

# GEM2000 / GEM2000Plus Gas Analyser

## Operating Manual



**Geotechnical Instruments (UK) Ltd**  
Sovereign House  
Queensway  
Leamington Spa  
Warwickshire  
CV31 3JR  
England  
Tel: +44 (0)1926 338111  
Fax: +44 (0)1926 338110  
Email: [sales@geotech.co.uk](mailto:sales@geotech.co.uk)  
[www.geotech.co.uk](http://www.geotech.co.uk)



## TABLE OF CONTENTS

<b>1.</b>	<b>INSTRUCTIONS SPECIFIC TO HAZARDOUS AREA INSTALLATIONS.....</b>	<b>4</b>
1.1	SAFETY RELATED INFORMATION IN THIS MANUAL .....	4
1.2	SAFETY INFORMATION .....	4
<b>2.</b>	<b>INTRODUCTION .....</b>	<b>5</b>
<b>3.</b>	<b>GENERAL OPERATIONAL FEATURES .....</b>	<b>6</b>
3.1	MAIN FEATURES OF THE INSTRUMENT.....	6
3.2	PHYSICAL CHARACTERISTICS OF ANALYSER .....	6
3.3	SWITCHING THE ANALYSER ON AND OFF .....	7
3.4	KEYPAD LOCK .....	7
3.5	WARM-UP SELF TEST.....	7
3.6	WARNING AND ERROR DISPLAY .....	8
3.7	COLD START .....	8
3.8	STORAGE.....	9
3.9	BATTERY/CHARGING .....	9
3.10	GA AND GEM MODE OF OPERATION .....	9
3.11	'READ GAS LEVELS' SCREEN (GA MODE) .....	10
3.12	EVENT LOG (GA AND GEM MODE) (OPTIONAL UPGRADE) .....	10
3.13	CALIBRATION RECORD (GA AND GEM MODE) (OPTIONAL UPGRADE) .....	10
3.14	TECHNICIAN LOG IN (GA AND GEM MODE).....	11
3.15	MEMORY .....	11
3.16	CO MEASUREMENTS (GA AND GEM MODE) .....	11
3.17	ZERO TRANSDUCERS (GA AND GEM MODE).....	12
3.18	UPDATE SITE DATA (GA AND GEM MODE) .....	12
3.19	DATA LOGGING (GA MODE).....	12
3.20	PRINT DATA (GA AND GEM MODE) .....	12
3.21	ADJUST CONTRAST.....	12
<b>4.</b>	<b>TAKING READINGS IN GA MODE .....</b>	<b>13</b>
4.1	PRELIMINARY CHECKS.....	13
4.2	UPDATE SITE DATA .....	13
4.3	TAKING READINGS - WITH ID.....	13
4.4	TAKING READINGS – WITHOUT ID .....	15
4.5	TEMPERATURE PROBE READING (GA AND GEM MODE).....	16
4.6	EXTERNAL GAS POD READING .....	16
4.7	ANEMOMETER PROBE READING .....	16
4.8	FLOW POD READING .....	16
4.9	CROSS-GAS EFFECTS .....	17
<b>5.</b>	<b>TAKING EXTRACTION WELL READINGS (GEM MODE).....</b>	<b>18</b>
5.1	PRELIMINARY CHECKS.....	18
5.2	UPDATE SITE DATA .....	18
5.3	TAKING GAS AND FLOW READINGS (GEM MODE).....	18
<b>6.</b>	<b>MODEM OPERATION (GA AND GEM MODE).....</b>	<b>20</b>
<b>7.</b>	<b>CALIBRATION (GA AND GEM MODE).....</b>	<b>22</b>
7.1	INTRODUCTION .....	22
7.2	CALIBRATION GASES .....	22
7.3	SET-UP .....	23
7.4	EQUIPMENT.....	24
7.5	GAS ANALYSER.....	24
7.6	LOW LEVEL CALIBRATION - MIXTURES 1 AND 2 .....	25
	<i>Step One</i> .....	25
	<i>Step Two</i> .....	25
	<i>Step Three</i> .....	26
	<i>Step Four</i> .....	27

