Geotech

HYPERBARIC

HYPERBARIC
Operating Manual

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MANUAL GUIDELINES

Hazard, warnings, and safety symbols

> **!** Information in this manual that may affect the safety of users and others will be shown clearly in this format. Failure to follow this information may result in physical injury which in some cases could be fatal.

Any general product label symbols that are used on the product should be detailed as below:

Symbol	Description	Symbol	Description
CE	CE conformity-The CE-marking is the manufacturer's statement to the EU authorities that the product complies with all relevant CE-marking directives.	CSA c US 236822	If the CSA mark appears with the indicator "US" or "NRTL" it means that the product is certified for the U.S. market, to the applicable U.S. standards.
VDE	VDE mark is a symbol for electrical, mechanical, thermal, toxic, radiological and other hazards.	(crossed-out wheelie bin)	Separate collection, handling and disposal for waste electrical and electronic equipment and its components.
(lightning bolt)	Electric shock warning.	(book with i)	Refer to operators manual.
(double square)	Double insulated construction - does not require an Earth.	(Ex)	Specific marking of explosion protection (ATEX only).
II 2G	Equipment group and category. G = gases; the type of explosive atmosphere.	IEC Ex	IECEx licenced mark (IECEx only).
(fuse symbol)	Fuse	(house symbol)	Equipment for indoor use only.
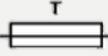
Notes

Important/useful information and instructions are shown clearly throughout the manual in a note format. For example:

> Note: For further information please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk

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INTRODUCTION

General

This manual explains how to use the Hyperbaric analyser.

The Hyperbaric analyser is designed to measure carbon dioxide, oxygen, and pressure levels in pressurised environments. It has been developed to incorporate the latest design and technology to provide the user with a fast, simple-to-use, and accurate analyser that is intended for use in commercial and military environments.

> **!** It is intended that the analyser itself is in the pressurised environment. The unit is not intended to be used in applications where the inlet and outlet ports are at a differential pressure greater than 100mbar, as this could cause damage to the instrument.

Note: Gas analysers are a sensitive piece of scientific equipment and should be treated as such.

Range of Environmenal Conditions

- The instrument is only for use in ambient temperatures in the range 0°C to 50°C and should not be used outside of this range.

- The instrument is only for use in ambient pressures in the range 0.75 to 10 bar absolute.

- If the equipment is likely to be exposed to aggressive substances, e.g. acidic liquids, gases that may attack metals or solvents that may affect polymeric materials, then it is the responsibility of the user to take suitable precautions. E.g. regular checks as part of routine inspections or establishing from the material's datasheet that it is resistant to specific chemicals that prevent it from being adversely affected.

Note: For further information please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk

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THE HYPERBARIC GAS ANALYSER

The Hyperbaric Analyser

The Hyperbaric analyser is a portable instrument that offers repeatable and accurate measurement of CO_2, O_2, and pressure levels under hyperbaric conditions, up to 10 bar absolute pressure.

Features

- CO_2 0 – 30,000ppm SEV measurement

- O_2 0 – 250% SEV measurement

- Pressure measurement range 0.75 – 10 bar absolute

- Pressure compensated gas measurements

- Ability to monitor the gas concentrations in the dry deck shelter of submarines and other hyperbaric environments

- User calibration function to maintain accuracy in extreme conditions

- IP65 rated for waterproofing

- Alarms and fault notifications

- 24 hour battery life

- 28VDC external supply support

- Clear, visual and informative display

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Benefits

- Approved by Naval Experimental Diving Unit (NEDU)
- Crew safety during operations from dry deck shelter
- Product longevity and reliability
- Ease of operation
- Local support for peace of mind

Analyser Data Manager PC Software Features

- Remote data tracing
- Access to logged data and event log
- Amalgamates readings from multiple units to allow comparison of data
- Export data in spreadsheet format for customer post-processing or archiving.

Event Log Features

- Logs significant events that occurred on the analyser
- Can be used as an aid to ensure correct use of the analyser
- Can aid diagnostics in the event of a problem with the analyser
- Can hold 400 events, when full begins to wrap

Note: For further information please refer to section Event Log.

Main Applications

- Dry deck shelter monitoring
- Submarine bank gas screening
- Room monitoring
- Submarine atmosphere control
- General gas monitoring under hyperbaric conditions

Packaging Contents

The following items will be found in the packaging box:

- Hyperbaric gas analyser
- Operating manual in paper format
- Battery charger
- Soft carry case with strap
- Sample tube kit and filters.

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HYPERBARIC INSTRUMENT FEATURES

Physical Characteristics of the Hyperbaric
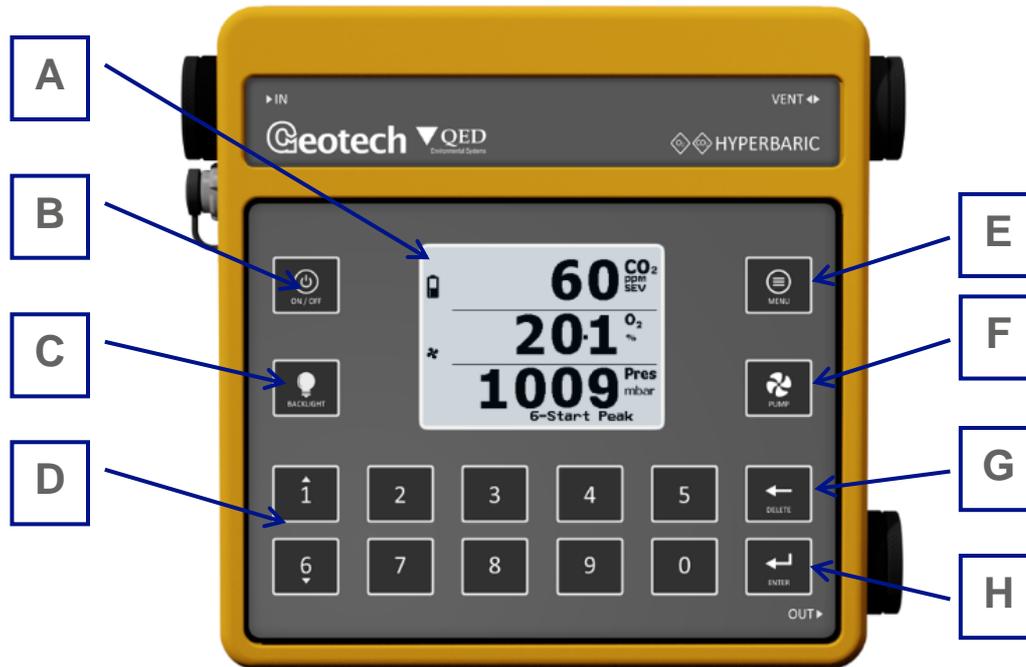
Reference	Title	Description
A	Main gas read screen	Start and end screen when using the analyser.
B	On / off key	Hold the 'on / off' key for two seconds to turn the analyser on and off.
C	Backlight key	Press the 'backlight' key to turn the backlight on and off.
D	General operational keys	Keys 0 – 9 can be used for numeric entry. In addition, keys 1 and 6 can be used to scroll up and down respectively.
E	Menu key	Sample tube kit with filters
F	Pump key	Press the 'menu' key to navigate to the 'main menu' from the 'main read screen'. Also used as the 'exit' key from various screens.
G	Backspace / delete key	Can be used to delete an entry.
H	Enter key	The 'enter' key accepts/confirms choices made by the operator for various functions and operations. Also required to confirm numeric data entry.

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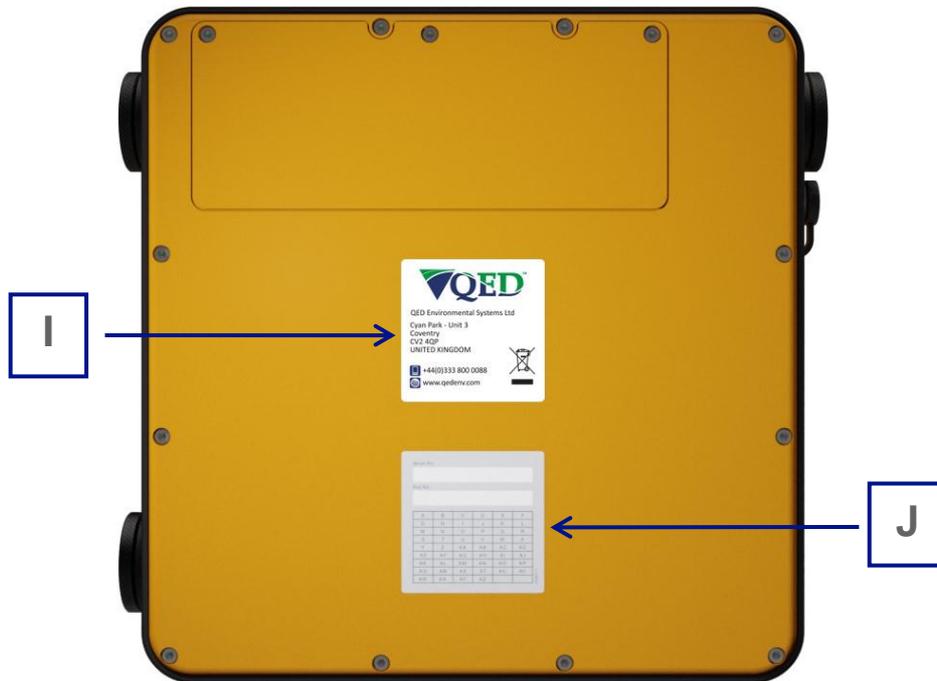
Reference	Title	Description
I	Manufacturer's label	Displays information regarding the manufacturer, such as contact details.
J	Serial number and product option number	The serial number is the unique identification number for the gas analyser. The product option number is a record of the analyser's internal configuration at the time of manufacture.

Analyser Connection Points

HYPERBARIC
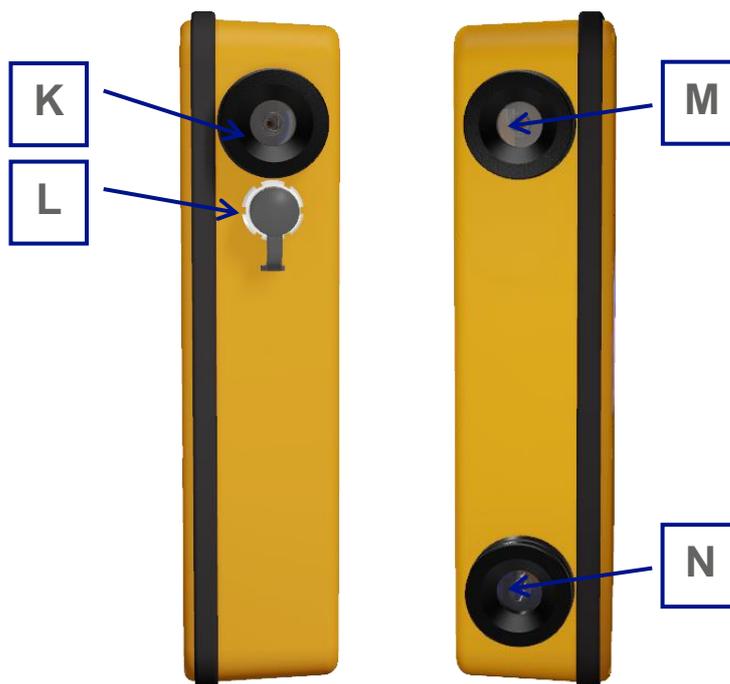
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Reference	Title	Description
K	Gas inlet port	The sample tube is attached to this port for the analyser to take a reading.
L	Connector A	Used to connect the analyser to a PC via a USB cable and enables the download of data. Also used to connect the analyser to the power supply to charge the battery.
M	Vent port	Allows the inside of the analyser to equilibrate to the atmospheric pressure.
N	Gas outlet port	Used to exhaust the sample gas from the analyser.

> ! Do not block the outlet port of the analyser as this can lead to over-pressurisation and could damage the analyser.

GENERAL OPERATIONAL INSTRUCTIONS

Storage

When not in use, the Hyperbaric analyser should be kept in a clean, dry, and warm environment, such as an office, and it should be stored flat which helps prolong the life of the O_2 sensor.

Battery and Charging

Note: Fully charge the analyser before use when first received or if the analyser has been in storage for a long period.

The battery used in the analyser is a custom designed nickel metal hydride cell. As such, it is recommended the analyser must only be charged using the power supply (Geotech part number HYPB1.10) supplied for use with the Hyperbaric analyser. This power supply is intended for indoor use only. Please ensure adequate ventilation whilst charging.

When the analyser is powered on and the power supply is plugged in, the analyser's battery symbol will have a plug icon above it (🔌) and will begin to flash to indicate it is charging. Once fully charged, the flashing will stop and the icons will become static. If the power supply is removed, the plug icon will disappear and the battery icon will remain in place.

Whilst the analyser is off and the charger is connected, the analyser display will show 'charging'. When complete, the display will change to show 'charged'. To switch the analyser on whilst charging, the operator will need to switch the analyser off and then on again.

Analyser	Input: Geotech power supply HYPB1.10 or 28VDC supplied via Geotech lead HYPB1.18.
Power supply	Input: 100 – 240VAC ~ 50-60Hz 1A Output: 24VDC ⎓ 1.75A

Note: A full charge will take approximately 3 hours. Typically, a fully charged battery will last approximately 24 hours.

Switching the Analyser On

1) To switch the analyser on, press and hold the 'on/off' key for two seconds. There will be a short beep and a slight pause followed by the Geotech logo. Release the 'on/off' key.

2) The 'power on self test' will then commence.

Power On Self-Test (POST)

When switched on the analyser will perform a pre-determined self test sequence taking approximately sixty seconds. The Geotech logo remains on screen with a progress bar until the POST has finished, see Screen 1 – Power On Self-Test for an example:

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Screen 1 – Power On Self-Test

During this time, many of the analyser's functions are tested, including:

- Testing of the CO_2, O_2, infra-red reference, and pressure transducer channels is performed continuously over a short period to check for faults and instability.

- The next service due date is checked.

- Component lifetime checks are performed to ensure they are within date.

Assuming there are no warnings or errors to display, the analyser will continue to the 'main read screen'.

In the event of errors or warnings, Screen 60 – Self-test results will be displayed (please refer to section Problem Solving in this operating manual for further information). Pressing the 'enter' key will acknowledge these errors and warnings and will allow the user to progress to the 'main read screen'.

> Note: The POST duration can vary based on the stability of the gas channels, previous gas concentrations, and other parameters.

