayed reading for viewing/download later.

Hold - Enables the operator to hold the current reading being taken.

Note:

The pump is turned off when a reading is stored.

2.4 Instrument Status Icons

The following icons may be displayed on the instrument read screens:

Icon	Description
▮ ▮ ▯ ▯ ▯ ▯	Battery charge state
▯ (flashing)	< 1 hour remaining
⚡ (flashing)	Battery charging
⚡	Charged
⚙	Pump running
⚙ (flashing)	Pump stalled (Backlight turns red)
🔔	Alarm set
🔔 (flashing)	Alarm active (Backlight turns red)
🖳	USB connected to PC (flickers when transferring data)
🗎	Logging mode active (flashes when memory nearly full)
↘	Temperature probe(s) connected
↘	Humidity probe connected
⚕ (flashing)	Service due (every 12 months)
⚕	Service overdue
⚡	Fault/repair
⌛	Waiting

Note:

A red backlight is displayed if the pump is stalled or the alarm is activated. For further information, please refer to 'section 2.9.2.3 Alarms' or 'section 2.9.2.5 Flow Fail'.

2.5 Entering Data

During normal operation the user may be prompted to enter data or information via the keypad, i.e. entering an ID code or setting an alarm level.

When entering data into the instrument all fields are fixed format and are populated from the right. For example, to enter a new time 09:25:00 the user would type in 092500 using the numeric keypad in the following sequence:

* : : 0
* : :09
* : 0:92
* :09:25
* 0:92:50
* 09:25:00

Press the 'Enter' key to confirm/accept data keyed.

Any mistakes can be corrected using the soft-key 'Delete' which will delete the last character typed. Alternatively, the sequence can be re-typed before the 'Enter' key is pressed and the existing numbers will be pushed off the screen.

Note:

The instrument will not allow invalid data to be entered; this should be deleted and re-entered.

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2.6 Changing Between Parameters

By default, the instrument displays the 'Main Read Screen' (for gas measurement). This shows the CO_2 reading along with the optional O_2 reading. The instrument will return to this screen after power on or when returning from the menus. The 'Scroll' keys can be used to switch to another measurement screen, i.e. temperature or humidity. Continue to press the 'Scroll' key to return to the 'Main Read Screen'.

2.7 Memory

The memory should not be used as a permanent storage medium and any important data should be transferred to a more permanent storage medium as soon as possible. The instrument should not be stored for prolonged periods with valuable data in its memory.

2.8 Storage

When not in use the instrument should be kept in a clean, dry and warm environment, such as an office. It should be stored flat with the stand folded away which helps prolong the life of the O_2 cell.

2.9 Main Menu

The 'Main Menu' enables the operator to select options to set up specific parameters and perform operational tasks prior to sample readings being taken or to view data/information stored in the instrument.

Press the 'Menu' key on the front of the instrument panel and the screen will displayed:

```
        Main Menu
      1-Information
      2-Utilities
      3-Calibration
      4-View Data
      5-Diagnostics
                    [ Exit ]
```

Press the soft-key 'Exit' to exit the 'Main' menu.

2.9.1 Information

The 'Information' option enables the operator to display information such as instrument type, serial number, current software version, service due date and the dates of the last factory and user calibrations.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 1' to display general information about the instrument.

```
          G100
      S/N: IN00016
    V1.01 - 090304
    Svc Due:01/01/00
    Fac Cal:01/01/00
    Usr Cal:01/01/00
                    [ Exit ]
```
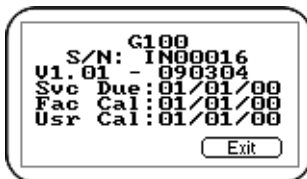
2.9.2 Utilities

The 'Utilities' option enables the operator to configure instrument settings prior to taking readings.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 2' to display the 'Utilities' menu and the following screen is displayed:

```
 Utilities Menu
1-Time & Date
2-Contrast
3-Alarms
4-Settings
5-Flow Fail
6-Logging
7-Reset      Exit
```

2.9.2.1 Time & Date

The 'Time and Date' option enables the operator to check or set the instrument's internal clock. The current time/date are appended to every stored reading.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 2' to display the 'Utilities' menu.
3. Press 'Key 1 – Time & Date' and the 'Set Time & Date' menu is displayed:

```
Set Time & Date

1-08:08:38
2-05/03/09
  DD/MM/YY

             Exit
```

Press 'Key 1' to change the time or press 'Key 2' to change the date.   Type the time or date using the numeric keypad followed by the 'Enter' key. The instrument will not allow invalid times or dates to be entered.

Note:
The clock will need to be manually adjusted to cope with daylight saving changes or changes when crossing time zones.

2.9.2.2 Contrast

The 'Contrast' option enables the operator to adjust the instrument screen contrast to compensate for changes in ambient temperature. The default setting is 0.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 2' to display the 'Utilities' menu.
3. Press 'Key 2' to select the instrument panel contrast settings and the screen will displayed

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```
┌─────────────────────┐
│   Adjust Contrast   │
│         +0          │
│   Use Cursor Keys   │
│                     │
│    (Accept)(Reject) │
└─────────────────────┘
```

4.   Press 'Key 3 - Scroll Left' and 'Key 6 - Scroll Right' to adjust the value displayed.
5.   Press the soft-key 'Accept' or 'Reject' accordingly to accept or reject the changes.

Note:
The manually set contrast setting is retained when the instrument is switched off.

2.9.2.3 Alarms
The instruments has the facility to set rising or falling alarms for the two main gas channels, CO_2 and O_2 (if selected as an option). The alarms for each channel can be enabled or disabled independently via the 'Alarms' menu option.

Once enabled these alarms become active in the 'Main Read Screen'; this is indicated by a bell 🔔 icon. If an alarm is triggered the screen turns red and a flashing bell 🔔 icon is displayed. The beeper is sounded until the gas level has recovered beyond the trigger point.

Rising alarms are triggered when the gas level exceeds the maximum value entered by the user.

Falling alarms are triggered when the gas level falls below the minimum value entered by the user.

1.   From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2.   Press 'Key 2' to display the 'Utilities' menu.
3.   Press 'Key 3' to select alarm settings and the following screen is displayed:

```
┌─────────────────────┐
│   Current Alarms    │
│ 1-CO2 Alarm  🔔     │
│ 2-O2 Alarm   🔔     │
│                     │
│            (Exit)   │
└─────────────────────┘
```
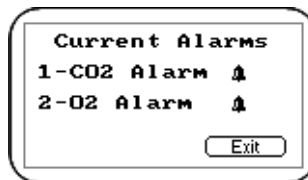
4.   Current AlarmsPress 'Key 1' to maintain CO_2 alarm and 'Key 2' to maintain O_2 alarm.
5.   Select from the following:
     1-Enabled/Disabled   Toggle between disabled and enabled alarm status.
     2-Max   Sets the upper limit alarm setting.
     3-Min   Sets the minimum alarm setting. The default is 0.
6.   Select the option to modify followed by the soft-key 'Accept' or 'Reject'.

2.9.2.4 Settings

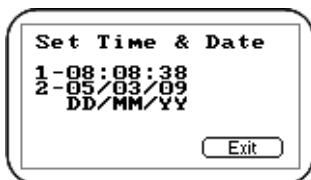The 'Settings' option enables the operator to maintain information with regards to taking samples and readings.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 2' to display the 'Utilities' menu.
3. Press 'Key 4' to select settings and the following screen is displayed:

```
┌─────────────────────┐
│      Settings       │
│                     │
│ 1-Prompt ID: Yes    │
│ 2-Temperature °C    │
│ 3-Date: DD/MM/YY    │
│ 4-Auto Off: No      │
│               ┌────┐│
│               │Exit││
│               └────┘│
└─────────────────────┘
```

The following instrument settings may be maintained:

1 - Prompt ID. Press 'Key 1' to prompt for ID code for each sample reading, answer Yes or No accordingly.

2 – Temperature. Press 'Key 2' to enter the default unit temperature, choosing from ^{O}C or ^{O}F.

3 – Date. Press 'Key 3' to switch the date format between dd/mm/yy and mm/dd/yy formats.

4 - Auto Off. Press 'Key 4' to auto switch off the instrument when not in use. Toggle between Auto Off: Yes or No. If set to Yes, the instrument will switch off after 10 minutes if not in use.

2.9.2.5 Flow Fail

The 'Flow Fail' option enables the operator to adjust the instrument flow fail detection point should it fail in normal operation with a clean filter.

The instrument's internal pump can be stalled when pulling against a vacuum or through a blocked filter. This is indicated by a flashing pump icon 🌀 and a red screen; to prevent damage to the pump, the pump will switch off after a few seconds.

Press the 'Pump' key again to remove the flashing pump icon.

Note:

Dirty or discoloured filters should be changed before use. Filters that have drawn in water should be changed immediately to prevent damage to the instrument.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 2' to display the 'Utilities' menu.
3. Press 'Key' 5 to select flow fail and the following screen is displayed:

```
┌──────────────────────┐
│  Adjust Flow Fail    │
│        -12           │
│  Use Cursor Keys     │
│                      │
│  ┌──────┐ ┌──────┐   │
│  │Accept│ │Reject│   │
│  └──────┘ └──────┘   │
└──────────────────────┘
```

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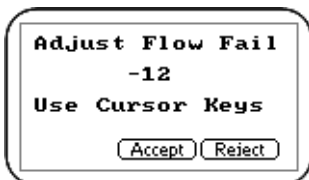
4. Use the 'Scroll' keys to adjust the value displayed. The larger the value, the less sensitive the flow fail detection is.
5. Press soft-key 'Accept' or 'Reject' accordingly.

Flow Fail Set-up Process – Best Practice

START → Increase the displayed value by 2

Turn pump on
Wait 5 seconds
Flow fail alarm? — Yes → Press pump cancel alarm → (back to Increase the displayed value by 2)
No → Decrease the displayed value by 1

Decrease the displayed value by 1
Wait 5 seconds
Flow fail alarm? — No → (back to Decrease the displayed value by 1)

Increase the displayed value by 3
Turn pump on
Block gas inlet
Wait 5 seconds
Flow fail alarm? — No → (to Decrease the displayed value by 1)
Yes →

Decrease the displayed value by 1
Block gas inlet
Wait 5 seconds
Flow fail alarm? — Yes → Press pump cancel alarm
No → Blocked or excessive restriction → Refer to Section 5.0 Problem Solving

Press pump cancel alarm
Decrease the displayed value by 1
Accept
END

2.9.2.6 Logging

Data logging mode can be started or stopped via 'Key 6 - Logging' accessed from the 'Utilities' menu. Press 'Key 4 – Start/Stop Logging' to start and stop data logging.

Whilst in data logging mode the instrument will automatically record data at the pre-set intervals including running the pump for a preset time.

Active logging mode is indicated on the 'Main Read Screen' by the 🗒 icon.

The operator is able to edit the default ID, pump run-time, interval and start/stop logging.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 6' to display the 'Logging' menu and the following screen is displayed:

```
       Logging

1-Every 60 mins
2-Pump 30 secs
3-ID 00000000
4-Start Logging
                    Exit
```

3. Select the desired option by pressing 'Keys 1 to 4'. Then enter the appropriate setting using the keypad followed by the 'Enter' key.

1-Every XX mins. Press 'Key 1' to enter the time in minutes for the timeframe between sample readings. The interval controls the reading frequency in minutes, i.e. every 10 minutes.
2-Pump XX secs. Press 'Key 2' to enter the time in seconds for the length of time you wish the pump to run when taking a sample reading. The pump run-time is the time in seconds for which the pump runs prior to the reading being stored. This figure will also need to take into account the length of sample tube and the volume of the sample gas. For example, there is little point setting a pump run-time of 10 seconds if it takes 30 seconds to draw in a new sample.
3-ID XXXXXXX. Press 'Key 3' to create an 8-digit numeric ID Code.
4-Start/Stop Logging. Press 'Key 4' to start and stop data logging.

Note:
Data logging mode is automatically stopped when the instrument is switched off or if the logging parameters are edited.

2.9.2.7 Reset

The instrument can be reset by pressing 'Key 7 - Reset' accessed via the 'Utilities' menu. Selecting this option will clear all user settings and any stored data including the event log.

A confirmation code (12345678) must be entered to confirm that a reset is really required.

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2.9.3 Calibration
The instruments is fully calibrated during manufacture and when returned for service. However, to improve accuracy between services a user/field calibration can be performed.

Note:
For further information please refer to section '4 Calibration' of this manual.

2.9.4 View Data
The 'View Data' option enables the operator to view the stored readings.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 4' to view stored data readings and the following screens are displayed:

```
    0002 of 0009              0002 of 0009
  5/03/09  8:22             5/03/09  8:22
  00000000 Auto             00000000 Auto
    CO2  0.0%                 Hum 41.5%
    O2 21.4%                   T1 37.1°C
  Baro  940                   T2 37.1°C
  ( More )    ( Exit )      ( More )    ( Exit )
```

Press 'Key 8 - Scroll Down'

View Data – Screen 1   View Data – Screen 2
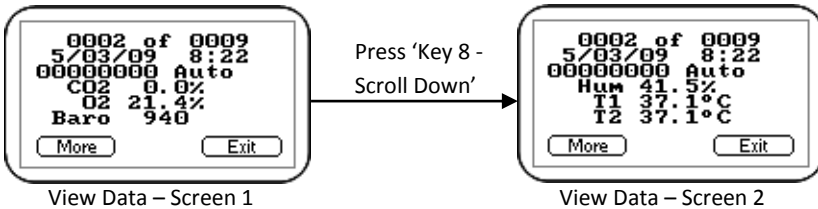
3. Press 'Key 4 - Scroll Left' and 'Key 6 - Scroll Right' to move through the stored readings either forwards or backwards. Press 'Key 2 - Scroll Up' and 'Key 8 - Scroll Down' to switch between the first (CO_2, O_2 & Baro) and second (T_1, T_2 & humidity) group of reading parameters.
4. Press the soft-key 'More' to refine or filter the readings to view.

```
          Options
    1-Delete all
    2-Filter
    3-Goto
                   ( Exit )
```

1-Delete All. Enables the operator to delete all the readings stored, (see below).
2-Filter. Used to refine/filter the range of readings displayed by ID or date ranges. Press between two dates, after a date, before a date or all dates.
3-Go to. Enables the operator to jump to the first or last reading in the memory or any other reading.

2.9.4.1 Clear Reading Memory
The 'Clear Reading Memory' function enables the user to check how many readings have previously been taken and clear them if necessary.

Note:
Before readings are actually deleted a caution message is displayed; once readings have been deleted they cannot be recovered.

The instrument can store up to 1000 readings. The reading structure is fixed and may contain optional parameters not activated for your particular instrument configuration, i.e. oxygen, temperature and humidity.

Once the reading memory is full it is not possible to store any more readings. When full and the 'Store' key is pressed or data logging is activated the instrument will show a brief message stating that the memory is full and that no further data will be recorded.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 4' to view data.
3. To clear the readings press the soft-key 'More' followed by 'Key 1 - Delete all'.

2.9.5 Diagnostics
The 'Diagnostics' option enables remote technical support to identify and resolve issues with the instrument and readings. If required, the operator may be asked to confirm the diagnostics displayed.

1. From the 'Main Read Screen' press the 'Menu' key on the instrument panel.
2. Press 'Key 5' to view diagnostics.

Note:
For further information contact your equipment supplier.

2.10 Warning and Error Codes
When switched on the instrument will perform a predetermined self-test sequence taking approximately 30 seconds. During this time many of the instrument's working parameters and settings are checked. If any operational parameters are out of specification or if the pre-programmed recommended calibration/service date has passed, errors or warnings may be displayed.

Note:
For further information please refer to section '5 Problem Solving' of this manual.

2.11 Battery/Charging
The battery used in the instrument is 2 Ah Lithium-Ion cell. The instrument must be charged using the power supply supplied with your instrument. The power supply supplied is intended for indoor use only. Please ensure adequate ventilation whilst charging.

Note:
Although the instrument can be powered via the USB connector it cannot be charged via USB.

When plugged into the power supply the instrument will power on and display charging. When complete the display will change to show that the instrument is charged. To switch the instrument ON whilst charging or charged is displayed, the operator will need to switch the instrument off and then on again.

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Instrument: Input   5VDC ± 0.5V(max 1000mA)

Power Supply: Input   100 – 240V ~ 60/50 Hz 120mA

                Output   5V $\overline{\cdots}$ 1000mA 5VA
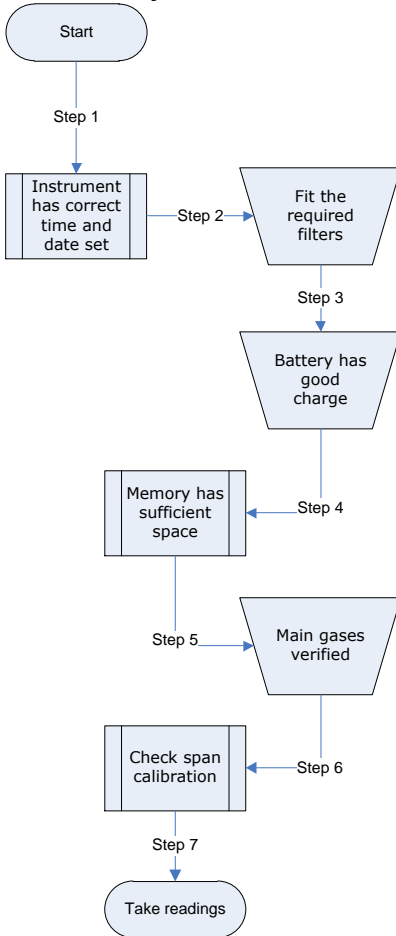
Note:
*A full charge will take approximately **3 hours**. Typically, a fully charged battery will last 8-10 hours.*

When the instrument is already powered on, the operation is slightly different as the battery icon changes to a flashing plug symbol. This will stop flashing when the charge is complete.

Chapter 3 – Taking Readings

3.1 Preliminary Checks – Best Practice