# GEM2000/GEM2000Plus Gas Analyser

---

7.7	SPAN MULTI GAS .....	27
7.8	HIGH LEVEL CALIBRATION - MIXTURE 3 .....	27
	<i>Step One</i> .....	27
	<i>Step Two</i> .....	28
	<i>Step Three</i> .....	29
7.9	CALIBRATION OF THE CO CHANNEL .....	29
	<i>Step One</i> .....	29
	<i>Step Two</i> .....	30
7.10	CALIBRATION OF THE CO CHANNEL (H <sub>2</sub> COMPENSATED) IN GEM2000 PLUS.....	30
	<i>Step One</i> .....	31
	<i>Step Two</i> .....	31
	<i>Step Three</i> .....	31
7.11	TROUBLE SHOOTING.....	33
7.12	CONFIRM CALIBRATION.....	33
7.13	FACTORY SETTINGS .....	34
7.14	LAST FIELD CALIBRATION.....	34
<b>8.</b>	<b>SERVICE .....</b>	<b>35</b>
<b>9.</b>	<b>TECHNICAL SPECIFICATION .....</b>	<b>36</b>
<b>10.</b>	<b>EC DECLARATION OF CONFORMITY .....</b>	<b>38</b>
<b>11.</b>	<b>APPENDIX 1 EVENT LOG.....</b>	<b>39</b>
<b>12.</b>	<b>INSTRUCTIONS FOR SAFE USE – ITALIAN LANGUAGE.....</b>	<b>41</b>
12.1	ISTRUZIONI SPECIFICHE PER LE INSTALLAZIONI IN AREE PERICOLOSE.....	41
12.2	INFORMAZIONI DI QUESTO MANUALE RELATIVE ALLA SICUREZZA .....	41
12.3	INFORMAZIONI SULLA SICUREZZA .....	42
12.4	VISUALIZZAZIONE DI AVVERTENZE ED ERRORI.....	42
12.5	BATTERIA/RICARICA .....	42
12.6	LETTURA DEL RILEVATORE DELLA TEMPERATURA .....	42
12.7	ACCESSORI CHE NON POSSONO ESSERE USATI IN UN'ATMOSFERA POTENZIALMENTE ESPLOSIVA. .	42
12.8	TARATURA.....	43
12.9	MANUTENZIONE.....	43
12.10	DICHIARAZIONE DI CONFORMITÀ EC .....	44
<b>13.</b>	<b>INSTRUCTIONS FOR SAFE USE – GERMAN LANGUAGE.....</b>	<b>45</b>
13.1	ANWEISUNGEN FÜR INSTALLATIONEN IN GEFAHRENBEREICHEN .....	45
13.2	SICHERHEITSRELEVANTE INFORMATIONEN IN DIESEM HANDBUCH .....	45
13.3	SICHERHEITSINFORMATION .....	46
13.4	WARN- UND FEHLERANZEIGE .....	46
13.5	AKKU/LADEVORGANG .....	46
13.6	TEMPERATURFÜHLER.....	46
13.7	ZUBEHÖR, DAS IN EINEM EXPLOSIONSGEFÄHRDETEN BEREICH NICHT EINGESETZT WERDEN DARF	47
13.8	KALIBRIERUNG.....	47
13.9	WARTUNG.....	47
13.10	EG-KONFORMITÄTSERKLÄRUNG.....	48
<b>14.</b>	<b>INSTRUCTIONS FOR SAFE USE – FRENCH LANGUAGE.....</b>	<b>49</b>
14.1	INSTRUCTIONS SPECIFIQUES POUR LES INSTALLATIONS DANS DES EMPLACEMENTS DANGEREUX ..	49
14.2	INFORMATIONS EN MATIERE DE SECURITE CONTENUES DANS LE PRESENT MANUEL .....	49
14.3	INFORMATIONS EN MATIERE DE SECURITE .....	50
14.4	AFFICHAGE D'AVERTISSEMENTS ET D'ERREURS .....	50
14.5	BATTERIE/MISE EN CHARGE .....	50
14.6	SONDE DE MESURE DE TEMPERATURE .....	50
14.7	ACCESSOIRES NON UTILISABLES EN ATMOSPHERES POTENTIELLEMENT EXPLOSIVES.....	50
14.8	ÉTALONNAGE .....	51
14.9	ENTRETIEN.....	51
14.10	DECLARATION DE CONFORMITE CE .....	52