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Analyser Main Read Screen

General

The 'main read screen' is considered the normal operating screen, an example is shown in Screen 2 – Main read screen.
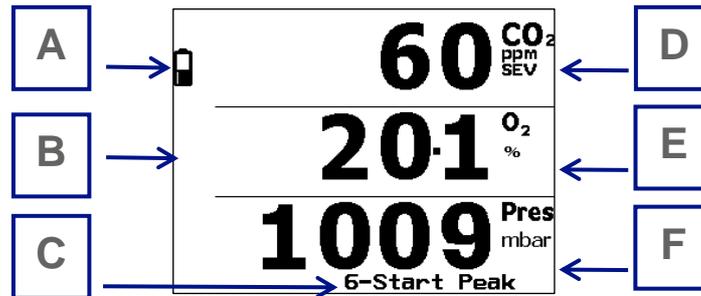
Screen 2 – Main read screen

Reference	Title	Description
A	Battery icon	Provides the operator with an estimation of the battery charge state.
B	Status icons	Various other status icons could be displayed down the left hand side of the screen. See section Status Icon Help for further information.
C	Peak options	Start / stop peak reading function. See section Start / Stop Peak Function for further information.
D	CO_2 measurement	Displays the current CO_2 concentration in ppm SEV.
E	O_2 measurement	Displays the current O2 concentration in % (volume) or ppATA.
F	Pressure measurement	Displays the current pressure in mbar, atm, or fsw.

Pump Operation

- The pump can be turned on or off by pressing the 'pump' key.

- When turned on, a fan (🌀) symbol will be present on the left hand side of the screen. This can be seen in Screen 3 – Pump on indication.

Screen 3 – Pump on indication

HYPERBARIC
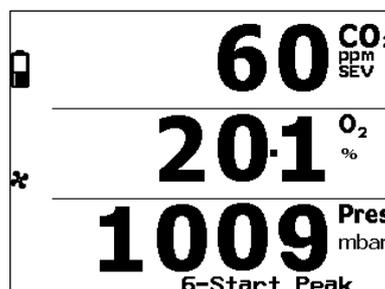
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Alarm Indications

- A bell (🔔) situated next to a channel indicates that an alarm condition has been set for it.

- A flashing bell (🔔) next to a channel indicates that the alarm condition has been reached.

- An audible warning from the gas analyser will accompany the alarm, if the sound is enabled.
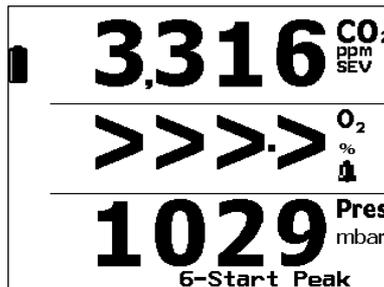
Screen 4 – Alarm indication

Note: For instructions on setting alarms, please refer to section Alarms.

Start / Stop Peak Function

- Pressing key '6' will start the peak function. During this time, the readings will be live and the peak value will be remembered. The display will also change to allow the user to stop the peak function, see Screen 5 – In peak mode.
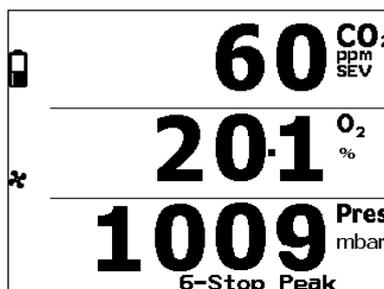
Screen 5 – In peak mode

- When key '6' is pressed again, the peak function will be stopped, and the user will be taken to the 'show peak values' screen. The following screens can be scrolled through on the analyser by using keys '1' and '6'.

```
      Show Peak Values
 Peak started on
   13/05/14  9:20:25
 CO2        120 ppmSEV    ▲
 Reading peaked on
   13/05/14  9:24:43
   Press Enter to clear
    and stop peak mode
 Enter=Clear    Menu=Exit
```

```
      Show Peak Values
 Peak started on
   13/05/14  9:20:25
 O2          2.4 %        ▲
 Reading peaked on
   13/05/14  9:27:34    ▼
   Press Enter to clear
    and stop peak mode
 Enter=Clear    Menu=Exit
```

```
      Show Peak Values
 Peak started on
   13/05/14  9:20:25
 Pressure 1012 mbar
 Reading peaked on
   13/05/14  9:20:43    ▼
   Press Enter to clear
    and stop peak mode
 Enter=Clear    Menu=Exit
```

Screen 6 – Show peak values, page 1 *Screen 7 – Show peak values, page 2* *Screen 8 – Show peak values, page 3*

- Each peak screen will display:
  - The time and date that the peak mode was started.
  - The channel identification and the peak reading.
  - The time and date that the peak reading occurred.
- At this screen, the user can either:
  - Scroll through the peak readings using keys '1' and '6'. The available scroll directions are shown by the ' ▲ ' and ' ▼ ' arrows on screen.
  - Press the 'enter' key to clear and stop the peak values which will return the user to the 'main read screen' in normal operation.
  - Alternatively, the user can press the 'menu' key to exit and return to the 'main read screen' and continue capturing readings in peak mode.

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 and information stored in the instrument. The 'main menu' can be seen in Screen 9 – Main menu.

```
          Main Menu
 0-Status Icon Help
 1-Information
 2-Backlight
 3-Contrast
 4-Sound On
 5-Advanced Menu




                 Menu=Exit
```

Screen 9 – Main menu

- The 'main menu' can be accessed from the 'main read screen' by pressing the 'menu' key, see annotation E in Physical Characteristics of the Hyperbaric.
- Options can be selected by pressing the relevant option number on the gas analyser keypad.

Exit Menu and Resume

By pressing the 'menu' key the user will exit from the 'main menu' and return to the 'main read screen'.

Status Icon Help

Status icons may be displayed on the analyser down the left hand side of the 'main read screen', see annotation B on Screen 2 – Main read screen, to provide the operator with useful information.

1) Press key '0' from the 'main menu' to provide a summary of the various icons that could be displayed. The following screens can be scrolled through on the analyser by using keys '1' and '6':
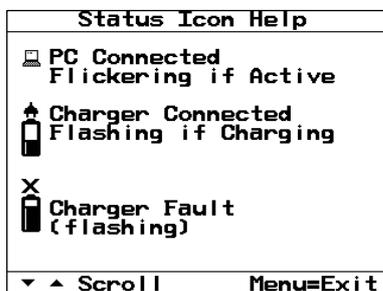
Screen 10 - Status icon help, page 1
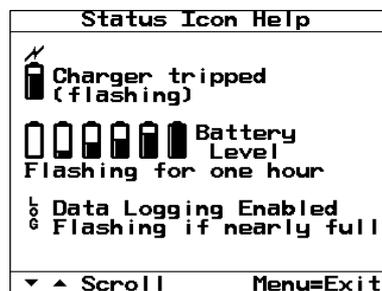
Screen 11 - Status icon help, page 2
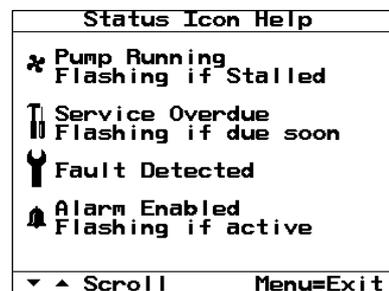
Screen 12 - Status icon help, page 3

The table below is a complete list of icons and their description:

Icon	Description
	Battery charge state
(flashing)	<1 hour remaining
(flashing)	Battery charging
	Battery charged
(flashing)	Charger fault
(flashing)	Charger tripped
	Pump running
(flashing)	Analyser flow failed / pump stalled
	Alarm set
(flashing)	Alarm active
	USB connected to PC (flickers when transferring data)
	Logging mode active
(flashing)	Logging mode active and memory full

⛏ (flashing)	Service due in less than one month
⛏	Service overdue
🔧	Fault / repair required

2) Press the 'menu' key to exit and return to the 'main menu'.

Information

This screen provides information regarding the gas analyser, such as the serial number, current firmware version, service due date and the dates of last factory and user calibration.

1) From the 'main menu' press key '1' to view the 'information screen', Screen 13 – Information screen will be displayed:

```
Analyser Information

      Hyperbaric

Serial Number: HB00004
Service Due  : 17/10/13
Last Fac. Cal: 02/09/13
Last User Cal: 11/09/13
               DD/MM/YY

Firmware V3.08 - 130919


            Menu=Exit
```

Screen 13 – Information screen

2) Press the 'menu' key to exit and return to the 'main menu'.

Backlight

The backlight option enables the operator to adjust the analyser's LED backlight intensity to allow for current lighting conditions or personal preference. The default setting is in the middle of the scale.

1) From the 'main menu' press key '2' to adjust the backlight brightness, Screen 14 – Adjust backlight will be displayed:

```
Adjust Backlight



Darker          Lighter

   Use Cursor Keys
Key 1 to move to right
Key 6 to move to left



            Menu=Exit
```

Screen 14 – Adjust backlight

2) Press the 'menu' key to exit and return to the 'main menu' without making any changes.

3) Press key '1' to move the cursor right and the backlight lighter or key '6' to move the cursor left and backlight darker.

> Note: There is a small power saving if the backlight intensity is darker.

4) Press the 'enter' key to confirm and store the new setting, or press the 'menu' key to cancel your changes and return to the 'main menu'.

```
     Adjust Backlight




    [===============■====]
    Darker        Lighter

      Use Cursor Keys
    Key 1 to move to right
    Key 6 to move to left


    Enter=Confirm Menu=Cancel
```
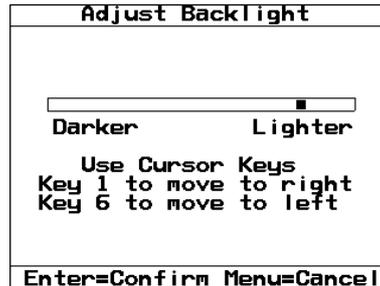
Screen 15 – Adjust backlight, with confirm / cancel

> Note: This setting is retained when the analyser is switched off.
>
> Note: The actual backlight on/off operation is controlled via the 'backlight' key. See annotation C on Physical Characteristics of the Hyperbaric.

Contrast

The contrast option enables the operator to adjust the analyser's contrast setting to allow for current lighting conditions or personal preference. Adjusting the contrast can make the display more or less readable. The default setting is in the middle of the scale.

1) From the 'main menu' press key '3' to adjust the display contrast, will be displayed:

```
     Adjust Contrast




    [===============■====]
    Darker        Lighter

      Use Cursor Keys
    Key 1 to move to right
    Key 6 to move to left


              Menu=Exit
```
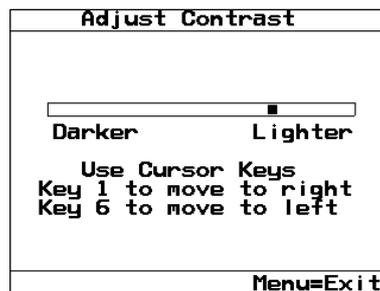
Screen 16 – Adjust contrast

2) Press the 'menu' key to exit and return to the 'main menu' without making any changes.

3) Press key '1' to move the cursor right and the contrast lighter or key '6' to move the cursor left and contrast darker.

> Note: The display contrast is most likely to be effected by temperature and may need adjusting when the analyser's temperature is changed.

4) Press the 'enter' key to confirm and store the new setting, or press the 'menu' key to cancel your changes and return to the 'main menu'.

```
        Adjust Contrast


      ┌──────────────■─────────┐
      └────────────────────────┘
      Darker          Lighter

          Use Cursor Keys
     Key 1 to move to right
     Key 6 to move to left


     Enter=Confirm Menu=Cancel
```
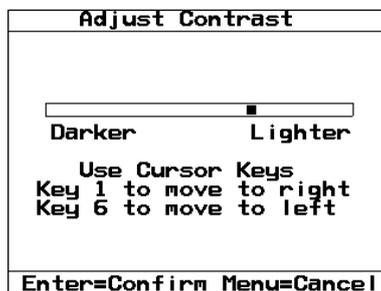
Screen 17 – Adjust contrast, with confirm / cancel

Note: This setting is retained when the analyser is switched off.

Sound

The sound option enables the operator to enable or disable the analyser's internal speaker. The speaker is used to provide feedback for key presses and menu selections alongside its primary function, gas alarms.

1) When in the 'main menu', the sound option will either be 'sound on' or 'sound off'.

2) Pressing key '4' will toggle the sound 'on' or 'off'.

```
        Main Menu
   0-Status Icon Help
   1-Information
   2-Backlight
   3-Contrast
   4-Sound On
   5-Advanced Menu




              Menu=Exit
```

```
        Main Menu
   0-Status Icon Help
   1-Information
   2-Backlight
   3-Contrast
   4-Sound Off
   5-Advanced Menu




              Menu=Exit
```

Screen 18 - Main menu, sound on   *Screen 19 - Main menu, sound off*
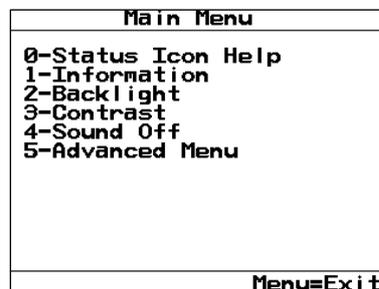
Note: The current sound setting is displayed on the main menu. Therefore, if option '4' displays 'sound on', the speaker is enabled.

3) Pressing the 'menu' key will exit the 'main menu' and return the operator to the 'main read screen'. No saving of the setting is required.

Note: This settings is <u>not</u> retained when the analyser is switched off.

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Advanced Menu

The 'advanced menu' option provides the user with more control with the features of the analyser, such as calibration options, alarm settings, and data logging.

The 'advanced menu' is accessed by pressing key '5' from the 'main menu'. Before gaining access, the operator is required to enter the passcode '0192'.

> Note: Only users with permission should gain entry to the 'advanced menu'.

Time and Date

The time and date option allows the operator to check or set the analyser's internal clock. In addition, the operator can also toggle the date format between UK or US format.

> Note: The correct time and date are important as they appened to each stored reading.