```
        Start
          |
       Step 1
          |
  ┌──────────────┐        ┌──────────────┐
  │  Instrument  │        │   Fit the    │
  │ has correct  │ Step 2 │   required   │
  │  time and    │───────▶│   filters    │
  │   date set   │        │              │
  └──────────────┘        └──────────────┘
                                  │
                               Step 3
                                  │
                          ┌──────────────┐
                          │ Battery has  │
                          │    good      │
                          │   charge     │
                          └──────────────┘
  ┌──────────────┐                │
  │  Memory has  │              Step 4
  │  sufficient  │◀───────────────┘
  │    space     │
  └──────────────┘
          │
       Step 5          ┌──────────────┐
          └───────────▶│  Main gases  │
                       │   verified   │
                       └──────────────┘
  ┌──────────────┐             │
  │  Check span  │           Step 6
  │ calibration  │◀────────────┘
  └──────────────┘
          │
       Step 7
          |
    Take readings
```

⚠ **Warning**
Always ensure that the exhaust gases emerge in a safe manner into a well ventilated area.

Prior to use, it is good practice to ensure that:
Step 1 The instrument has the correct time and date set.

Step 2 Fit the sample filter checking that it is clean and dry. If experiencing condensation in sample line or the sample filter keeps getting blocked, fit the moisture trap or similar at take-off point.

Step 3 The battery has a good charge (minimum 25% charge, even if only a few readings are required).

Step 4 The memory has sufficient space available.

Step 5 The main gases have been verified with zero gas concentration present.

Step 6 If necessary check the span calibration with a known concentration calibration-check gas.

Step 7 Take readings.

Do protect the instrument from strong direct sunlight which will quickly raise the temperature of the instrument beyond its operating range and the LCD display will appear almost black. The contrast setting cannot then alter the contrast.

Do remember to always use the sample filter! If the sample filter becomes flooded, change it and ensure all sample tubes are clean and dry before re-use.

Don't place the instrument against anything hot as this may cause excessive internal temperatures which can lead to erroneous readings.

Don't get the instrument wet, for example exposure to rain.

3.2 Gas Measurement Process – Best Practice
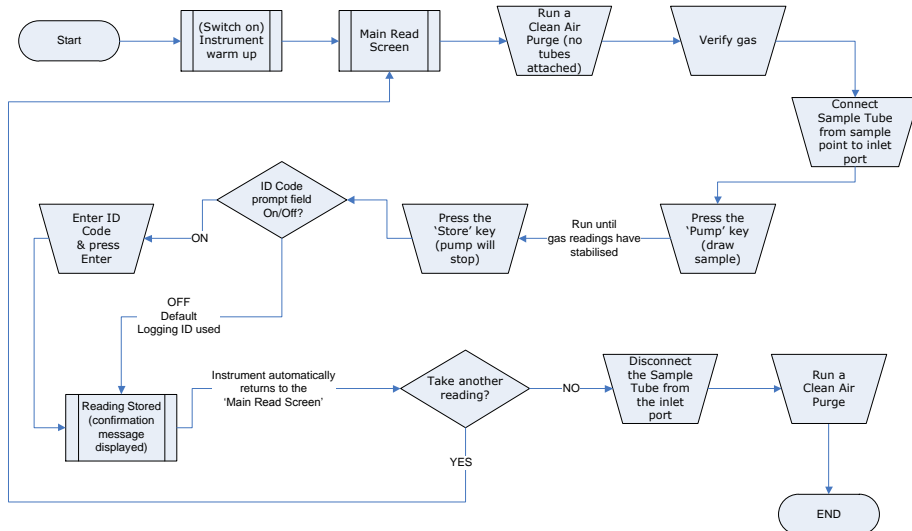
Depending on preferences the exact reading procedure can change.

The following method is considered best practice and when followed correctly will allow quick and consistent readings to be recorded.

1. When the instrument is first switched on it should be purged with fresh air and allowed to stabilise for a few minutes.
2. At this point it is good practice to verify the CO_2 channel. Calibrate only if required. This option is available via the 'Calibration' menu.
   The instrument is now ready to take the first reading.
3. Connect the sample tube, if relevant (always use the sample filter) from the sample point to the inlet port of the instrument, ensuring the filter is seated correctly.
4. Press the 'Pump' key to draw a sample into the instrument.
   Notice the main gas readings start to change. It is recommended to run the pump until the gas readings have stabilised (approx. 30 seconds) then press the soft-key 'Store'.
5. The pump will stop and the operator will be prompted to enter an ID code to identify the reading. A "reading stored" confirmation message will be displayed briefly before returning to the 'Main Read Screen'.
   Note:
   The ID code prompt can be switched on or off. This option is accessed via the 'Settings' menu, then press 'Key 1 - Prompt for ID: Yes or No'. If the ID prompt is set to 'No' the reading is stored using the default logging ID.
6. After each reading the instrument should be purged with fresh air.
7. Disconnect the sample tube from the instrument. Then, run the pump for a minimum of 30 seconds. The gas readings should return to nominal values for fresh air.

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Regardless of the instrument configuration the following data will be stored for each reading:-
- ID code (8 characters)
- Reading Type (0=User, 1=Auto, 2=peak, 3=hold)
- Current time/date
- Gas readings (CO_2, O_2)
- Sample pressure (for indication only)
- Temperature x 2
- Humidity

3.3 Alternative Reading Methods
There are three other reading methods which require slightly different operating procedures.
- Logged reading
- Peak reading
- Hold reading

3.3.1 Logged Reading
Logged readings need to be configured and initiated via the 'Utilities' menu by pressing 'Key 6 - Logging'. During configuration the user will be asked to supply an ID, reading interval and pump run-time.