# GEM2000 / GEM2000 Plus Gas Analyser

---

<b>15.</b>	<b>INSTRUCCIONES FOR SAFE USE – SPANISH LANGUAGE .....</b>	<b>53</b>
15.1	INSTRUCCIONES ESPECÍFICAS PARA INSTALACIONES EN ÁREAS DE PELIGRO.....	53
15.2	INFORMACIÓN RELACIONADA CON LA SEGURIDAD EN ESTE MANUAL .....	53
15.3	INFORMACIÓN DE SEGURIDAD .....	54
15.4	ADVERTENCIA Y VISUALIZACIÓN DE ERROR.....	54
15.5	BATERÍA/CARGA .....	54
15.6	LECTURA DE LA Sonda DE TEMPERATURA.....	54
15.7	ACCESORIOS QUE NO PUEDEN UTILIZARSE EN UNA ATMÓSFERA POTENCIALMENTE EXPLOSIVA .....	54
15.8	CALIBRACIÓN .....	55
15.9	REVISIÓN .....	55
15.10	DECLARACIÓN DE CONFORMIDAD CE .....	56

# GEM2000/GEM2000 Plus Gas Analyser

## 1. Instructions Specific to Hazardous Area Installations

(Reference European ATEX Directive 94/9/EC, Annex II, 1.0.6.)

The following instructions apply to equipment covered by certificate numbers Sira 06ATEX2202X:

- The equipment may be used with flammable gases and vapours with apparatus group IIA and temperature class T1
- The equipment is only certified for use in ambient temperatures in the range 0 °C to +40 °C and should not be used outside this range
- Installation shall be carried out in accordance with the applicable code of practice by suitably trained personnel
- Repair of this equipment shall be carried out in accordance with the applicable code of practice.
- The manufacturer will specify those materials which are important to the type of protection.
- When the GEM2000 or GEM2000 Plus methane detector is in the hazardous area it shall only be externally attached via connector A to devices that are marked with the certificate number Sira 06ATEX2202X.
- If the equipment is likely to come into contact with aggressive substances, e.g. acidic liquids or 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 data sheet that it is resistant to specific chemicals that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.


The GEM2000/GEM2000 Plus Gas Analyser has been certified to Hazardous Area Classification

 **II2G EEx ibd IIA T1 (Ta = 0°C to +40°C)**

It is vital the instructions in this manual are followed closely.


It is the responsibility of the operator to determine the protection concept and classification required for a particular application.

### 1.1 Safety Related Information In This Manual

Information in this manual that may affect the safety of users and others is preceded by the following symbol:  **Warning**.

Failure to follow this information may result in physical injury which in some cases could be fatal.

### 1.2 Safety Information

 <b>Warning</b>	The GEM2000/GEM2000 Plus can be used for measuring gases from landfill sites and other sources as described in this manual. Inhaling these gases may be harmful to health and in some cases may be fatal. It is the responsibility of the user to ensure that he/she is adequately trained in the safety aspects of the gases being used and appropriate procedures are followed. In particular, where hazardous gases are being used the gas exhausted from the analyser must be piped to an area where it is safe to discharge the gas. Hazardous gas can also be expelled from the instrument when purging with clean air.
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# GEM2000 / GEM2000 Plus Gas Analyser

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## 2. Introduction

This manual explains how to use the GEM 2000 range of Landfill Gas Extraction Monitors. This includes the GEM2000 and GEM2000Plus.

The GEM2000 range of instruments is specifically for use on landfills to monitor landfill gas extraction systems, flares and migration control systems.

There are a number of versions of the GEM2000 analyser, and several options. Where a section in the manual applies only to some of the versions, this is indicated in the section heading

<b>Note</b>	Gas analysers are a sensitive piece of scientific equipment, and should be treated as such.
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# GEM2000/GEM2000 Plus Gas Analyser

## 3. General Operational Features

### 3.1 Main features of the Instrument

The instrument includes the following main features

Measurement of the following gases:

- Methane and Carbon Dioxide by Infra-Red Absorption
- Oxygen
- Carbon monoxide
- Hydrogen sulphide
- Hydrogen compensated Carbon Monoxide (Plus version only)
- Other gases - contact supplier