1) From the 'advanced menu' press key '1' to check or change the time and date settings, Screen 20 – Set time and date will be displayed:

```
┌─────────────────────────┐
│    Set Time & Date      │
│ 1-13:57:45              │
│ 2-21/07/10              │
│ 3-DD/MM/YY              │
│                         │
│                         │
│                         │
│                         │
│                         │
│               Menu=Exit │
└─────────────────────────┘
```

Screen 20 – Set time and date

2) Press key '1' to edit the time or key '2' to edit the date. When in edit mode, the required setting will become blank; see Screen 21 – Time in edit mode.

```
┌─────────────────────────┐
│    Set Time & Date      │
│ *-__:__:__              │
│ *-18/09/13              │
│ *-DD/MM/YY              │
│                         │
│                         │
│                         │
│                         │
│ Enter=Accept  Menu=Cancel│
└─────────────────────────┘
```

Screen 21 – Time in edit mode

3) Use the numeric keypad to enter the time or date. Data will be entered from the right. For example, to enter a new time 11:11:00 the operator must type in 111100. An example can be seen in Screen 22 – Setting the time.

```
       Set Time & Date
 *-__:_1:11
 *-18/09/13
 *-DD/MM/YY




 Enter=Accept   Menu=Cancel
```

Screen 22 – Setting the time

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

Note: The analyser will not allow invalid time or date entries, see Screen 23 – Invalid time entry.

```
       Set Time & Date
 *-99:99:99
 *-18/09/13
 *-DD/MM/YY

      Invalid Time




 Enter=Accept   Menu=Cancel
```

Screen 23 – Invalid time entry

Note: These settings are retained when the analyser is switched off.

4) To change the date format, press key '3', this will automatically change the date format seen on line two when doing so.

```
       Set Time & Date
 1-13:58:42
 2-07/21/10
 3-MM/DD/YY




              Menu=Exit
```

Screen 24 – Change date format

5) Press the 'enter' key to 'accept' and store the new setting, or press the 'menu' key to cancel your changes. Both of these options will return you to the 'set time and date' screen, where you will need to press the 'menu' key to exit to the 'advanced menu'.

Calibration

The Hyperbaric analyser is fully calibrated during manufacture and when returned for service. However, the ability has been provided to perform a user calibration on each of the gas channels to ensure its accuracy between services and whilst in its current operating condition and environment.

> Note: To ensure optimum performance please ensure your analyser is returned for service and calibration on time.

1) From the 'advanced menu' press key '2' to select 'calibration', <u>Screen 25 – Calibration menu</u> will be presented to the operator.

```
┌─────────────────────────────┐
│      User Calibration       │
│                             │
│  1-Zero CO2 Offset          │
│  2-Span Calibration         │
│  3-Factory Reset            │
│                             │
│                             │
│                             │
│                             │
│                             │
│                             │
│                             │
│                 Menu=Exit   │
└─────────────────────────────┘
```
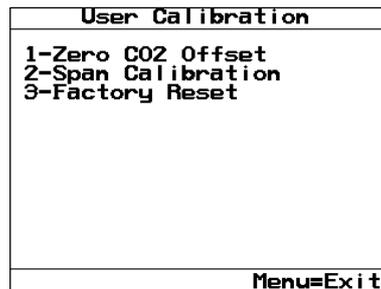
Screen 25 – Calibration menu

> Note: For more information on user calibration, please refer to section <u>Gas Check and Calibration</u> in this operating manual.

2) Press the 'menu' key to return to the 'advanced menu'.

Logging Options

Whilst in data logging mode, the analyser will automatically record data at the pre-set intervals and will automatically run the pump for a pre-set time. The operator is able to change the pump runtime, logging interval, and the pump mode of operation.

1) From the 'advanced menu', press key '3' to select 'logging options', <u>Screen 26 – Logging options menu</u> will be displayed.

```
┌─────────────────────────────┐
│       Logging Options       │
│                             │
│  1-Every 1 mins             │
│  *-Pump always on           │
│  3-Pump Mode                │
│  4-Start Logging            │
│                             │
│                             │
│                             │
│                             │
│                             │
│                 Menu=Exit   │
└─────────────────────────────┘
```
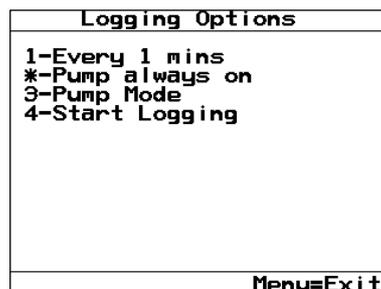
Screen 26 – Logging options menu

2) The 'logging options' menu will present the operator with four options:

- Key '1' – allows the operator to edit the logging interval, i.e. how often a reading is stored.

- Key '2' – allows the operator to edit the pump runtime, i.e. how long the pump runs at the end of the interval before storing the reading.

- Key '3' – allows the operator to edit the pump mode, this can be always on, always off, or editable via key '2'.

> Note: If the pump is set to 'always on' or 'always off', line two in the 'logging options' menu will

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become unavailable for editing.

- Key '4' – allows the operator to start or stop the logging function.

Note: Logging will only begin once the operator returns to the 'main read screen'.

Note: Option four will not be available if in edit mode.

3) Press key '1' to edit the logging interval or key '2' to edit the pump runtime (if available). When in edit mode, the required setting will become blank. In addition, the option to start/stop logging will also be removed; see Screen 27 – Logging interval in edit mode.

```
┌─────────────────────────┐
│    Logging Options      │
├─────────────────────────┤
│ *-Every 1 mins          │
│ *-Pump ___ secs         │
│ *-Pump Mode             │
│                         │
│                         │
│                         │
│                         │
│                         │
│                         │
│ Enter=Accept  Menu=Cancel│
└─────────────────────────┘
```

Screen 27 – Logging interval in edit mode

4) Use the numeric keypad to enter the logging interval (in minutes) or pump runtime (in seconds). Data will be entered from the right. For example, to enter a new pump runtime of 60 seconds, the operator must type 060. An example can be seen in Screen 28 – Setting the logging interval.

```
┌─────────────────────────┐
│    Logging Options      │
├─────────────────────────┤
│ *-Every 1 mins          │
│ *-Pump _06 secs         │
│ *-Pump Mode             │
│                         │
│                         │
│                         │
│                         │
│                         │
│                         │
│ Enter=Accept  Menu=Cancel│
└─────────────────────────┘
```

Screen 28 – Setting the logging interval

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Note: The analyser will not allow the pump runtime to exceed the logging interval, see <u>Screen 29 – Invalid pump runtime</u>.

```
        Logging Options
    *-Every 1 mins
    *-Pump 120 secs
    *-Pump Mode



    Pump Runtime > Interval


    Enter=Accept  Menu=Cancel
```
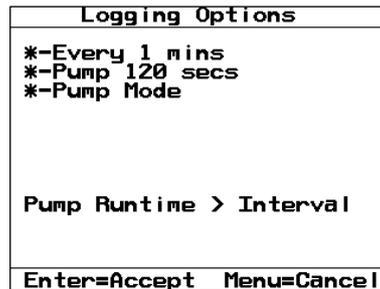
Screen 29 – Invalid pump runtime

---

5) Once the new logging interval or pump runtime is entered, accept the setting by pressing the 'enter' key.

6) Pressing key '3' will change the pump mode of operation, this toggles the text seen on option 2 between the pump runtime in seconds, pump always on, and pump off.

```
      Logging Options
    1-Every 1 mins
    2-Pump 2 secs
    3-Pump Mode




    Enter=Confirm Menu=Cancel
```

```
      Logging Options
    1-Every 1 mins
    *-Pump always on
    3-Pump Mode




    Enter=Confirm Menu=Cancel
```

```
      Logging Options
    1-Every 1 mins
    *-Pump off
    3-Pump Mode




    Enter=Confirm Menu=Cancel
```
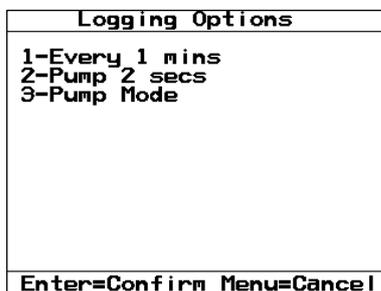
Screen 30 - Pump mode in seconds *Screen 31 - Pump always on* *Screen 32 - Pump always off*
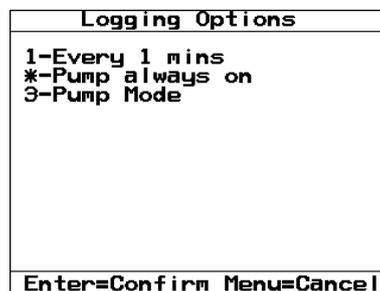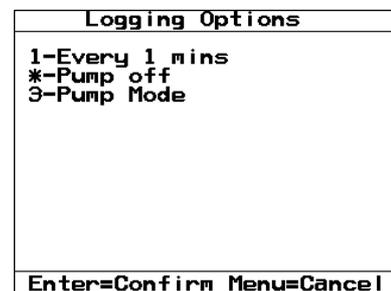
7) Press the 'enter' key to confirm and store the new setting(s), or press the 'menu' key to cancel your changes. Both of these options will return you to the 'logging options' menu and line four will become available once more.

8) Press key '4' to start logging, followed by the 'menu' key until you return to the 'main read screen', where logging will automatically begin and is indicated on the 'main read screen' by the log (LOG) icon.

9) To stop logging, navigate to the 'logging options' menu from the 'main read screen' and press key '4', 'stop logging'.

Note: Whilst logging mode is enabled, the 'pump' key is deactivated.

Note: Once the reading memory is full, it is not possible to store any further readings.

Note: If data logging is enabled and the memory becomes full, the analyser will show a brief message stating the memory is full and that no further data will be recorded, i.e. the logging mode is stopped.

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View Data

The 'view data' option enables the operator to view the stored readings from the data logging function.

1) From the 'advanced menu', press key '4' to select 'view data', <u>Screen 33 – Stored readings</u> will be displayed.

```
     Stored Readings

       0001 of 0208
   17/05/13  9:37

   Type     Auto
   CO₂          625 ppmSEV
   O₂          20.3 %
   Pressure 1020 mbar



   5=Options       Menu=Exit
```

Screen 33 – Stored readings

Note: In the event there are no readings to display, the operator will be informed by the way of an onscreen message, see <u>Screen 34 – No stored readings</u>.

```
     Stored Readings

   No Readings






   5=Options       Menu=Exit
```

Screen 34 – No stored readings

2) The next reading can be viewed by pressing key '1' and the previous reading can be viewed by pressing key '6'.

3) The readings can be refined / filtered by pressing key '5' for 'options'.

```
       View Options

   1-Go to First Reading
   2-Go to Last Reading
   3-Go to Reading No.    1
   4-Show Dates: All





                   Menu=Exit
```

Screen 35 – Logged data, view options

4) Pressing key '1' will take the operator to the first reading.

5) Pressing key '2' will take the operator to the last reading.

6) Pressing key '3' allows the operator to manually select which reading they wish to view:

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a. When in edit mode, the current reading number will become blank; see Screen 36 – Go to reading no..

```
       View Options

*-Go to First Reading
*-Go to Last Reading
*-Go to Reading No. ____
*-Show Dates: All




 Enter=Accept   Menu=Cancel
```
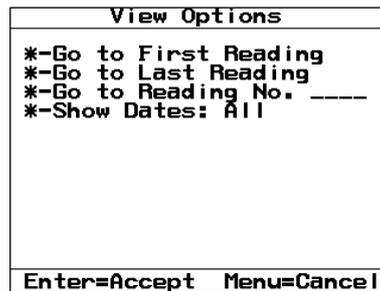
Screen 36 – Go to reading no.

b. Use the numeric keypad to enter the number of the reading you wish to view. Data will be entered from the right. For example, to view reading 124, the operator must type 0124. An example can be seen in Screen 37 – Edit reading no..

```
       View Options

*-Go to First Reading
*-Go to Last Reading
*-Go to Reading No. _012
*-Show Dates: All




 Enter=Accept   Menu=Cancel
```
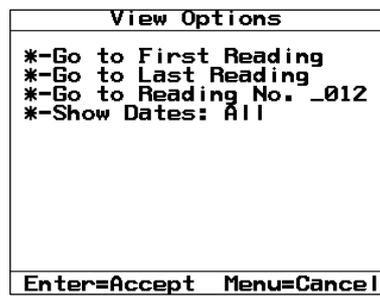
Screen 37 – Edit reading no.

c. Press the 'enter' key to accept the selection and the operator will immediately be taken to that reading.

```
      Stored Readings

      0124 of 0208
 17/05/13 11:40

 Type    Auto
 CO₂        423 ppmSEV
 O₂        21.3 %
 Pressure 1014 mbar



 5=Options      Menu=Exit
```
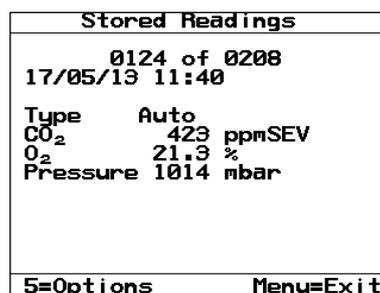
Screen 38 – Selected reading

7) Pressing key '4' in the 'view options' menu allows the operator to filter the reading by various dates, the options are 'all', 'after', 'before', or 'between' dates:

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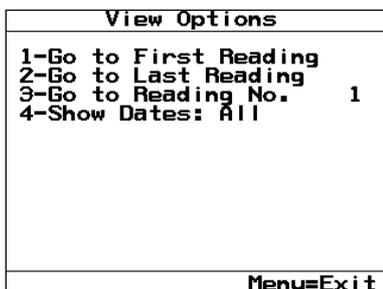
```
        View Options
1-Go to First Reading
2-Go to Last Reading
3-Go to Reading No.    1
4-Show Dates: All




                  Menu=Exit
```
Screen 39 – Filter all dates
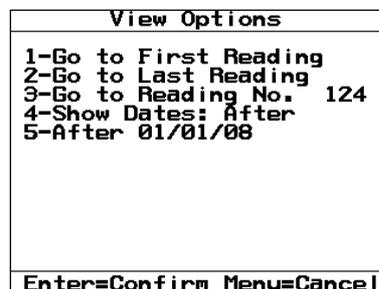
```
        View Options
1-Go to First Reading
2-Go to Last Reading
3-Go to Reading No.  124
4-Show Dates: After
5-After 01/01/08



     Enter=Confirm Menu=Cancel
```
Screen 40 – Filter after date
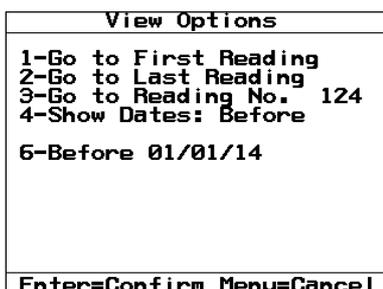
```
        View Options
1-Go to First Reading
2-Go to Last Reading
3-Go to Reading No.  124
4-Show Dates: Before

6-Before 01/01/14



     Enter=Confirm Menu=Cancel
```
Screen 41 – Filter before date
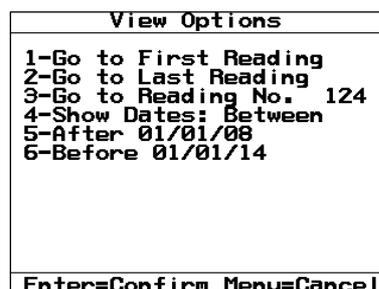
```
        View Options
1-Go to First Reading
2-Go to Last Reading
3-Go to Reading No.  124
4-Show Dates: Between
5-After 01/01/08
6-Before 01/01/14


     Enter=Confirm Menu=Cancel
```
Screen 42 – Filter between dates

a. Pressing keys '5' or '6' when available whilst filtering allow the user to enter the required dates. When in edit mode, the current reading number will become blank; see Screen 43 – View data filtering options in edit mode.
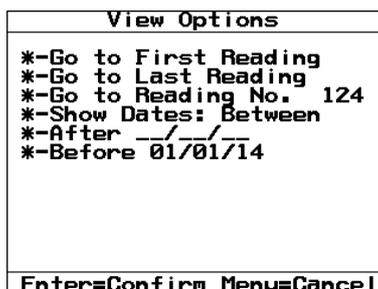
```
        View Options
*-Go to First Reading
*-Go to Last Reading
*-Go to Reading No.  124
*-Show Dates: Between
*-After __/__/__
*-Before 01/01/14



     Enter=Confirm Menu=Cancel
```
Screen 43 – View data filtering options in edit mode

b. Use the numeric keypad to enter the required dates for filtering. Data will be entered from the right. For example, to enter a date of 27/09/13, the operator must type 270913. An example can be seen in Screen 44 – View data, input dates.

```
        View Options
*-Go to First Reading
*-Go to Last Reading
*-Go to Reading No.  124
*-Show Dates: Between
*-After __/27/09
*-Before 01/01/14



     Enter=Confirm Menu=Cancel
```
Screen 44 – View data, input dates
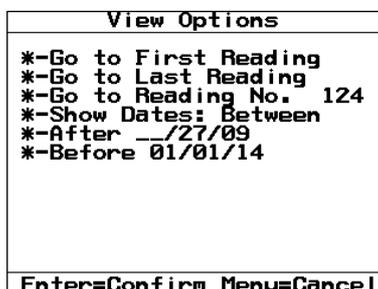
    c. Once the dates are entered, press the 'enter' key to confirm. The operator will automatically be taken to the first reading in the filtered set.