These parameters are used to control the reading frequency in logging mode. Once logging mode is activated the instrument will automatically record a reading at every interval until stopped by the operator or the memory becomes full. Logging is also suspended temporarily whilst the user is accessing the menu options.

Whilst the logging mode is active the 'Hold', 'Pump' and 'Store' key will be deactivated, only logged readings can be stored.

3.3.2 Peak Reading
The operator can toggle the reading mode between normal (current) and peak readings. Whilst in peak reading mode the instrument will only display peak values for each of the channels. These values can then be stored by pressing the 'Store' key or automatically at the appropriate logging interval (if logging is enabled).

The peak value is reset after a reading is stored or by exiting the peak mode using the appropriate soft-key. The current mode of operation can be identified by the status of the soft-key, either 'Normal' or 'Inverse', where inverse indicates peak mode is active.

3.3.3 Hold Reading

The 'Hold Reading' option allows the user to freeze the currently displayed reading. This allows it to be manually recorded or moved away from the sample point. Once activated, press the soft-key 'Hold' and the readings are fixed until the 'Hold' key is pressed again or by storing the reading.

The current mode of operation can be identified by the status of the soft-key which is inversed whilst in the hold phase.

Chapter 4 – Calibration

4.1 User Calibration

The instruments is fully calibrated during manufacture and when returned for service. However, to improve accuracy between services a user/field calibration can be performed. This section sets out the correct procedures to achieve an accurate user calibration.

Note:
If the calibration is completed incorrectly it may decrease the accuracy of the instrument.

Two important terms that are used within this section are "Zero" and "Span".

- **Zero**: The point at which the instrument is calibrated when there is none of the target gas present.
- **Span**: The point at which the instrument is calibrated when a known quantity of the target gas is present.

4.2 Calibration Gases

User calibration of the instrument will improve the data accuracy in the range of the calibration gases used. However, it may cause less accurate readings of concentrations outside this calibrated range. Users should select the correct calibration gas for the expected gas levels on their particular application. Only use gases with a known certified gas concentration.

⚠ **Warning**
For each gas used the appropriate material safety data sheet must be read and understood before proceeding. Calibration gases and the use of pressure regulators can be dangerous.

4.3 Calibration Set-up

The regulator supplied with the calibration kit has been configured to deliver a fixed flow. It only requires a few turns to open and no adjustment is necessary.

⚠ **Warning**
Exhaust Port
When the instrument is being calibrated, there are two possible exits for the gas; via the usual manner out of the exhaust port of the instrument or in cases of over-pressurisation the 1/16″ port on the pressure relief valve

It is recommended that both ports have exhaust tubing attached. The exhaust tubing must emerge in a well-vented area. Ensure there are no leaks in the tubing and connections. The calibration should always be carried out in a safe area with all necessary precautions taken as all pressurised gases are potentially dangerous.

4.4 Calibration Equipment

The diagram below displays the regulator and tubing equipment for user calibration:
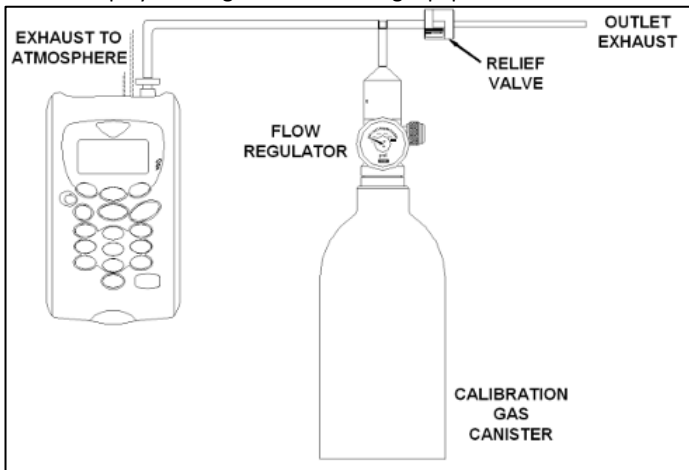
- Contact your equipment supplier for further information.
- The regulator supplied with the calibration kit is recommended as flow and pressure rates are factory set.

Note:

Maximum input pressure 250mb, maximum flow 300ml.

4.5 Calibration Method

Before you begin ensure the unit is stabilised at its working temperature before performing any of the calibration operations.

To achieve the processes set out in this section, press 'Key 3 – Calibration' from the 'Main' menu. The first screen displayed provides the option to select the gas that requires calibration.

The exact calibration method can vary depending on the gases used.

4.5.1 Zero CO_2 Channel:

For maximum accuracy it is recommended that the CO_2 Channel is zeroed using bottled gas (certified 100% N_2). However, if nitrogen gas is not available the optional soda lime filter kit can be fitted to the gas inlet. This allows the user to perform a zero using normal air as the

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soda lime filter will absorb virtually all CO_2 from the sample air. For both these options select 'Key 1-Zero with N_2' from the user calibration menu.

If neither of the recommended methods is available the user can select the option to perform an air calibration. This option assumes that the user has access to fresh air at around 390ppm. Generally, this can be found outside or in a well ventilated corridor (typically, an office or lab would have a higher CO_2 concentration).

1. From the 'Calibration' Menu, press 'Key 2 - CO_2 channel'.