Measurement of borehole pressure

Measurement of barometric pressure

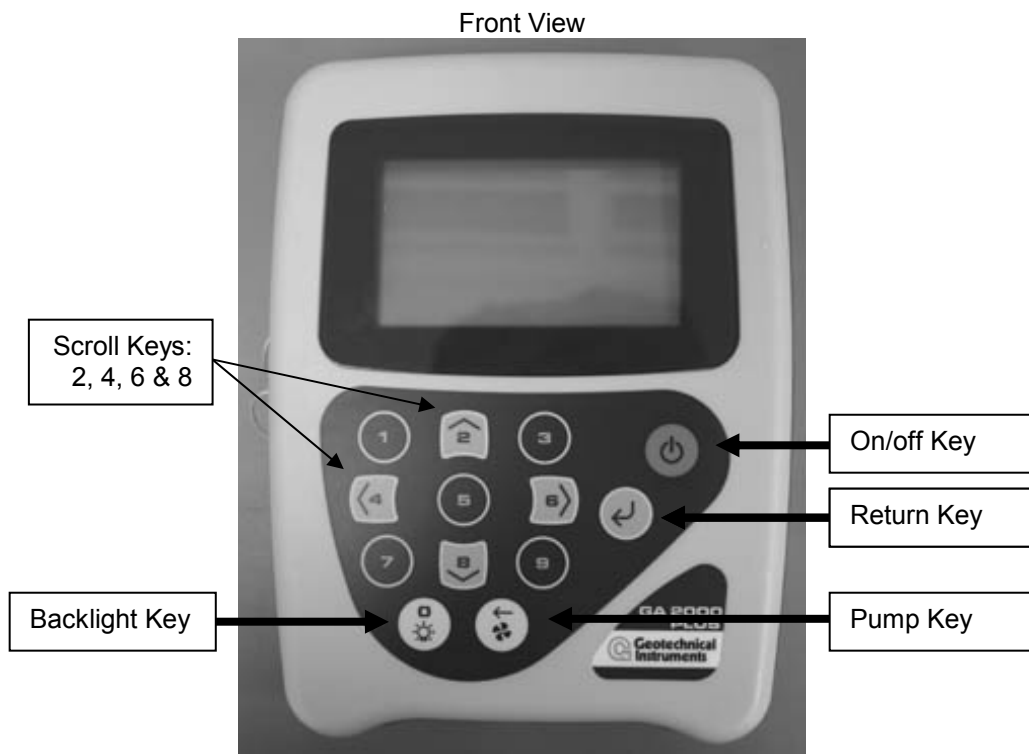
Temperature of gas in borehole (optional)

Measurement of gas flow by use of Accuflo wellhead, orifice plate, or pitot tube

Calculation of BTU or Kilowatts

Switchable between GA and GEM mode of operation.

### 3.2 Physical Characteristics of analyser



Right hand view showing two gas inlets. The far inlet is for the gas sample for analysis. The near inlet is for the pressure measurement.

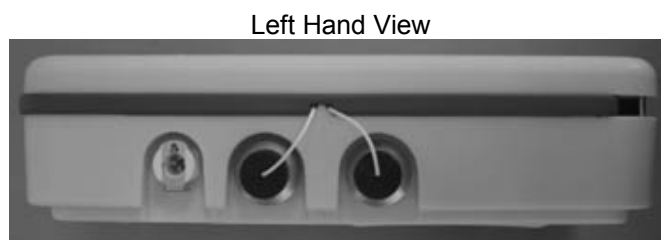




# GEM2000 / GEM2000 Plus Gas Analyser

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Left hand view shows gas outlet and connectors



Whenever a key is pressed the unit will emit a short 'beep' as an acknowledgement. This function cannot be turned off.

### 3.3 Switching The Analyser On And Off

When switching the analyser on a long beep will be emitted followed by the Geotechnical Instruments (UK) Ltd logo being displayed. The power on self-test will then commence. Following this the service reminder screen will be displayed. Pressing return will take you to the technician log in screen (if this function is turned on) followed by the main gas reading screen.

When switching the analyser off, the on/off button must be held down for approximately 1.5 seconds, at which point a clean air purge will be carried out. If for any reason the analyser 'locks-up' and will not switch off in this manner, press and hold the on/off button for 15 seconds; this will force the instrument to switch off.

Whenever a key is pressed the unit will emit a short 'beep' as an acknowledgement.

### 3.4 Keypad lock

The keypad can be locked by pressing and holding the 'backlight' key for 2 seconds. This will avoid accidental key presses when carrying the analyser. Press and hold again to unlock the keypad.