Note: If there are no readings meeting the search criteria, the operator will be informed by the way of an onscreen message, see Screen 45 – No matches for filtering criteria.

```
┌─────────────────────────────┐
│       Stored Readings       │
├─────────────────────────────┤
│                             │
│ No Matches                  │
│                             │
│                             │
│                             │
│                             │
│                             │
│ 5=Options         Menu=Exit │
└─────────────────────────────┘
```
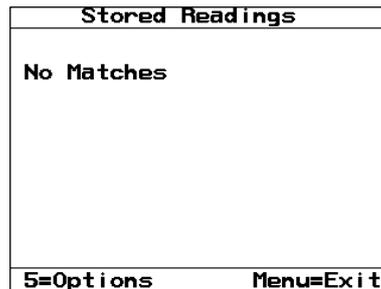
Screen 45 – No matches for filtering criteria

Note: When filtering dates, the 'go to' functions (options one, two, and three) available in the 'view optinos' screen are relevant for the filtered data set only.

---

8) Pressing the 'menu' key in the 'view options' screen will return the operator to the 'stored readings' screen.

9) Pressing the 'menu' key in the 'stored readings' screen will return the operator to the 'advanced menu'.

Delete Readings

The 'delete readings' function allows the operator to clear the instruments readings, taken as part of the logging function.

Note: Before readings can be deleted, the operator must enter the confirmation code '0192'.

---

1) From the 'advanced menu', press key '5' for 'delete readings', see Screen 46 – Delete all readings.

```
┌─────────────────────────────┐
│      Delete All Readings    │
├─────────────────────────────┤
│ Stored Readings: 10         │
│ Enter Confirmation Code     │
│ Code: ____                  │
│                             │
│                             │
│                             │
│ Enter=Accept      Menu=Exit │
└─────────────────────────────┘
```
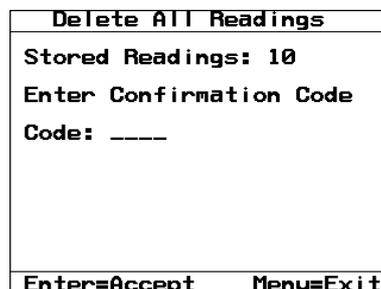
Screen 46 – Delete all readings

2) If you do not wish to delete the readings, press the 'menu' key to exit and return to the 'advanced menu'.

3) Use the numeric keypad to enter the confirmation code '0192'.

4) Press the 'enter' key to 'accept' the code. This will immediately delete the readings.

Note: Once readings have been deleted, they cannot be recovered.

5) Once the readings are deleted, the operator will be returned to the 'advanced menu'.

Alarms

The Hyperbaric analyser has the facility to set 'above' and 'below' alarms for the CO_2, O_2, and pressure channels. The alarms for each channel can be enabled or disabled independently via the 'alarms' menu option.

Alarms can be set as 'if above', 'if below', or 'outside' of a set criteria.

Once an alarm is enabled, the 🔔 icon next to the channel will indicate that an alarm condition has been set for it.

A flashing 🔔 icon next to a channel indicates that the alarm condition has been reached. The speaker will 'beep' until the channel has recovered to within the set limits or the alarm has been disabled, if the sound is enabled.

- 'If above' alarms are triggered when the channel exceeds the value entered by the operator.
- 'If below' alarms are triggered when the channel falls below the value entered by the operator.

1) From the 'advanced menu', press key '6' to select 'alarms', <u>Screen 47 – Current alarms menu</u> will be displayed.

```
     Current Alarms
 1-CO₂
 2-O₂
 3-Pressure




                  Menu=Exit
```
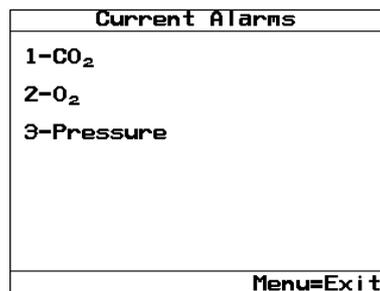
Screen 47 – Current alarms menu

2) Press the relevant numeric key for the channel of the alarm you wish to edit.
3) Press key '1' to 'enable' or 'disable' the alarm.

```
 CO₂ Alarm Settings
 1-Disabled
 2-If above   1000 ppmSEV
 3-If below    900 ppmSEV




           Menu=Exit
```
```
 CO₂ Alarm Settings
 1-Enabled
 2-If above   1000 ppmSEV
 3-If below    900 ppmSEV




   Enter=Confirm Menu=Cancel
```
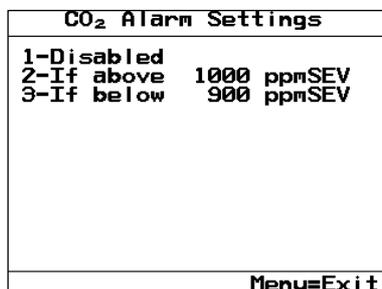
Screen 48 - Alarm disabled   *Screen 49 - Alarm enabled*
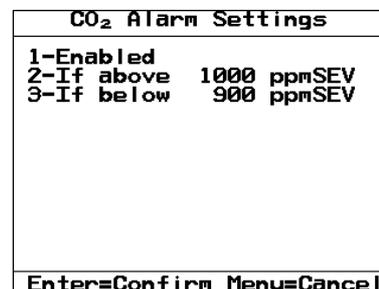
Note: An alarm cannot be 'enabled' until the 'if above' and 'if below' conditions have been set.

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4) Press key '2' to edit the 'if above' condition or key '3' to edit the 'if below' condition. When in edit mode, the required setting will become blank; see Screen 50 – CO2 'if above' in edit mode.

```
   CO₂ Alarm Settings
 *-Disabled
 *-If above _____ ppmSEV
 *-If below   900 ppmSEV




   Enter=Accept   Menu=Cancel
```
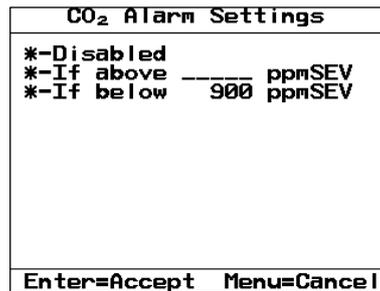
Screen 50 – CO₂ 'if above' in edit mode

5) Use the numeric keypad to enter the alarm threshold. Data will be entered from the right. For example, to enter a limit of 2500ppm, the operator must type 02500. An example can be seen in Screen 51 – Setting the CO2 'if above' limit.

```
   CO₂ Alarm Settings
 *-Disabled
 *-If above __025 ppmSEV
 *-If below   900 ppmSEV




   Enter=Accept   Menu=Cancel
```
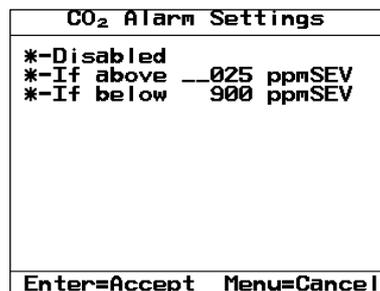
Screen 51 – Setting the CO₂ 'if above' limit

6) Once the threshold is entered, press the 'enter' key to accept your changes, or the 'menu' key to cancel.

Note: The 'if below' value cannot be greater than the 'if above' value. If this error occurs, the user will be notified by an onscreen message, as seen in Screen 52 – Alarm condition not valid.

```
   CO₂ Alarm Settings
 *-Disabled
 *-If above __800 ppmSEV
 *-If below   900 ppmSEV

    'Below' >= 'Above'



   Enter=Accept   Menu=Cancel
```
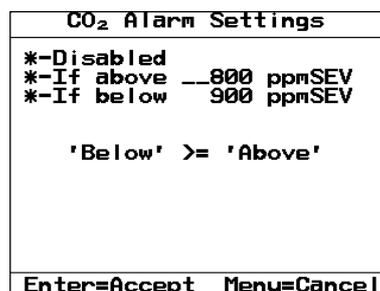
Screen 52 – Alarm condition not valid

7) Press the 'enter' key once more to 'accept' the changes, the operator will be returned to the 'current alarms' screen. Alternatively, the operator can press the 'menu' key to cancel their changes and return to the 'current alarms' screen.

8) Press the 'menu' key to return to the 'advanced menu'.

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> Note: If the operator only wishes to set an 'if above' or 'if below' alarm, they can do this by setting the opposite condition to the maximum or minimum range of the channel as indicated in Table 1.
>
> | Channel | Min | Max |
> |---------|-----|-----|
> | CO_2 | 0 | 30,000ppm SEV |
> | O_2 | 0 | 999.9% or 9.999ppATA |
> | Pressure | 0 | 9,999FSW or 9,999mbar |
>
> *Table 1*

Flow Fail

The 'flow fail' option enables the operator to adjust the sensitivity of the flow fail detector, should it fail in normal operation with a clean, dry filter.

The analysers internal pump can be stalled when pulling against a too high a vacuum or through a blocked/restricted inlet filter. A stalled pump is indicated on the 'main read screen' by a flashing ✻ icon. To prevent damage to the pump, the analyser will automatically switch the pump off after a few seconds.

The default setting for the sensitivity is in the middle of the scale.

> Note: Dirty or discoloured filters should be changed before use. Filters that have been subjected to water should be replaced immediately to avoid damge to the analyser.

1) From the 'advanced menu', press key '7' to adjust the flow fail, Screen 53 – Adjust flow fail will be displayed.

```
 Adjust Flow Fail
 _____

   Sensitivity
 [========■========]
 More           Less

   Use Cursor Keys
 Key 1 to move to right
 Key 6 to move to left

   Turn on  Pump

           Menu=Exit
```
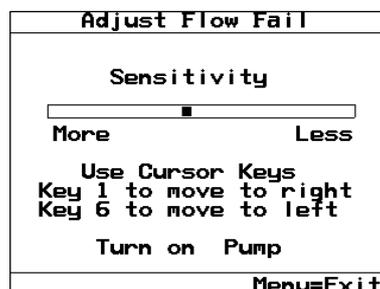
Screen 53 – Adjust flow fail

2) Use key '1' to move the cursor to the right and make the sensitivity less sensitive, or use key '6' to move the cursor to the left and make the sensitivity more sensitive.

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```
┌─────────────────────────────┐
│      Adjust Flow Fail        │
│                              │
│        Sensitivity           │
│                              │
│ ┌────────────────────┐       │
│ └────────────────■───┘       │
│  More           Less         │
│                              │
│      Use Cursor Keys         │
│    Key 1 to move to right    │
│    Key 6 to move to left     │
│                              │
│       Turn on  Pump          │
│                              │
│  Enter=Confirm Menu=Cancel   │
└─────────────────────────────┘
```
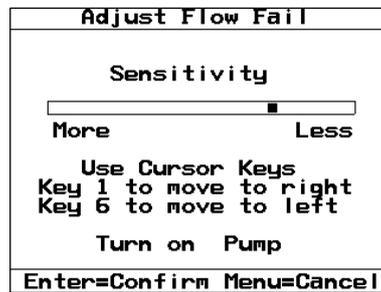
Screen 54 – Adjust sensitivity setting

> Note: If the analyser pump is stalling in normal operation, it is recommended that the sensitivity is adjusted whilst the pump is turned on.

3) Once the required adjustment has been made, press the 'enter' key to 'confirm' and store the setting, or press the 'menu' key to 'cancel' your changes. Both of these options will return the operator to the 'advanced menu'.

Diagnostics

The operator may be asked by a member of the Geotech technical support team to confirm values from the 'diagnostics' screen in order to identify and resolve issues with the analyser and readings, if required.

1) From the 'advanced menu', press key '8' to access the 'diagnostics' screen, Screen 55 – Diagnostic information will be displayed.

```
┌─────────────────────────────┐
│    Diagnostic Information    │
│                              │
│            ADC               │
│  0:0535  1:00D5  2:FFFE      │
│                              │
│                              │
│      0:+2127212              │
│      1:+2127212              │
│      2:+2127212              │
│                              │
│  0=Help        Menu=Exit     │
└─────────────────────────────┘
```
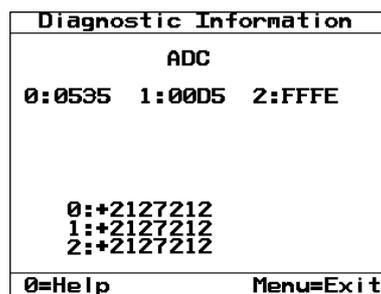
Screen 55 – Diagnostic information

2) Pressing key '0' for 'help' will provide the user with a list of various diagnostic options, pressing the relevant number on the keypad will navigate the operator to this screen.

3) Press the 'menu' key to 'exit' to the 'advanced menu'.

> Note: For further information please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk

Units of Measurement

The Hyperbaric analyser has the facility to change the units of measurement for the O_2 and pressure readings. Each of these can be independently set via the 'units of measurement' option.

1) From the 'advanced menu', press key '9' to take you to the 'units of measurement' screen,

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Screen 56 – Units of measurement will be displayed.