```
┌─────────────────────────┐
│  User Calibration       │
│                         │
│  1-Zero with N2         │
│  2-Zero with Air        │
│  3-Span with CO2        │
│                         │
│              ( Exit )   │
└─────────────────────────┘
```

2. Press either 'Key 1 - Zero with N_2' (recommended) or 'Key 2 - Zero with Air' from the menu. Then, either attach the 100% N_2 or sample pipe to allow access to fresh air.
3. Ensure the zero gas has flowed and is stable.
4. Press the 'Start' key. The instrument will now wait (approximately 60 seconds) for the gas reading to stabilise at the correct level. If zeroing with air press the 'Pump' key to draw in fresh air.
5. The instrument will then indicate a successful zero has been completed. Press the soft-key 'Accept' to confirm the calibration and 'Store' the new user offset. Alternatively, soft-key 'Reject' to exit without change.

Note:
If the calibration failed then purge and try again or select a different air source.

4.5.2 Span CO_2 Channel:
It is recommended that the instrument is spanned to target the desired reading range (e.g. 5%); ideally this should not be a low level close to zero.

1. If not already preset, enter the **span target**, i.e. certified concentration of your calibration gas. Press 'Key 1' and enter the new value. Then attach the gas and open regulator valve to allow the gas to flow.
2. Press the 'Start' key and wait for the reading to stabilise. This can take a couple of minutes. Press the 'Pump' key to draw sample gas.
3. Once a stable reading is shown press the soft-key 'Accept'. A successful span calibration message will then be displayed. Press the soft-key 'Accept' again to confirm the calibration and 'Store' the new user span. Alternatively, press soft-key 'Reject' to exit without change.

Note:
If the calibration failed then try again using a longer purge time or different target gas.

4.5.3 Zero O₂ Channel:

It is not required to zero the O_2 channel. A span calibration corrects the reading across the whole range.

4.5.4 Span O₂ Channel:

It is recommended that the O_2 channel is spanned in fresh air with a target concentration of 20.9%, although other gases and target concentrations can be used if required.

1. If not already preset, enter the **span target**, i.e. certified concentration of your calibration gas.
2. Press the soft-key 'Start' and wait for the reading to stabilise. Press the 'Pump' key to draw in fresh air. It can take a couple of minutes to stabilise.
3. Once a stable reading is shown press the soft-key 'Accept'. A successful span calibration message should then be displayed. Press the soft-key 'Accept' again to confirm the calibration and 'Store' the new user span. Alternatively, press soft-key 'Reject' to exit without change.

Note:
If the calibration failed then try again using a longer purge time or different target gas.

4.5.5 Reset Factory Settings

This option will reset the instrument to its factory programmed calibration characteristics and will clear the user calibration points for both gas channels.

1. To reset to factory settings, press 'Key 1 - Factory Reset' from the 'Calibration' menu.

2. To prevent the user calibration data being accidentally erased the user must confirm the action by pressing the soft-key 'Accept', or soft-key 'Reject' to exit without change.

4.6 Last Field Calibration

This data can be found in the 'Information' screen accessed via the 'Utilities' menu. This option displays the date that the last field calibration was perfomed on the instrument.

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4.7 Calibration Record

The instruments have the facility to log user calibrations via the 'Event Log'. This can be used as an aid in ensuring that gas measurements are valid and accurate.

During calibration the instrument will record the following in the event log. For each entry the time and date will be stored.

Event	Data Recorded
Successful user zero CO_2	Type (N_2 or Air) and Readings before and after
Successful user span CO_2	Target Value, Readings before and after
Successful user span O_2	Target Value, Readings before and after
Failed user zero CO_2	Type (N_2 or Air) and Reading
Failed user span CO_2	Target Value, Gas Reading
Failed user span O_2	Target Value, Gas Reading
Return to factory settings	

Note:

If the calibration failed, then try again using a longer purge time or different target gas. This event log can only be downloaded and viewed via the optional Analyzer Data Manager software. It cannot be viewed on the analyzer screen.

Chapter 5 – Problem Solving

This section outlines various warning and error messages which the operator may receive during general operation of the instrument. For further assistance please contact your equipment supplier.

5.1 Warnings and Errors

When switched on the instrument will perform a predetermined self-test sequence taking approximately 15 seconds. During this time many of the instrument's working parameters and settings are checked.

If any operational parameters are out of specification or if the pre-programmed recommended calibration/service date has passed, errors or warnings may be displayed.

Use the 'Scroll Up' and 'Scroll Down' keys to move through the list if required.

There are two types of warning that may be displayed:
- General warnings that may not affect the instrument's function and those where the self-test has detected a function that is outside the usual operating criteria, e.g. battery charge low, memory nearly full.
- Operational parameters that could affect the performance of the instrument, e.g. CO_2 out of calibration.

The most likely reason for these errors is either an incorrect user calibration, or may indicate sensor failure. If an incorrect user calibration has caused the warning it should be correctable by way of returning the instrument to factory settings, zeroing or carrying out a user calibration as necessary for the relevant function.

Under and Over Range Codes
If a reading is over range (i.e. above the maximum allowed reading) it will be displayed with more than chevrons (>>.>). This can occur if a channel has been incorrectly calibrated or the sample gas has exceeded its specified range (e.g. CO_2 > 20%).

If a reading is under range (i.e. below zero) it will be displayed with less than chevrons (<<. <). Refer to section '4.0 Calibration' of this manual to remedy under-range by performing a user zero.

A number displayed as asterisks (**.*) indicates an error, usually where the instrument has been unable to complete a particular calculation. Typically, this will be the first indication of a fault condition.