### 3.5 Warm-up Self Test

When switched on the read-out will perform a pre-determined self-test sequence taking approximately 30-40 seconds depending on the types of chemical cells fitted. During this time many of the analyser's functions are tested, including:

- General operation
- Pump function
- Gas flow measurement
- Calibration
- Backlight function
- Solenoid function

During the self-test the following information is also displayed:

- Manufacturers service due date
- The last gas check date
- Software version programmed
- Date format
- Serial number
- Operating language
- Baud rate
- The currently enabled sales options

# GEM2000/GEM2000 Plus Gas Analyser

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## 3.6 Warning and Error Display

During the self-test, if any operational parameters are out of specification or the pre-programmed recommended calibration/service date has passed, errors or warnings may be displayed. Only three warnings/errors can be displayed at any time. To ascertain if more have occurred use the 'v' and '^' key to scroll down/up the list.

### Warnings Displayed

All warnings displayed will be prefixed by the word 'WARNING' followed by a relevant description. There are two types of warning that may be displayed, firstly the general warnings that may not affect the instrument's function and those where the self-test has detected a function that is outside the usual programmed operating criteria, e.g. battery charge low, memory nearly full. The second being operational parameters that could affect the performance of the analyser: Cell out of calibration, CH<sub>4</sub> out of calibration, CO<sub>2</sub> out of calibration.

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 instrument to factory settings, zeroing or carrying out a user calibration as necessary for the relevant function.

### Errors Displayed

All errors displayed will be prefixed by the word 'ERROR' followed by an error code. The errors detected by the self-test are usually caused by a user calibration being out of specification or possible memory corruption and will affect the instrument's function and should therefore be corrected before use, e.g. 01-User cal data, CH<sub>4</sub> reading out of specification, 02-User cal data, CO<sub>2</sub> reading out of specification, 04-User cal data, Cell 1 reading out of specification.

<b>Note</b>	If any other types of warning or error are displayed it is advisable to contact Geotechnical Instruments (UK) Ltd for further information.
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### Under and Over Range Codes

If a reading is under range (ie below zero) it will be displayed with 'less than' chevrons (<<). This can occur if a channel has been incorrectly calibrated.

If a reading is over range (ie above the maximum allowed reading) it will be displayed with 'more than' chevrons (>>).

A number displayed as '\*' indicates an error and a '#' indicates where no data is available.

## 3.7 Cold Start

<b>Note</b>	This function should only be used as a last resort. For gas calibration error messages ensure a factory setting and user calibration has been carried out first.
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A cold start should only be carried out to correct an instrument if no other course of action has proved successful, as this function will clear the instrument memory entirely, reset all factory settings and reset the internal time and date to a default setting.

To carry out a cold start, turn the analyser on and during the self-test press continue to hold the '↵' key until such time as the self-test has been completed. Upon completion of the self-test a 'Passcode Entry' screen will be displayed. At this point the '↵' key may be released. Enter the code '12345' and press '↵' to confirm.

After the passcode entry has been accepted the instrument's serial number will be displayed along with the hours of operation and two options:

# GEM2000 / GEM2000 Plus Gas Analyser

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- 1-Cold Start
- 0-Exit

Only select option '1' if a cold start is to be carried out. After selection, key '1' will require pressing again to confirm this operation. The cold start menu will be displayed again; press key '0' to continue with normal operation.

## 3.8 Storage

The analyser should not be exposed to extremes of temperature. Do not keep the analyser in a hot car.

When not in use analysers should be kept in a clean, dry and warm environment, such as an office.

The read-out should be discharged and fully charged at least once every four weeks, regardless of indicated charge state. The discharge function may be carried out with the use of the 'Data Logging' function.

## 3.9 Battery/Charging

 <b>Warning</b>	The battery charger is NOT covered by the Ex certification. The battery must be charged only in a safe area.
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The battery used in the GA 2000 Platform is Nickel Metal Hydride and manufactured as an encapsulated pack from six individual cells. This type of battery is not as susceptible to the top-up charging 'memory effects' as Nickel Cadmium batteries, although it is not recommended that the unit be given small top-up charges. The charger should only be disconnected when 'charged' is indicated.

The battery charger is intelligent and will indicate when the unit is charging, charged or if there is a fault. A full charge should take approximately two hours.

## 3.10 GA and GEM mode of operation

The GEM2000/GEM2000Plus can be switched into a 'GA' mode of operation. In this mode the operation of the analyser more closely resembles that of the GA2000/GA2000Plus range of instruments. This mode of operation may be better suited to borehole measurements.

Note that a GEM instrument in GA mode does not have exactly the same functionality as a normal GA instrument. In particular the following functions are unavailable:

Measurement of borehole flow.