```
┌─────────────────────────────┐
│    Units of Measurement     │
│                             │
│ 1-O₂        %               │
│ 2-Pressure mbar             │
│                             │
│                             │
│                             │
│                             │
│                             │
│                             │
│                  Menu=Exit  │
└─────────────────────────────┘
```
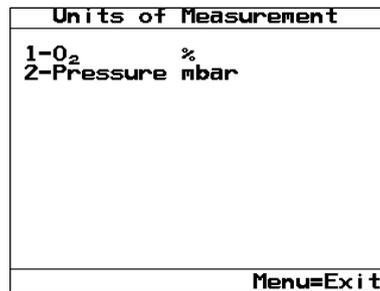
Screen 56 – Units of measurement

2) Pressing key '1' will toggle the units of measurement for the O_2 channel between 'ppATA' and '%'. Pressing key '2' will toggle the units of measurement for the pressure channel between 'mbar', 'atm', and 'fsw'.

```
┌─────────────────────────────┐
│    Units of Measurement     │
│                             │
│ 1-O₂        ppATA           │
│ 2-Pressure atm              │
│                             │
│                             │
│ Accept Changes?             │
│ (Will also clear alarm      │
│  and reset peak)            │
│ Enter=Confirm Menu=Cancel   │
└─────────────────────────────┘
```
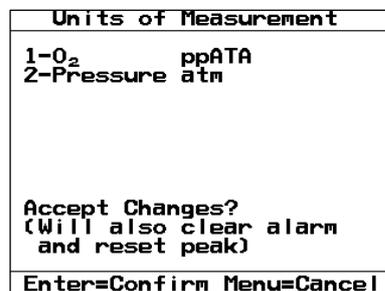
Screen 57 - Units of measurement, ppATA and atm

```
┌─────────────────────────────┐
│    Units of Measurement     │
│                             │
│ 1-O₂        %               │
│ 2-Pressure fsw              │
│                             │
│                             │
│ Accept Changes?             │
│ (Will also clear alarm      │
│  and reset peak)            │
│ Enter=Confirm Menu=Cancel   │
└─────────────────────────────┘
```
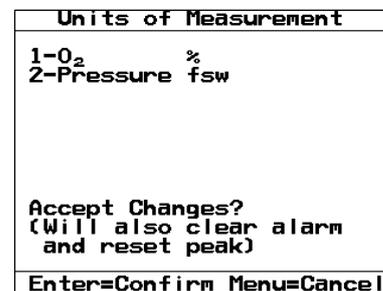
Screen 58 - Units of measurement, % and fsw

3) When the required changes have been made, press the 'enter' key to 'confirm' the selection. Alternatively, press the 'menu' key to 'cancel' your changes. Both of these options will return the operator to the 'advanced menu'.

> Note: Changing the units of measurement will reset the alarm settings and the peak reading for the channel that has been altered.

Operating Manual

Gas Readings
Preliminary Checks – Best Practice

Prior to use, it is good practive to ensure that:

START

STEP 1

Analyser has correct time and date set

STEP 1: The analyser has the correct time and date set.

STEP 2

Check and/or replace filters

STEP 2: Check the analyser sample filters are fitted to the inlet, outlet, and vent ports, and ensure that they are clean and dry. If necessary, replace them for new filters – see Replacing the Inlet, Outlet, and Vent PTFE Water Trap Filters.

If condensation is being experienced in the sample line or the sample filter keeps being blocked, it is recommended that additional protection is used prior to the instrument.

STEP 3

Check battery has good charge

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

STEP 4

Memory has sufficient space

STEP 4: The memory has sufficient space available to store the required data.

STEP 5

Gas channels verified and/ or calibrated

STEP 5: The main gases have been verified with zero gas concentration present, and if necessary, check the current calibration using a known calibration check gas. If required a span calibration can be performed to improve the accuracy and performance in the environmental conditions the analyser is to be used in.

STEP 6

Take readings

STEP 6: Take readings.

Flow Chart 1 – Preliminary che

> **!** Always ensure that the exhaust gases emerge in a well ventilated area.

Note: Protect the analyser from strong, direct sunlight which will quickly raise the temperature of the analyser beyond its operating range. In addition, excess temperatures can cause the display to appear almost black; the contrast setting cannot then alter the contrast.

Note: Always use the sample filter! If the sample filter becomes saturated, change it and ensure

Operating Manual

> all the sample tubes are clean and dry before re-use.
>
> Note: Don't place the analyser against anything hot as this may cause excessive internal temperatures which can lead to erroneous readings.

Gas Measurement Process – Best Practice

Depending on operator preferences, the exact reading procedure can change. The following method is considered best practice and when followed correctly, will allow quick and consistent gas readings.
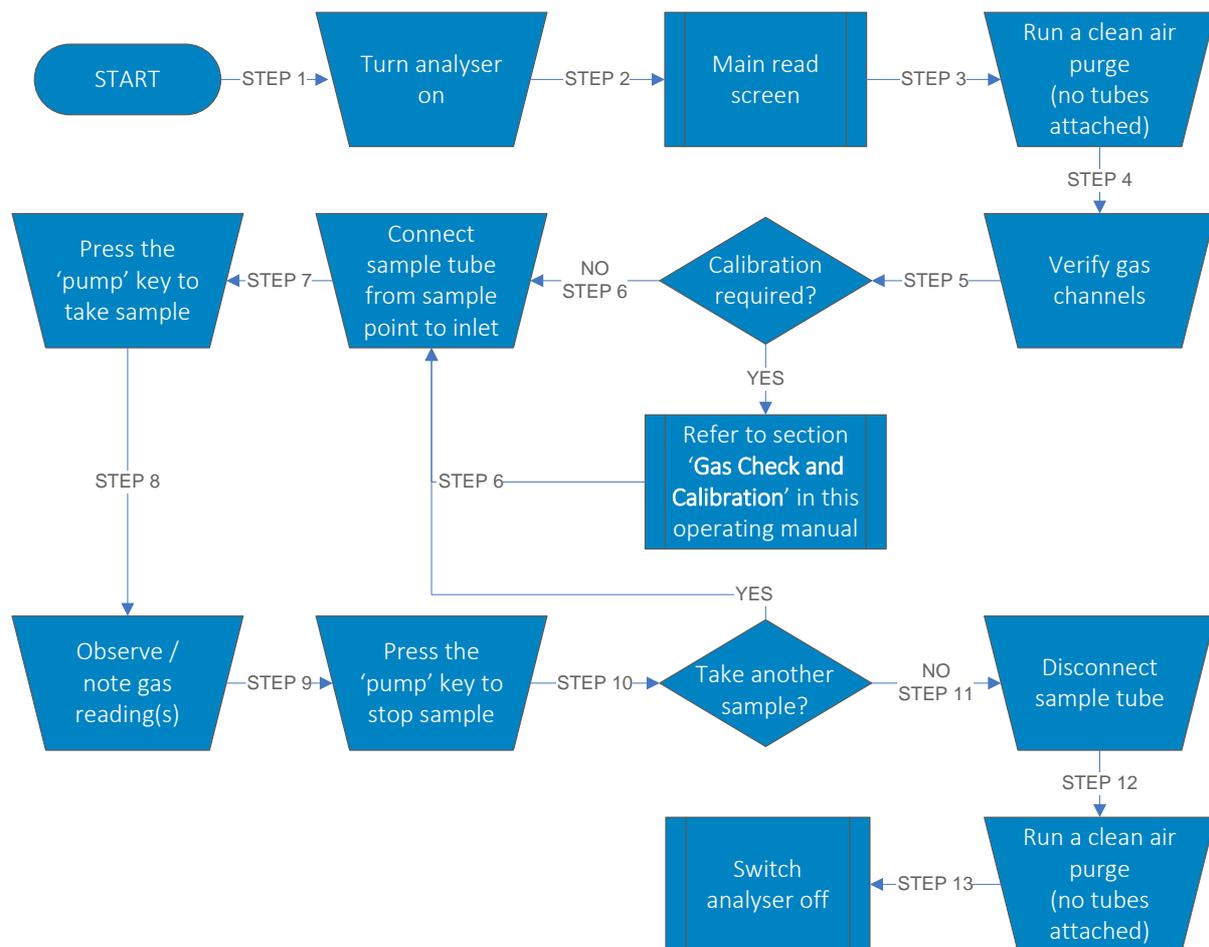
Flow Chart 2 – Gas measurement process

STEP 1: Turn on the analyser by pressing the 'on/off' key.

STEP 2: After the successful power on self test has completed, the operator will be presented with the 'main read screen'.

Step 3: After first turning the analyser on, it should be purged with fresh, clean air by running the pump and allowed to stabilise for a few minutes. This is best undertaken with no tubing attached to the instrument.

Step 4: At this point, it is good practice to verify the gas channels with a known gas concentration.

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STEP 5: Calibrate only if required using the 'calibration' option from the 'advanced menu'. Refer to the Gas Check and Calibration section of this operating manual for further information.

Step 6: Connect the sample tube (always use the inline water trap) from the sample point to the gas inlet port of the instrument (see annotation K on Analyser Connection Points), ensure the filter is seated correctly.

Step 7: Press the 'pump' key to draw the sample in to the analyser. The main gas readings will begin to change and after a short time (approximately thirty seconds) will begin to stabilise.

Step 8: Once stabilised, observe, or if required make a note of, the readings.

Step 9: Press the 'pump' key to stop the sample.

Step 10: If another gas sample is required, follow steps 6 – 9.

Step 11: Once the measurement process is complete, remove the sample tube from the analyser and sample point.

Step 12: After each monitoring session, the analyser should be purged with fresh, clean air to ensure there are no contaminant gases left in the gas paths.

Step 13: Switch the instrument off.

<div style="background:gray">Switching the Analyser Off</div>

Note: Before the analyser is switched off, a clean air purge should be performed. This ensures that the analyser is free from contaminated gas and ready for the next measurement. This final purge is extremely important for the O_2 sensor, as it may degrade if stored with contaminated gas.

1) Prior to turning the instrument off, purge the analyser with clean air by running the pump for approximately thirty seconds or until the readings have returned to normal levels.

2) Press and hold the 'on/off' key for approximately two seconds and the instrument will turn off.

Operating Manual

GAS CHECK AND CALIBRATION

Introduction

The Hyperbaric analysers are carefully calibrated at manufacture and when returned for service using a number of gas concentrations. However, it is sometimes desirable for the user to carry out a gas check on the analyser to prove its accuracy and rectify any inaccuracies with a calibration process between services.

The Hyperbaric measures CO_2 and O_2 and these channels can be user calibrated. This section will describe in detail the correct procedure to gas check and calibrate these channels.

> Note: This does **not** replace the factory service and calibration.
>
> Note: If this calibration is completed incorrectly, it may decrease the accuracy of the analyser.

Four important terms that are used within this section are:

Gas check: This is where a known concentration of gas is applied to the analyser and its responses are checked with no adjustments being made.

Calibration: This is when an adjustment is made to the analyser's readings after a gas check has been performed, by either a zero, span, or both.

Zero: The point at which the analyser is calibrated when there is none of the target gas present.

Span: The point at which the analyser is calibrated when there is a known concentration of the target gas present.

> Note: A more detailed explanation of user calibration can be found within section User Calibration Explained.

Required Equipment

Gas

User calibration of the analyser will greatly improve the data accuracy in the range of the calibration gas used and the environmental conditions for which the Hyperbaric is calibrated. This may cause less accurate readings of concentrations outside of this calibrated range.

Users should select the correct calibration gas for the expected gas levels in their particular application. In addition, nitrogen (N_2) can be used for a zero calibration. If this is not available, then clean ambient air can be used with the soda lime filter kit (see item D in Hyperbaric Consumable Products).

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> ❗ Calibration gases can be dangerous. For each gas used, the appropriate material safety data sheet must be read and fully understood before proceeding.

It is recommended that the regulator available via Geotech be used as it has been configured to deliver a fixed flow of 300ml/min and correct pressure relief to avoid damage to the analyser (see item B in Hyperbaric Consumable Products). As the regulator's flow is factory set it only requires a few turns to open, no adjustment will be necessary.

> Note: If using a regulator that was not supplied by Geotech, please ensure the flow rate is adjusted to a maximum of 300ml/min. Suitable pressure relief should be ensured to protect the system from damage because of over-pressurisation – typically 3-5psi (200-350mbar).

> ❗ When the analyser is being calibrated, in cases of overpressurisation, the 1/16" port on the red pressure relief valve (supplied with the Geotech pressure regulator) will release gas to protect the analyser.
>
> It is recommended that tubing is fitted to the exhaust of the analyser and the pressure relief valve which emerges in a well-ventilated area.
>
> Ensure there are no leaks in the tubing and connections before carrying out a user calibration.
>
> The calibration of the Hyperbaric should be carried out by trained personnel taking all necessary precautions when using dangerous, explosive, or toxic gases.

Connecting a Gas Bottle to the Hyperbaric

Figure 1 – Gas bottle set-up displays the required set-up for the equipment to successfully gas check or calibrate the analyser.

> ❗ Pressurised gas bottles can be dangerous and great care needs to be taken when in use.
>
> Ensure the regulator is fitted to the bottle at arms length in case of a gas leak.
>
> Ensure that no cross threading occurs during tightening of the regulator.
>
> During the rare occasion that gas does leak from the seal, place the bottle and regulator on the floor and leave the area until the leak has stopped. DO NOT attempt to solve the leak as this could be dangerous.

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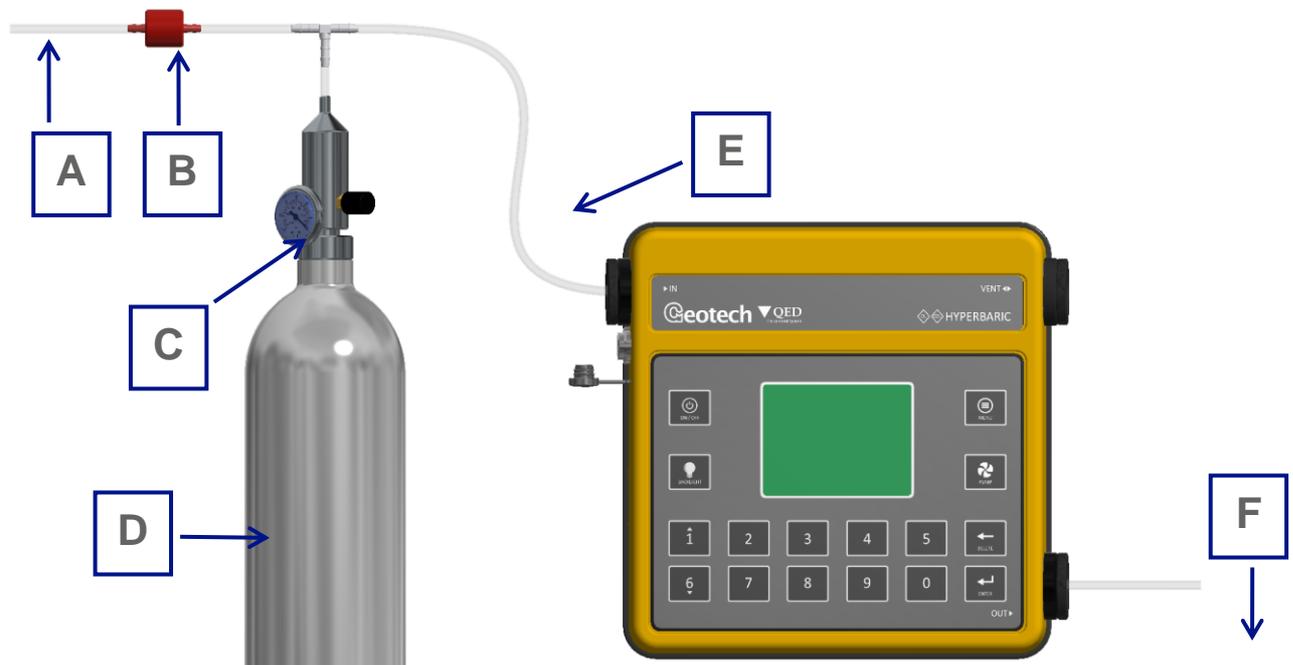
Figure 1 – Gas bottle set-up

Reference	Description
A	Pressure relief valve exhaust tubing
B	Pressure relief valve
C	Pressure and flow regulator
D	Gas bottle canister
E	Inlet tubing to Hyperbaric
F	Exhaust tubing from Hyperbaric

Gas Check and Calibration
Introduction

Before each use, it is recommended that a gas check be performed to ensure the analyser is accurate and determine whether a user calibration is required.

The gas used for a check or a calibration should be representative of the gas within the application, for example 1,500ppm CO_2, 21% O_2, balanced with N_2.

If the result of a gas check is that the analyser's accuracy is good, a calibration may not need to be performed. Alternatively, the accuracy may need improving and at this point, the user can decide to correct the errors by way of a user calibration.

Note: It is recommended that before performing a gas check or calibration the analyser has

stabilised at its working temperature.

Gas Check

START

STEP 1

Turn analyser on

STEP 2

Set-up calibration equipment

STEP 3

Ensure pump and peak mode are off

STEP 4

Flow gas and wait

STEP 5

Calibration required?

YES
STEP 6 → Refer to 'Gas Check and Calibration' section

NO
STEP 6

Take readings

Flow Chart 3 – Gas check
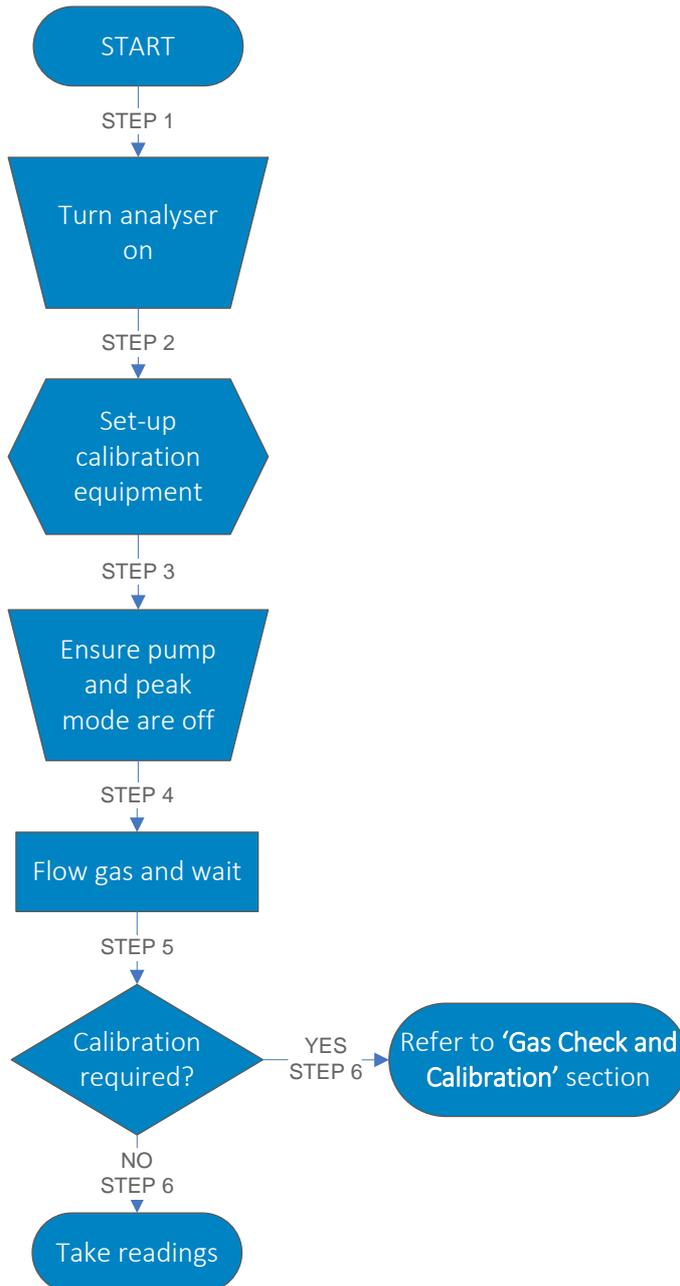
STEP 1: Turn the analyser on and ensure it has stabilised at its working temperature.

STEP 2: Set-up the calibration equipment as per Figure 1 – Gas bottle set-up.

STEP 3: At the 'main read screen', ensure the pump is turned off and the peak functionality is turned off.

STEP 4: Flow the gas through the instrument for several minutes and allow the readings to stabilise.

STEP 5: Observe the gas readings and decide if the performance is acceptable or if a calibration is required.

STEP 6: Proceed to taking readings or refer to section Gas Check and Calibration of this operating manual to user calibrate the analyser.

Calibration Method

If a calibration is required:

1) From the 'main read screen' press the 'menu' key to access the 'main menu'.

2) Access the 'advanced menu' by pressing key '5'. Before gaining access, the operator is required to enter the passcode '0192'.

3) From the 'advanced menu' press key '2' to select 'calibration', <u>Screen 25 – Calibration menu</u> will be presented to the operator.

Zero CO_2 Channel

For maximum accuracy, it is recommended that the CO_2 channel is zeroed using bottled nitrogen (N_2). However, if N_2 is not available the optional soda lime filter kit (see item D in <u>Hyperbaric Consumable Products</u>) can be fitted to the gas inlet. This allows the user to perform a zero using air, as the soda lime filter will absorb virtually all CO_2 from the sample air.

Use <u>Flow Chart 4 – User Zero</u> to perform a user zero calibration on the CO_2 channel.

> Note: It is not possible to zero the O_2 channel. A span calibration will correct the reading across the range of this channel.
>
> Note: If the zeroing function repeatedly fails, please refer to our <u>Problem Solving</u> section for assistance, or please contact Technical Support at QED on +44(0)333 800 0088 or email <u>technical@qedenv.co.uk</u>
>
> Note: Pressing the 'menu' key throughout the zeroing process will return the operator to the 'user calibration' menu and cancel any changes made.

Span CO2 and O2 Channels

It is recommended that the analyser is spanned to target the desired reading range for the specific application (e.g. 1500ppm CO_2 or 20.9% O_2); ideally, this should not be a level close to zero.

The span calibration option allows the operator to span either the CO_2 or O_2 channels independently of each other, or both together if a calibration gas containing the correct mixture is available. Use <u>Flow Chart 5 – Span CO2 or O2</u> to perform a span calibration on either the CO_2 or O_2 channels or <u>Flow Chart 6 – Span both CO2 and O2 together</u> to span calibrate both channels together.

> Note: If the span function repeatedly fails, please refer to our <u>Problem Solving</u> section for assistance, or please contact Technical Support at QED on +44(0)333 800 0088 or email <u>technical@qedenv.co.uk</u>.
>
> Note: Pressing the 'menu' key throughout the span process will return the operator to the 'user calibration' menu and cancel any changes made.

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Start

Press key '1' from the 'user calibration' menu to 'zero CO2 offset'