Where no data is available dashes (--.-) are displayed. This usually occurs when a particular reading or parameter has been skipped by the user, or where an optional accessory is not fitted correctly, i.e. a temperature probe.

5.2 Flow Fail Warning

A common error is a premature flow fail. This is caused by a blocked or flooded inlet filter. However, new instruments can go into flow fail prematurely as the pump loosens up over the first few days of use. For further information, please refer to 'section 5.9.2.5 Flow Fail'.

5.3 Self-test Warning Messages

The following warnings may be displayed during the self-test period when the instrument is switched ON.

Warning		Description
Check Memory		The instrument only has space to store less than 50 readings before it is full. The exact number can be checked using the 'View Readings' option.
Memory Full		There is no more space in memory to store readings. Both the store and log options will be disabled until the memory is cleared. The readings should be downloaded to PC using the optional download software before memory is cleared.
Battery Low	🗋	The instrument does not have enough power to operate for a full day. The instrument should be recharged or connected to an external power supply.
Service Due	⊺⊦	It has been 12 months (or more) since your instrument was returned to the manufacturer for a service. The performance and accuracy of the instrument may be impaired.
Flow Fail		The instrument's gas inlet (or outlet) may be blocked. This warning is most commonly caused by a water-logged or dirty sample filter. Change the sample filter and check for obvious blockages in the sample tubes. Alternatively, a small amount of adjustment can be made to the low flow detection point to compensate for minor changes in the performance of the pump fitted to the instrument.
Check CO_2 Cal.		This warning is most commonly caused by an incorrect user calibration. Try recalibrating the sensor or press 'Return to factory settings'. If the warning persists it may be caused by dirt or damage to the infrared sensor. The instrument will need to be returned to the manufacturer for service/repair.
Check O_2 Cal.		This warning is most commonly caused by an incorrect user calibration. Try re-calibrating the sensor or press 'Return to factory settings'. If the warning persists it may be caused by a damaged or faulty sensor. The instrument will need to be returned to the manufacturer for service/repair.
Ref. Fault		This may be caused by dirt or damage to the infrared sensor in the instrument. The instrument will need to be returned to the manufacturer for service/repair.
*Invalid Config.		The instrument has detected a problem with the configuration parameters. The instrument will need to be returned to the manufacturer for service/repair. Most likely to be caused after firmware update.

| Change O$_2$ Cell	�	The oxygen cell has not been changed for at least 3 years; its performance and accuracy may be impaired. The instrument will need to be returned to the manufacturer for service.
Change Pump	�	The pump has exceeded its recommended run-time and should be changed. The instrument will need to be returned to the manufacturer for service.
Change Battery	�	The Lithium Ion battery has exceeded its recommended life-time or number of charge cycles and should be changed. The instrument will need to be returned to the manufacturer for service.
User Cal. Due		It has been over a month since the instrument was last user calibrated. For optimal performance and accuracy it is recommended that the instrument is user calibrated each time it is used.
Invalid Time		The instrument has an invalid time. This is most likely to occur after a reset. The correct time should be entered using the set 'Time & Date' option via the 'Utilities' menu.
Invalid Date		The instrument has an invalid date. This is most likely to occur after a reset. The correct date should be entered using the set 'Time & Date' option via the 'Utilities' menu.
Baro. Fault		The instrument has detected a fault with the barometric sensor or its calibration. This will have an effect on the accuracy of the readings as they are pressure compensated. The instrument will need to be returned to the manufacturer for service.

Note:

Certain configuration problems can be corrected remotely. Using the Analyzer Data Manager software, it is possible to export the current configuration and e-mail it to the manufacturer's Technical Support or Service Department. Depending on the type of error it may be possible to correct the configuration file and import it back into the instrument.

5.4 User Calibration Trouble Shooting

Error	Remedy
User Zero failed	A possible reason for this is because the instrument is trying to zero to a level which is outside the predetermined range set when the unit was calibrated at the factory or; the gas is not stable i.e. is still flushing the measure gas or is using ambient air/gas that is varying in concentration. To rectify this, first ensure the unit contains absolutely none of the gas which is being zeroed by flushing thoroughly with nitrogen. If it will not zero, then refer to the instructions given in the 'Factory Settings' section. If the instrument continues to fail to zero then the unit must be returned to the manufacturer for investigation.
Calibration failed	Check the span target is set to the correct value, if not, correct and retry spanning the channel. Repeat the entire procedure, including zeroing the channel and then calibrate the span. Ensure the reading is stable before spanning the channel.

User Calibration Explained:
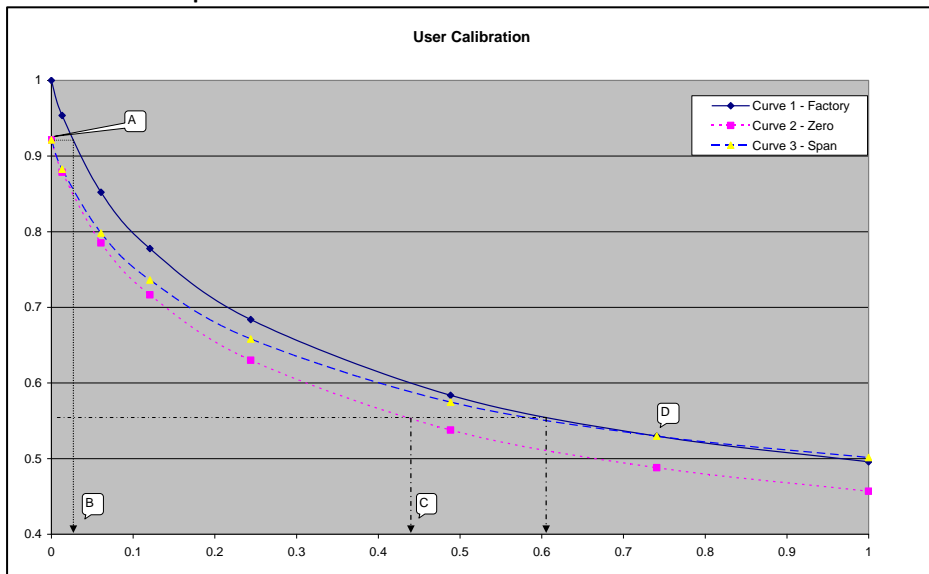
User calibration is a means of optimising the performance of the instrument to the current operating conditions such as ambient temperature and pressure as well as correcting for instrument drift caused by lamp and filter settling.

In general, the instrument should not require calibration more than once a month, but we do recommend verifying the instruments operation each day.

User calibration has two operations and each may be performed individually, however for a complete user calibration both must be completed.

Factory Calibration (Curve 1)
The instruments are 'Factory' calibrated and stable.

Zero Calibration (Curve 2)
This corrects the entire curve for lamp and filter variations caused by aging and user induced drift due to dirt etc. If done correctly there is often no need to complete a span calibration. However a poor calibration[**A**] will result in a span error as shown with the zero indicating a small error [**B**] but a significant span error [**C**].