To switch between the GA and Gem modes of operation use the main menu to select the required mode of operation.

Note that the total number of readings and IDs available is shared between the GA mode and GEM mode. For example if 500 readings are taken in GA mode and the instrument is switched to GEM mode there will be space for 1500 readings.

The availability of each function in either GA or GEM mode is indicated in the headings to each section.

# GEM2000/GEM2000 Plus Gas Analyser

## 3.11 'Read Gas Levels' Screen (GA mode)

The 'Read Gas Levels' screen is also considered to be the normal operation screen and all operations are carried out from this starting point.

The actual data displayed on this screen will depend on the version of the instrument and the options that have been selected. In general all of the main readings will be displayed. The instrument will only connect to the Gas Analyser Manager PC software whilst in this screen.

## 3.12 Event Log (GA and GEM mode) (Optional Upgrade)

The GEM2000 and GEM2000Plus analysers incorporate the facility for a log of events. This can be used as an aid to monitoring the use of the analyser. It can also be used as a diagnostic tool if there is a problem with the analyser. The event log can be viewed via the Gas Analyser Manager software. It cannot be viewed on the analyser screen.

A list of the events that are logged is included in the appendix. Applicable events are stored in the event log automatically. No user intervention is required.

The log can hold approximately 1000 events. If the log becomes nearly full a warning will be given on the start up screen. If the log becomes full then no further events will be stored.

The log can be downloaded, viewed, and cleared by using the Gas Analyser Manager PC software. The log is also cleared when the analyser is cold started.

## 3.13 Calibration record (GA and GEM mode) (optional upgrade)

The GEM2000 and GEM2000Plus have the facility to log user calibrations. This can be used as an aid to ensuring that gas measurements are valid and accurate.

A 'confirm calibration' option will display in the calibration menu. When selected a further sub-menu is displayed which allows the user to select which gas to confirm. The result is displayed as a table giving target, factory, and actual gas values. This option is available only for the three main gases.

A multi-gas 'confirm calibration' option is also available in the sub-menu. This allows the calibration of the CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> channels to be confirmed with a single key press.

The analyser will record the following in the event log. For each entry the time and date will be stored.

Event	Data recorded
Successful User zero Ch4	Readings before and after
Successful User span Ch4	Target Value, Readings before and after
Successful User zero Co2	Readings before and after
Successful User span Co2	Target Value, Readings before and after
Successful User zero O2	Readings before and after
Successful User span O2	Target Value, Readings before and after
Successful User zero CELL1	Readings before and after
Successful User span CELL1	Target Value, Readings before and after
Successful User zero CELL2	Readings before and after
Successful User span CELL2	Target Value, Readings before and after
Successful User zero CELL3	Readings before and after
Successful User span CELL3	Target Value, Readings before and after
Successful User zero internal flow	Readings before and after
Failed User zero Ch4	Reading
Failed User span Ch4	Target Value, Gas Reading
Failed User zero Co2	Reading
Failed User span Co2	Target Value, Gas Reading
Failed User zero O2	Reading
Failed User span O2	Target Value, Gas Reading
Failed User zero CELL1	Reading
Failed User span CELL1	Target Value, Gas Reading
Failed User zero CELL2	Reading
Failed User span CELL2	Target Value, Gas Reading

# GEM2000 / GEM2000 Plus Gas Analyser

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Failed User zero CELL3	Reading
Failed User span CELL3	Target Value, Gas Reading
Failed User zero internal flow	Reading
Confirm Ch4 calibration	Target, Factory and Actual gas values
Confirm Co2 calibration	Target, Factory and Actual gas values
Confirm O2 calibration	Target, Factory and Actual gas values

This calibration event log can be downloaded and viewed via the Gas Analyser Manager PC software. It cannot be viewed on the analyser screen.

## 3.14 Technician log in (GA and GEM mode)

This facility allows the operating technician to log in when the analyser is switched on and to tag all subsequent readings with a four character technician ID.

The technician selects their ID/Name from a pre-loaded list before proceeding to the reading screen. The 4 character ID will be tagged to all subsequent readings.

The list of IDs and names is created using Gas Analyser Manager. Alternatively the user can create a new 4-digit ID from the keypad by pressing key 5 at the technician log in screen.

The log in facility can be disabled using Gas Analyser Manager software.

The technician ID is displayed on the view readings screen.

Technician names can be uploaded into the instrument via the Gas Analyser Manager PC software.