```
User Calibration

1-Zero CO2 Offset
2-Span Calibration
3-Factory Reset




                        Menu=Exit
```

Zero with N2 or soda lime kit?

—— SODA LIME ——

N2

Connect N2 to inlet port and flow gas

```
Zero Calibration
• Connect to bottle
• Flow Gas
• Press Enter to Start




Enter=Continue  Menu=Exit
```

Connect soda lime filter to inlet port

Press 'enter' key to continue

Turn pump on

```
Zero Calibration
• Connect to bottle
• Flow Gas
• Press Enter to Continue

           *


Enter=Continue  Menu=Exit
```

The instrument will now wait for the readings to stabilise

```
Zero Calibration
     Waiting for
       gas to
      stabilise

       ...
         *


             Menu=Exit
```

Zero successful? —— NO ——

Press 'menu' key to exit

```
Zero Calibration

  Reading too unstable!

   Check gas purity
    or return unit
      for repair.

             Menu=Exit
```

YES

Press 'enter' key to confirm

```
Zero Calibration

   Completed OK
Press Enter to Confirm

         *



Enter=Confirm    Menu=Exit
```

Operator returned to 'user calibration' menu

```
User Calibration

1-Zero CO2 Offset
2-Span Calibration
3-Factory Reset



             Menu=Exit
```

Flow Chart 4 – User Zero

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Start

Press key '2' from the 'user calibration' menu for 'span calibration'

```
     User Calibration
  1-Zero CO2 Offset
  2-Span Calibration
  3-Factory Reset



               Menu=Exit
```

Calibrate which channel?

SPAN ALL → Refer to Flow Chart 6

CO2 ONLY

O2 ONLY

Press key '1' to 'span CO2'

Press key '2' to 'span O2'

```
   Confirm Cal Gasses
 1-Cal Gas CO2   1000 ppm




 Enter=Continue  Menu=Exit
```

```
   Confirm Cal Gasses
 1-Cal Gas O2     21.0 %




 Enter=Continue  Menu=Exit
```

Edit target concentration?

YES

```
   Confirm Cal Gasses
 1-Cal Gas CO2  ____ ppm




 Enter=Accept  Menu=Cancel
```

```
   Confirm Cal Gasses
 1-Cal Gas O2   __._ %




 Enter=Accept  Menu=Cancel
```

Press key '1' to edit the target

NO

Use numeric keypad to enter concentration of gas

```
   Confirm Cal Gasses
 1-Cal Gas CO2  ___10 ppm




 Enter=Accept  Menu=Cancel
```

```
   Confirm Cal Gasses
 1-Cal Gas O2   __2.1 %




 Enter=Accept  Menu=Cancel
```

Press 'enter' key to 'accept' or 'menu' key to 'cancel'

Connect gas bottle to gas inlet and flow gas - OR- turn pump on and sample fresh, clean air

```
     User Calibration
  • Connect to bottle
  • Flow Gas
  • Press Enter to Continue



```

Press 'enter' key to 'continue'

Allow the reading to stabilise

```
      Stabilising
 Cal Gas CO2   1000 ppm
 Current       1375 ppm


 Wait at least 3 mins
   and then confirm
 when readings are stable

 Enter=Confirm   Menu=Exit
```

```
      Stabilising
 Cal Gas O2     21.0 %
 Current        19.7 %


 Wait at least 3 mins
   and then confirm
 when readings are stable

 Enter=Confirm   Menu=Exit
```

```
      Stabilising
 Cal Gas CO2   1000 ppm
 Current       1380 ppm

 Cal Gas O2     21.0 %
 Current        19.7 %
 Wait at least 3 mins
   and then confirm
 when readings are stable
 Enter=Confirm   Menu=Exit
```

Press 'enter' key to 'confirm'

Span successful?

YES → Press 'enter' key to 'confirm'

```
      Calibration Ok

      Calibration
       Complete
  Press Enter to Confirm



 Enter=Confirm Menu=Cancel
```

NO

Try again?

YES

NO → Press 'menu' key to 'exit'

Operator returned to 'user calibration' menu

```
     User Calibration
  1-Zero CO2 Offset
  2-Span Calibration
  3-Factory Reset



               Menu=Exit
```

Flow Chart 5 – Span CO$_2$ or O$_2$

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Start → **Press key '2' from the 'user calibration' menu for 'span calibration'**

```
User Calibration
1-Zero CO2 Offset
2-Span Calibration
3-Factory Reset



            Menu=Exit
```

Calibrate which channel? —CO₂ OR O₂ ONLY→ **Refer to Flow Chart 5**

SPAN ALL

Press key '5' to 'span all'

```
Confirm Cal Gasses
1-Cal Gas CO₂    1000 ppm
2-Cal Gas O₂       21.0 %

          ------------

Enter=Continue  Menu=Exit
```

Edit target concentration? NO

YES

Press key '1' to edit CO2 target or key '2' to edit O2 target

```
Confirm Cal Gasses
1-Cal Gas CO₂    ____ ppm
2-Cal Gas O₂      21.0 %




Enter=Accept  Menu=Cancel
```
```
Confirm Cal Gasses
1-Cal Gas CO₂    1000 ppm
2-Cal Gas O₂      ___._ %




Enter=Accept  Menu=Cancel
```

Use numeric keypad to enter concentration of gas

```
Confirm Cal Gasses
1-Cal Gas CO₂    ___10 ppm
2-Cal Gas O₂      21.0 %




Enter=Accept  Menu=Cancel
```
```
Confirm Cal Gasses
1-Cal Gas CO₂    1000 ppm
2-Cal Gas O₂      _2.1 %




Enter=Accept  Menu=Cancel
```

Edit other target concentration? YES

NO

Press 'enter' key to 'accept' or 'menu' key to 'cancel'

```
User Calibration
• Connect to bottle
• Flow Gas
• Press Enter to Continue



```

Connect gas bottle to gas inlet and flow gas - OR- turn pump on and sample fresh, clean air

Press 'enter' key to 'continue'

```
Stabilising
Cal Gas CO₂   1000 ppm
     Current  1380 ppm

Cal Gas O₂      21.0 %
     Current    19.7 %

 Wait at least 3 mins
 and then confirm
 when readings are stable

Enter=Confirm   Menu=Exit
```

Allow the reading to stabilise

Press 'enter' key to 'confirm' → **Span successful?** —YES→ **Press 'enter' key to 'confirm'**

```
Calibration Ok

  Calibration
   Complete
Press Enter to Confirm



Enter=Confirm Menu=Cancel
```

NO

Try again? —NO→ **Press 'menu' key to 'exit'** → **Operator returned to 'user calibration' menu**

YES (loops back to Allow the reading to stabilise)

```
User Calibration
1-Zero CO2 Offset
2-Span Calibration
3-Factory Reset



            Menu=Exit
```

Flow Chart 6 – Span both CO₂ and O₂ together

Operating Manual

Factory Reset

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

1) From the 'user calibration' menu, press key '3' to 'factory reset' the analyser, Screen 59 – Reset user calibration will be presented to the user.