Note:
The Zero calibration is very sensitive and even 100% instruments will detect in the 0 to 100ppm range even though they do not display to this resolution. Please refer to the chart 'Typical Zero Gas Purge Time'.

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Span Calibration (Curve 3)
This optimises the instrument at the span calibration concentration [**D**] for the current operational conditions and variations in user calibration gasses. It corrects the span point leaving the zero unadjusted and should be done at the concentration of normal operation.

Typical Calibration Purge Times
Typical zero calibration although displaying zero needs to be given time to settle. We recommend commencing the calibration at least five minutes after the display concentration stabilises.

Typical Zero Gas Purge Time

Gas %

display reads 0.0%

wait to Start Zero calibration

Time (mm:ss)
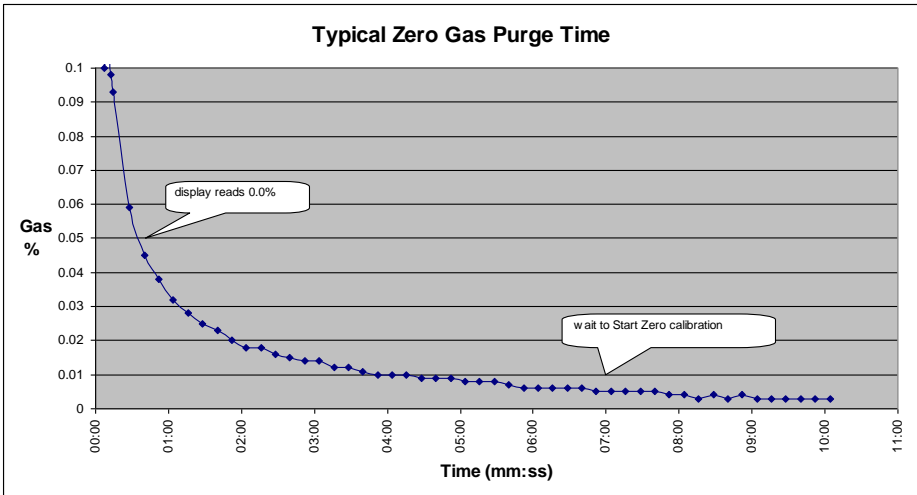
5.5 Cross-Gas Effects
Carbon dioxide is measured by infrared absorption at a wavelength specific to carbon dioxide. Therefore, the carbon dioxide reading will not be affected by any other gases. The oxygen sensor is a galvanic cell type and suffers virtually no influence from CO_2, CO, H_2S, NO_2, SO_2 or H_2, unlike many other types of oxygen cell.

5.6 Error Due to CO_2 Solubility in Water
Due to the water trap and filter it is possible that some of the CO_2 in the sample gas will be absorbed in to any trapped water.

5.7 Hardware Reset

If for any reason the instrument 'locks up' and will not switch off, it is possible to force a hardware reset. Press and hold the 'On/Off' key for 10 seconds; wait at least 15 seconds and the instrument should restart automatically.

Note:

Performing a hardware reset may cause loss or corruption of currently stored data including the time/date.

Chapter 6 – Service

The instrument should be regularly serviced to ensure correct operation and accurate readings. The manufacturer recommends a full service and recalibration **every 12 months**.

Depending on usage the O_2 cell should be replaced every 2-3 years.

User Serviceable Parts

Note:
There are no user serviceable parts inside the instrument. Please do not attempt any repair as this may invalidate any warranty supplied with your instrument.

The following parts are supplied by your instrument manufacturer and can be user serviced:

Sample Filter	This should be regularly inspected for damage or discolouration and changed if needed. The instrument should never be operated without the sample filter as this may result in water or dust entering the instrument. The filter should be changed immediately if water can be seen. Failure to do so can damage the instrument.
Sample Tubing	Always ensure that sample tubes are not contaminated or damaged.

Cleaning

The instrument and accessories (including power supply unit) can be wiped clean using a non-fibrous damp cloth.

Note:
- *Do NOT apply pressure to the LCD display as this can cause damage.*
- *Do NOT apply any moisture to the moisture removal tube on the rear of the instrument as this may damage the membranes.*
- *Do NOT use solvents or any other chemical cleaners.*

Chapter 7 – Technical Specification

COA-2010-F - Esco Electronic CO2 Analyzer Technical Specification		
Power Supply		
Battery type		Li Ion
Battery life		10 Hours (8 hours with pump)
Battery lifetime		>300 Cycles
Battery charger		5v DC external power supply and internal charging circuit
Charge time		3 Hours
Alternative power		USB connector, DC power supply
Gas Ranges (Conditions during factory calibration, typically 20°C, 1000mBar)		
Gases	CO_2	By custom dual wavelength infra-red cell with reference channel
Measured	**O_2 (Opt)**	By internal electrochemical cell
Oxygen cell lifetime		Approximately 3 years in air
Range	CO_2	0-20%
	O_2	0-100%
Measurement	**Gas**	
Accuracy	CO_2	**Accuracy:** ±(1% of range+ 2% of reading) at reference conditions[1] **Temperature dependence:** ±0.2% reading /°C (typical at 5% CO_2) **Pressure dependence:** ±0.02% of reading/hPa (typical at 5% CO_2)
	O_2	±1.0% Full Scale @ constant temperature and pressure ±2.0% Full Scale over operating temperature range
Response time, T^{90}	CO_2	≤20 seconds
	O_2	≤60 seconds
Facilities		
Temperature (Opt)		X2 using optional probes, range 0°C to +50.0°C
Temperature accuracy		±0.2°C from 32 to 44°C, ±0.5°C over the rest of the range
Barometric pressure		800-1200 mbar
RH measurement (Opt)		RH Probe 0-100% RH non condensing
RH accuracy		±1.5%RH across the range
Visual and audible alarm		User selectable CO_2 and O_2 alarm levels
Communications		USB type B mini-connector, HID device class
Data Storage		1000 reading sets + 270 events
Pump		
Flow		100cc/min typically
Environmental Conditions		
Operating temperature		5°C – 40°C
Relative humidity		0 - 95% non-condensing (RH Probe 0-100% non-condensing)
Barometric pressure		±500mbar from calibration pressure
IP rating		IP40
Physical		
Weight		495 grams
Size		L 165mm, W100mm, D55mm
Case Material		ABS / Polypropylene with Silicone Rubber Inserts
Keys		17 Resin capped Silicone rubber keys
Display		Liquid crystal display, 128 x 64 pixel with RGB LED back-light
Gas sample filters		Built-in gas dryer tube to remove moisture User replaceable PTFE water trap filter

Chapter 8 – Event Log

The following events are recorded in the instrument's event log. The event log can only be downloaded using the additional Analyzer Data Manager software. Please refer to the Analyzer Data Manager software manual for further details.

Event	Data
Cold Start/Reset	Type of start (MCUSR, boot_key)
Firmware Version	Description
Set time	Before and After
Set date	Before and After
Re-flash requested	None
Restore to factory settings	Type
Comms clear memory	Type 0=Readings, 1=Event Log
Change contrast	Before and After
Change flow fail current limit	Before and After
Battery less than critical voltage	Critical, Actual
RTC date/time invalid	None
Factory calibration invalid or overdue	Date, difference
Service invalid or overdue	Date, difference
Power on self-test, sensor out of range	Channel, reading, limit
User calibration set zero OK	Before, After
User calibration set span OK	Target, Before, After
User calibration set zero failed	Target, Reading
User calibration set span failed	Target, Reading
Attempt to store when readings memory full	Max
Readings memory nearly full	Limit, Actual
Change logging mode	Status, Interval, Pump time
Change logging mode ID	ID
Flow fail current limit exceeded	Limit, Actual