```
┌─────────────────────────────┐
│      User Calibration       │
├─────────────────────────────┤
│                             │
│        Reset User           │
│      Calibration?           │
│                             │
│                             │
│                             │
│   Code: ____                │
│                             │
├─────────────────────────────┤
│ Enter=Accept   Menu=Cancel  │
└─────────────────────────────┘
```

Screen 59 – Reset user calibration

2) To reset the instrument to its original factory settings, the operator will need to enter the passcode '0192' using the numeric keypad, followed by the 'enter' key.

3) Once complete, the operator will be returned to the 'user calibration' menu.

4) Alternatively, the operator can press the 'menu' key to cancel the factory reset and return to the 'user calibration' menu.

Last Field Calibration

This information can be found in the 'information' screen. Refer to section Information in this operating manual for further information.

Calibration Record

The Hyperbaric analyser has the facility to record user calibrations via the 'event log'. This can be used as an aid in ensuring that the gas measurements are valid and accurate, or as a tool to assist with operator training. During the calibration, the analyser will record the following in the 'event log' in addition to the time and date being recorded.

Event	Data Recorded
Successful user zero CO_2	Readings before and after calibration
Successful user span CO_2	Target value, readings before and after calibration
Successful user span O_2	Target value, readings before and after calibration
Failed user zero CO_2	Reading
Failed user span CO_2	Target value, readings before and after calibration
Failed user span O_2	Target value, readings before and after calibration
Return to factory settings	

Note: The 'event log' can only be downloaded and viewed via the optional Analyser Data Manager software (see section Analyser Data Manager PC Software Features). It cannot be viewed on the analyser screen.

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MAINTENANCE

This section outlines maintenance requirements which the operator may need to perform on the analyser, and instructions for user replaceable components.

> Note: For further information, please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.

> **!** The use of non-Geotech approved parts being fitted to the equipment may cause a hazard and will invalidate any warranty on the analyser.
>
> The equipment should not be altered in any way other than described within this operating manual. Alterations or changes outside of this operating manual could affect the safety of the equipment or invalidate the warranty.

Maintenance Schedule

> Note: This maintenance schedule is a minimum guide and dependant upon the application and usage of the Hyperbaric analyser, may need to be adapted accordingly.

As a minimum, Geotech recommend that each month the following be undertaken to ensure the Hyperbaric is in its optimum working and safe condition:

- Inspect the Hyperbaric for damage.
- Review the use of the analyser for continued suitability (i.e. physical and environmental conditions).
- Check the main case gasket for damage to ensure the IP rating can be maintained.
- Inspect, and replace if required, the inlet, outlet and vent PTFE Water Trap Filters (see Replacing the Inlet, Outlet, and Vent PTFE Water Trap Filters).
- Perform a Pressure Test to ensure there are no gas leaks within the instrument.
- Perform a gas check to determine the accuracy of the analyser and if required a calibration (see Gas Check and Calibration).

> Note: It is the operator's responsibility to keep a record of when and what maintenance has been performed.
>
> Note: If you suspect the Hyperbaric to have been damaged and are unsure of the consequences of this, please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.
>
> Note: Inspection of the inlet, outlet, and vent filters may be required more frequently depending upon the application and the likelihood of liquid in the sample gas.

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Hyperbaric Consumable Products

Optional replacement parts may be purchased for the Hyperbaric analyser from Geotech only.

Event	Data Recorded	Part Number
A	28VDC power supply / charger	HYPB1.10
B	Check gas regulator for Hyperbaric analyser. Used in conjunction with calibration gas canisters. This valve controls the flow of gas and includes a pressure relief valve.	HYPB1.11
C	Calibration gas	Please contact us
D	Soda lime filter kit	HYPB1.12
E	5m length 4mm I.D. tubing	GA3K.S6
F	USB lead for Hyperbaric analyser	HYPB1.17
G	Lead for 28VDC external power supply	HYPB1.18
H	Analyser Data Manager software c/w USB lead	HYPB1.16
I	Inlet/outlet/vent port filters (pack of 10) Inlet/outlet/vent port filters (pack of 30)	HYPB1.14 HYPB1.14 (30)
J	Inline water trap elements (pack of 10) Inline water trap elements (pack of 30)	GA4.2 GA4.2 (30)
K	Soft carry case for Hyperbaric analyser	HYPB1.13

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Replacing the Inlet, Outlet, and Vent PTFE Water Trap Filters

Geotech recommends that the water trap filters be replaced if they become wet or contaminated, but should be checked during regular maintenance. The following filters can be replaced on the Hyperbaric analyser:

- Inlet – see annotation K on Analyser Connection Points

- Outlet – see annotation N on Analyser Connection Points

- Vent – see annotation M on Analyser Connection Points

Step 1 - Vent filter location	All filter housings are the same on the Hyperbaric analyser and an example of the vent filter can be seen in Step 1 - Vent filter location
Step 2 - Filter lock-nut removal	Remove the filter lock nut by turning anti-clockwise to gain access to the PTFE filter, see Step 2 - Filter lock-nut removal.
Step 3 - PTFE filter replacement and orientation.	Simply remove the PTFE filter and replace with new, with the tapered luer lock facing in to the housing, see Step 3 - PTFE filter replacement and orientation for guidance. Reverse Step 2 - Filter lock-nut removal to lock the filter in place.

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Tests to Perform after Maintenance

General

After replacing the PTFE filters in the [Replacing the Inlet, Outlet, and Vent PTFE Water Trap Filters](#) section, the analyser must be tested to ensure that it is leak-free and that unwanted ambient air is not drawn in to the gas sample and diluting the readings.

The following sections outlines the required procedure for performing this test.

Pre-Test Checks

To ensure of a gas tight seal, ensure that:

- The o-ring is clean and in good condition, it should not be dry, slit or cracked.
- The filter lock-nuts are fully hand tightened against the PTFE filter and it is not cross threaded.

Pressure Test

The following instructions test that a reasonable gas tight seal has been made on the inlet filter for the Hyperbaric analyser.

1) Turn the analyser on, allow it to complete the power on self test and proceed to the 'main read screen'.
2) Press the 'menu' key, followed by key '5' to access the 'advanced menu'.
3) Press key '7' to select 'flow fail'.
4) Use key '1' to adjust the sensitivity to its lowest setting (least sensitive).
5) Turn the pump on using the 'pump' key.
6) Block the inlet port / tubing with a finger and ensure the analyser pump stalls (this will be indicated by a flashing ✿ icon). This should happen in less than 10 seconds.
7) Press the 'pump' key to acknowledge the stalled pump.
8) Press the 'menu' key to cancel your changes.
9) Press the 'menu' key twice more to return to the 'main read screen'.

> Note: If the pump does not stall in this time, turn the pump off and repeat the test.
>
> Note: If the test continues to be unsuccessful, ever after the [Pre-Test Checks](#) have been proven, please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.

Cleaning and Decontamination

The equipment must be switched off and not connected to any power source prior to cleaning or decontamination. The analyser case can be cleaned externally using a mild soapy water and non-abrasive, non-fibrous cloth.

> Note: Do not apply pressure to the LCD display area as this could cause damage.

Note: Do not use solvents or any chemical cleaners.

When the Hyperbaric analyser is due to be returned for service, it is the responsibility of the owner to ensure that the analyser has been decontaminated. Geotech must be made aware of any contaminants that may be present, prior to it being returned.

HYPERBARIC

Operating Manual

SERVICE

General

The Hyperbaric analyser should be regularly serviced to ensure correct and accurate operation. Geotech recommends a service and recalibration every **18 months**.

It is recommended that only qualified engineers service the analyser. Failure to observe this will result in the warranty becoming invalid.

> Note: For further information on how to return your Hyperbaric analyser for service, please contact our service team at at QED on +44(0)333 800 0088 or email service@qedenv.co.uk

Service Notifications

The Hyperbaric uses two icons on the 'main gas read' screen to notify the user that the analyser is due a service.

Icon	Description
(flashing)	Service due in less than one month
	Service overdue

In addition to the icon on screen, the next service date is viewable in the Information screen.

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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 Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.

Error, Warning, and Fault Display

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

If any operational parameters are out of specification, the pre-programmed recommended calibration/service data has passed, errors, warnings, or faults are present, they will be displayed on the 'self-test results' screen (see Screen 60 – Self-test results).

```
Self Test Results
Cal Overdue
Service Due




                 Enter=Continue
```
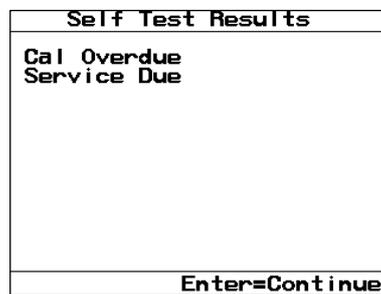
Screen 60 – Self-test results

Use the 'scroll up' and 'scroll down' keys to move through the list if required.

The instrument also performs background tests in normal operation.

There are two types of warnings that may be displayed:

- General warnings that may not affect the analysers function and those where the self-test has detected a function that is outside the usual operating criteria (e.g. battery charge low or memory full).

- Operational parameters that could affect the performance of the analyser (e.g. out of calibration).

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

In addition to the 'self-test results' screen, errors or warnings can be identified on the 'main read screen' by status icons being displayed down the left hand side (see section Status Icon Help).

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Under and Over Range Codes

If a reading is under range (i.e. below zero), it will display 'less than' chevrons (<<<). This can occur if:

- a channel has been incorrectly calibrated

- the Hyperbaric analyser has been damaged (e.g. during transit)

- the Hyperabric analyser has drifted out of calibration or it is due a factory calibration.

If a reading is over range (i.e. above the maximum allowed reading), it will be displayed with 'more than' chevrons (>>>). This can occur:

- for the same reasons as an under range error

- if the channel has exceeded its specified range (e.g. CO_2 > 30,000ppm).

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

In most circumstances, a return to factory settings (see Factory Reset) and performing a user calibration (see Gas Check and Calibration) will resolve the error. If the error is not cleared by performing these tasks, please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.

Analyser Will Not Turn On

If the Hyperbaric analyser will not turn on, fully charge the battery (see Battery and Charging) and turn the instrument on by pressing the 'on/off' key for two seconds.

If the problem persists, please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.

Analyser Lock-Up

In the rare event that the Hyperbaric analyser 'locks up' and will not recognise button presses or switch off in the usual manner of holding the 'on/off' key, press and hold the 'on/off' key for approximately fifteen seconds; this will force the analyser to switch off.

If this procedure does not resolve the issue, allow the battery to fully discharge before fully recharging and attempting to turn the analyser on.

If the problem persists, please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.

Low Flow / Fail Fail

A flow fail occurs when there is not enough gas flowing through the Hyperbaric analyser. This can be for a number of reasons:

- You are sampling against a vacuum outside of the range of the system.

- There are blockages in the system.

- There is a gas leak in the system.

A stalled pump is indicated on the 'main read screen' by the flow fail screen – see Screen 61 – Flow fail notification.

```
          Flow Fail!

  • Please check filter
    and pipe for blockage
  • Press Pump Key to reset

  or...

  • Press Enter key to
    adjust flow limit

```
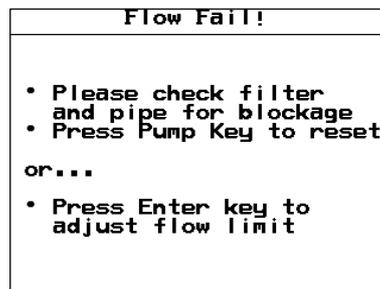
Screen 61 – Flow fail notification

To prevent damage to the pump, the analyser will automatically switch the pump off after a few seconds.

The first step to rectifying this issue is to replace the PTFE filters on the analyser (see Replacing the Inlet, Outlet and Vent PTFE Water Trap Filters) and the sample tubing if this has become saturated or contaminated.

If the above does not rectify the flow fail, it could be that the flow fail sensitivity is too high and is failing prematurely. To check or change this, please refer to section Flow Fail in this operating manual.

If the problem persists, please contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.

Self-Test Warning Messages

The following warnings may be displayed on the 'self-test results' screen after the power on self-test is completed.

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Warning	Description
Cal Overdue	It has been over three years since the analyser had a full factory calibration. For optimal performance and accuracy, it is recommended that the analyser is factory calibrated every 18 months.
Sensor 'n' failed	'n' will be shown to the user as a number. There is no signal being received by the specified sensor. The operator will need to contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.
Sensor 'n' range	'n' will be shown to the user as a number. The specified sensor is exceeding the limits that have been pre-set on the analyser. The operator will need to contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.
Sensor 'n' stability	'n' will be shown to the user as a number. The specified sensor's signal is unstable. The operator will need to contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.
IR Source Limit	The infra-red source for the analyser has reached its limit. The operator will need to contact Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.
User cal. due	It has been over 30 days since the analyser had a user calibration. For optimal performance and accuracy, it is recommended that the analyser is user calibrated before each use. Refer to section Gas Check and Calibration.
Clock invalid	The analyser has an invalid time and/or date. This is most likely to occur after a hardware reset. This should be correctable by setting the time and date via the 'advanced menu'. For more information, refer to the Time and Date section in this operating manual.

Note: Using the Analyser Data Manager software, it is possible to export the current configuration settings and e-mail it to our technical support team for review. Depending on the type of error, it may be possible to correct the configuration settings and import them back in to the analyser.

User Calibration Explained
General

User calibration is a means of optimising the performance of the analyser to the current operating conditions such as temperature and pressure as well as correcting for analyser drift caused by the infra-red source.

User calibration has two operations, zero and span, and each may be performed individually. However, for a complete user calibration both must be completed.
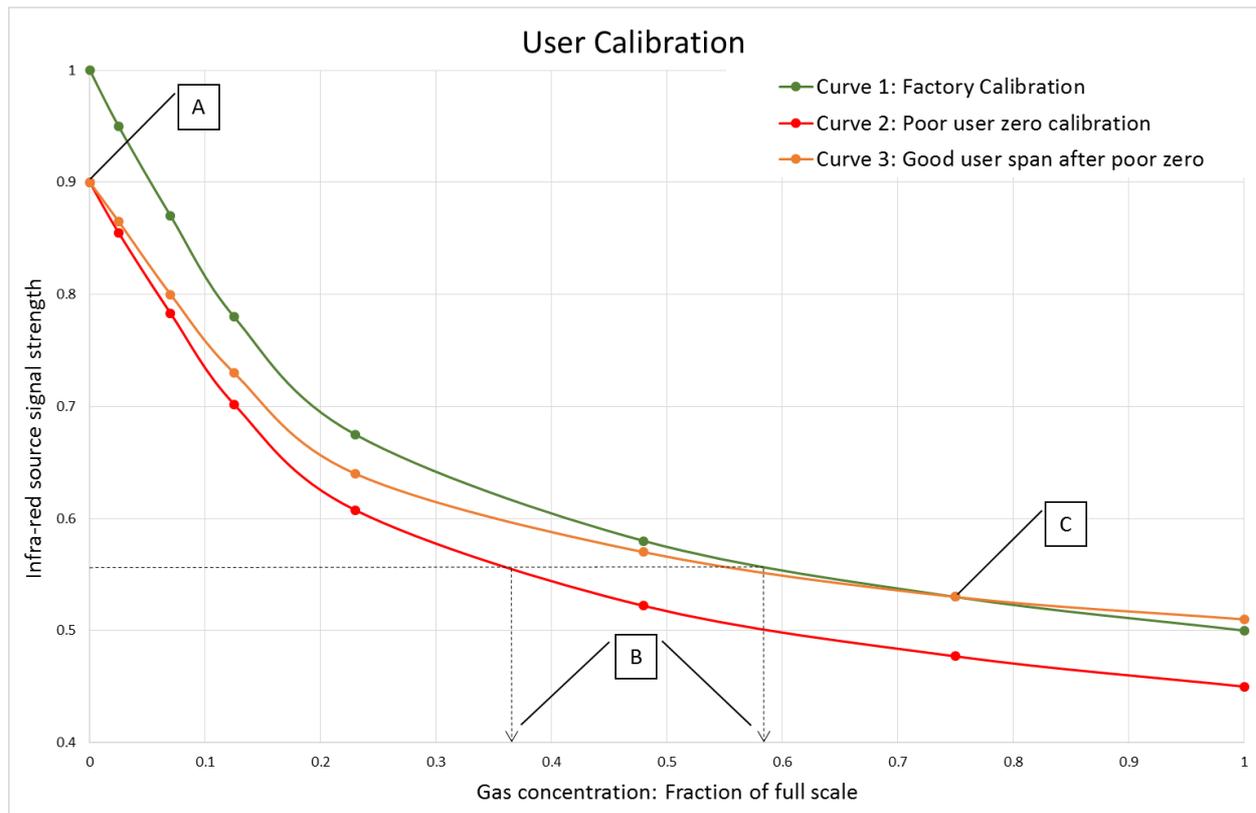
Graph 1

Factory Calibration

When the analyser is factory calibrated, a stable gas curve is generated (see curve 1 on Graph 1). This curve is then used to determine the gas concentration based on the infra-red signal strength after being absorbed by the gas.

User Zero Calibration

A zero calibration is used to correct the entire curve for the infra-red source and filter variations caused by aging and user induced drift due to dirt and other contaminants. If done correctly, there is often no need to complete a span calibration, as the new curve will follow closely to the factory calibration curve (curve 1 on Graph 1).

The zero calibration is very sensitive and a rushed or poor calibration, (such as the target gas still being present), will result in a span error; see point A on curve 2 of Graph 1. This also produces an error throughout the remainder of the curve proportional to signal strength, but the effect on the span is significant, see point B on Graph 1.

Note: To perform an accurate user calibration it is critical that a good user zero has been performed. Geotech recommend that this be done in nitrogen in order to guarantee that none of the gas of interest is present.

> Note: To obtain a good zero it may be necessary to flow nitrogen for several minutes, especially if the Hyperbaric analyser has been subjected to high levels of gas previously, in order to ensure there are no remains of the target gas present.

User Span Calibration

A span calibration is used to optimise the analyser at the span calibration concentration (see point C on Graph 1) for the current operational conditions and variations in user calibration gases. It corrects the span point but leaves the zero unadjusted (this will be left at the last user zero if this has been performed) and should be done at the concentration of interest in the particular application.

If the user zero is poor and the span calibration is good, it will correct the gas curve for the point of interest, but other points on the curve could be incorrect, see curve 3 on Graph 1.

User Zero Failed Troubleshooting

Three possible reasons for this are that:

- the Hyperbaric analyser is trying to zero to a level which is outside the predetermined range set when it was last factory calibrated

- the gas is not stable i.e. it is still purging out the measured gas

- the system is not seeing a flow of gas.

To rectify this:

- ensure the Hyperbaric analyser contains none of the gas that is being zeroed by flushing through with nitrogen, or the soda lime kit if this is not available and repeat a user zero calibration

- ensure the flow regulator on the gas bottle is open (if being used).

If the analyser continues to fail the zeroing process, refer to the instructions given in the Factory Reset section of this operating manual and retry the procedure.

If the problem persists, please contact our Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.

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User Span Calibration Failed Troubleshooting

Check the span target is set to the value given on the calibration bottle. If not, correct and re-span the channel. In addition, check that the flow regulator on the gas bottle is open.

If the problem persists, repeat an entire user calibration by zeroing the channel prior to performing a span calibration.

> Note: Always ensure that the on-screen reading is stable before span calibrating the channel.

If the analyser continues to fail to span then please contact our Technical Support at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.

Cross-Gas Effects

Carbon dioxide is measured by infra-red 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 other gases, unlike many other types of cell.

CO_2 Reading Low

If you believe that the CO_2 reading is lower than you expect, there could be two reasons for this:

- There could be a leak in the sample tubing and when running the pump you could be drawing in air.

- If the PTFE filters in the instrument or sample tubing become saturated, it is possible that some of the CO_2 in the sample gas could be absorbed in to any trapped water.

Event Log

The Hyperbaric analyser incorporates the facility to log significant events via the 'event log'. This can be used as an aid to monitoring the correct use of the analyser. It can also be used as a diagnostic tool if there is a problem. Whilst always active, the 'event log' can only be viewed via the optional Analyser Data Manager software. It cannot be viewed on the analyser screen. Applicable events are stored in the 'event log' automatically and no user intervention is required.

The 'event log' can hold approximately 400 events. When the log is full the events are wrapped, for example, event 001 would become 401 and so on. The log is cleared by using Analyser Data Manager or by performing a hardware reset.

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TECHNICAL SPECIFICATION

POWER SUPPLY

Battery type	Rechargeable nickel metal hydride battery pack (not user replaceable)
Battery life	Up to 24-hours
Battery lifetime	Minimum 1,000 charge cycles
Battery charging	28VDC external power supply and internal charging circuit. Compatible with 110-240VAC supplies
Charge time	Approximately three hours
Alteranative power	28VDC power supply if used with additional custom-made lead

GAS RANGES

Gases measured	CO_2	By custom dual wavelength infrared including reference channel
	O_2	By electrochemical cell
Oxygen cell lifetime	Approximately 18-months in air	

Gas ranges	Cell	Range	Typical accuracy	Repeatability
	CO_2	0-30,000ppm SEV	±10% of reading	±1% of reading
	O_2	0-25% vol	±5% of reading	±0.2% vol

Units of measurement	CO_2	ppmSEV (surface equivalent value)
	O_2	User selectable - %vol (volume) or ppATA (partial pressure)
Resolution	CO_2	10ppm
	O_2	0.1%vol
Response time (T_{90})	CO_2	≤20 seconds
	O_2	≤40 seconds

PRESSURE MEASUREMENT

Units of measurement	User selectable – mbar (millibar), atm (atmosphere), or fsw (feet of sea water)
Typical accuracy	±2% of reading
Repeatability	±1% of reading
Resolution	1mbar
Pressure compensation	Oxygen gas reading can be compensated in real-time

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PUMP	
Type	Diaphragm fitted with brushless motor
Flow	Approximately 300ml/min
Flow fail point	User adjustable - -200 to -400mbar vacuum
Maximum vacuum restart	-400mbar maximum
FACILITIES	
Display	Large, easy to read, backlit, LCD display
Alarms	User selectable alarms for CO_2, O_2, and pressure that provide a visual and audible indicator to the user
Available memory	1100 readings and 450 events[1]
Communications	USB via a custom waterproof connector[1]
Software	Analyser Data Manager software available for download of instrument readings and viewing of the instrument event log
ENVIRONMENTAL CONDITIONS	
Operating temperature	0°C to +50°C (32°F to 122°F)
Storage temperature	-10°C to +60°C (14°F to 140°F)
Pressure range	0.75 to 10bar absolute
Relative humidity	0 to 100% non-condensing
IP rating	IP65
PHYSICAL	
Weight	Approximately 1.5kg (3.3lb)
Size	L 235mm, W 230mm, D 55mm (L 9.5", W 9", D 2.25")
Case material	ABS plastic
Keypad	16-key numeric keypad with 'tactile' membrane
Display	320 x 240 pixels, white LED backlight
Filters	Inlet, outlet, and vent are all user-replaceable 1.0µm PTFE filters

Note: The information within this technical specification is correct at the time of generation. We do however, reserve the right to change the specification without prior notice as a result of continuing development.

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1 Analyser Data Manager software will be required to communicate with the instrument, and download readings and events.

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HYPERBARIC WARRANTY TERMS AND CONDITIONS

Hyperbaric Warranty Terms and Conditions

QED will repair or replace (at QED's discretion) any goods supplied by the company in respect to defects arising within **12 months** from date of purchase or delivery, whichever is later, provided that:

- The defect is due to faulty parts or workmanship provided by QED.
- Proof of delivery/purchase must be provided to QED for any claims. This includes a QED sales order, invoice, or delivery note.
- All warranty repairs can only be carried out by QED or its authorised agents. In certain circumstances, permission may be granted by QED for the owner to replace a supplied part under warranty.
- Any repair or replacement component under warranty will not extend the warranty period of the analyser.
- Products must have been returned for service and calibration as recommended by QED as per the individual operating manual.
- Where replacement parts have been supplied by QED under warranty, the replaced parts must be returned to QED. If not returned, QED reserve the right to charge for the replacement part.
- If no fault is found an investigation charge may apply.
- QED's Technical Support MUST be notified in the event of a pending warranty claim. They will then issue a returns reference number that must be included in any return. Failure to provide this will void any warranty claim.

The following is not included:

- Normal wear and tear of parts that might wear out over time, or be consumed, is not covered. Parts not covered include, but not limited to the PTFE filter, oxygen sensor, and tubing.
- A service is not part of a warranty claim.
- Accidental damage, including dropping during use.
- Damage as a result of vandalism.
- Faults arising from use of the equipment that is not in accordance with standard operating procedures laid out in QED's operating manual.
- Faults arising from use of the equipment in unsuitable applications.
- Repairs or alterations carried out by parties other than QED, its authorised agents, or under the instruction of QED.
- Any data stored on the equipment that may be lost.
- A claim due to a failure in maintaining the analyser in accordance with the operating manual.
- A claim as a result of poor quality or inadequate repairs.
- Any business related losses such as income, profits, and contracts (as far as the law allows).

Hyperbaric Warranty Terms and Conditions

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The following voids the warranty:

- When non-approved QED parts have been used for repair or maintenance.
- When parts are added, or alterations made, to the analyser outside the scope of the operating manual.
- The analyser has been opened, unless by QED approved service centres (where applicable).
- The equipment has been stored or installed outside of the operating range and environmental conditions determined in the operating manual.
- The equipment has not been maintained in accordance with the operating manual.

Service Warranty:

- QED offer a three-month warranty period, following a QED service, to cover any defects that have arisen because of that service.

> **Note**
>
> Warranty repair is only granted after an investigation by QED.
>
> For assistance in determining if your equipment qualifies for warranty investigation, please contact your local distributor, or our technical support team at QED on +44(0)333 800 0088 or email technical@qedenv.co.uk.
>
> For extended warranty options, please contact your local distributor, or our sales team at QED on +44(0)333 800 0088 or email sales@qedenv.co.uk.
>
> For any other queries please contact your local distributor, or our sales team at QED on +44(0)333 800 0088 or email sales@qedenv.co.uk.

QED Environmental Systems reserve the right to update these terms and conditions without notice.

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HYPB2.0WARRANTY Iss.02
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GLOSSARY

Term	Definition
Air purge	Process used to clear out gas from the tubing within the analyser and used as part of a user zero in air when using the soda lime filter kit or spanning the O_2 channel.
atm	An abbreviation for 'atmosphere' and a unit of measurement for the pressure channel.
CO_2	Carbon dioxide.
Factory settings	Default settings pre-set at time of manufacture or service.
Firmware	Firmware is the term by which the analyser software is known and is not accessible by the client. This firmware is updated to the latest version when the analyser is returned to Geotech for servicing. In addition, the firmware can be updated by the end user using Geotech's Analyser Data Manager Software.
Flow fail	A flow fail is the result of not enough gas flowing through the Hyperbaric analyser and consequently stops the operation of the pump.
fsw	An abbreviation for 'feet of sea water' and a unit of measurement for the pressure channel.
Hazard	A potential source of harm.
Hyperbaric	Pressures that are typically higher than normal and is the name given to the Geotech gas analyser to measure CO_2, O_2, and pressure in such an application.
Infrared source	The component used to provide a source of energy that can be absorbed by the gas.
Infrared source drift	The component used to provide a source of infrared energy has changed its brightness and may not have been fully compensated by the reference channel. This may be due to age or contamination.
Material safety data sheet	A document that contains information about a particular substance, abbreviated as MSDS.
mbar	An abbreviation of 'milli bar' and a unit of measurement for the pressure channel.
Polymeric materials	Organic material, natural or synthetic, with high molecular weight made of repetitive structural units. Examples include woor and PVC.
ppATA	An abbreviation for partial pressure expressed in atomspheres and a unit of measurement for the O_2 channel.
ppm	Abbreviation of 'parts per million' and is the unit of measurement for the CO_2 channel.
Pressure	This is the atmospheric pressure at the given location.
Pump	Used to draw the gas sample from the monitoring point to the Hyperbaric analyser.
Reference channel	An infrared channel that has no sensitivity to the gas of interest that is used as a baseline for CO_2 absorption.
SEV	An abbreviation for 'surface equivalent value' and a unit of measurement for the CO_2 channel.
Soda lime filter	A mixture of chemicals in a granular form that removes CO_2 from the sample gas.