## 3.15 Memory

The analyser's memory is volatile, although it is retained by a battery back-up system.

The memory is not to be used as a permanent storage medium and any data should be transferred to a more permanent storage medium as soon as possible. An analyser should never be stored for prolonged periods with valuable data in its memory.

Although unlikely, sudden shocks, high levels of electromagnetic interference or static discharge may cause memory corruption or loss. If this occurs the memory should be cleared and the calibration re-set to factory settings before further use. To clear the memory a confirmation code must be entered.

## 3.16 CO Measurements (GA and GEM mode)

Measurements of CO are important in Landfill Management. The PLUS version of the analyser incorporates an improved CO measurement.

Normal measurements of CO can be affected by two other gases that can be found in Landfill gas – Hydrogen and Hydrogen Sulphide.

To reduce the effect of Hydrogen, the PLUS version of the instrument uses a technique that is Hydrogen compensated. Hydrogen compensation is achievable up to a level or around 1% Hydrogen. Above this level the CO reading can be incorrect.

In order to assist the operator the PLUS instrument also indicates the level of Hydrogen present as low, medium, or high. If a high Hydrogen reading is present then the CO reading may be affected.

The effect of Hydrogen Sulphide is eliminated by the use of a filter. The PLUS version will prompt the user to connect the filter at the appropriate time.

# GEM2000/GEM2000 Plus Gas Analyser

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## 3.17 Zero Transducers (GA and GEM mode)

Allows the relative pressure transducer to be user zeroed. Upon selection the current relative pressure reading is displayed. The operation will be carried out when the '↵' is pressed.

## 3.18 Update Site Data (GA and GEM mode)

Allows the user to answer pre-defined questions (defined via PC software) relating to the site, e.g. prevailing conditions.

## 3.19 Data Logging (GA mode)

Enables the user to leave the analyser unattended to take samples at a pre-determined time. The reading interval and pump run-time may be edited prior to commencing the logging cycle.

Once the logging function has been activated the analyser will carry out a 30 second warm-up countdown (displayed bottom right) and begin the first sample. After each sample the unit will shut down to conserve power if the time between the pump ending and the next sample is greater than 30 seconds.

When the analyser is switched on during a logging cycle the company logo will be displayed for a few seconds and the 'Read Gas Levels' screen will be displayed. This will initiate a 30 second countdown to the next sample being taken, unless the logging function is stopped.

If for any reason during a logging cycle the inlet port were to become blocked, the analyser will sense this as a flow fail during the 'pump on' time and will automatically retry until such time as a reading can be obtained. Therefore care must be taken when positioning the sample tubing to ensure water/moisture ingress does not occur.

## 3.20 Print Data (GA and Gem mode)


Allows all the data currently stored to be printed. This may only be carried out with an appropriate RS232 cable (available from Geotechnical Instruments (UK) Ltd) and a printer with a serial port connection, or a PC based 'Terminal' programme.

## 3.21 Adjust Contrast

The GEM2000/GEM2000 Plus automatically adjusts the screen contrast to maintain a normal viewing contrast according to the current read-out temperature.

Manual adjustment of the contrast is also available and can be carried out with use of the '<' and '>' cursor keys. The manually set contrast setting is retained when the read-out is switched off and therefore may require re-setting when next switched on.

## 4. Taking Readings in GA mode

 <b>Warning</b>	Inhaling hydrogen sulphide gas can cause death. It is the responsibility of the user to ensure that he/she is adequately trained in the safety aspects of using H <sub>2</sub> S. In particular, where hazardous gases are being used the gas exhausted from the analyser must be piped to an area where it is safe to discharge the gas. Hazardous gas can also be expelled from the instrument when purging with clean air.
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### 4.1 Preliminary Checks

Prior to going to site, it is good practice to ensure:

- All necessary ID codes and readings have been uploaded
- The time and date are correct
- The water trap has a clean and dry filter fitted
- The inlet port microfibre filter is clean and dry
- A supply of spare filters is available in case of accidental water blockage or contamination
- The battery has a good charge (minimum 25% charge, even if only a few readings are required)  
DO NOT charge the battery for 25% of the charge time
- The memory has sufficient space available
- The CH<sub>4</sub>, H<sub>2</sub>S and CO readings have been auto-zeroed, without gas concentration present
- If necessary, check the span calibration with a known concentration calibration-check gas

Travel to site with the read-out in the vehicle's interior - not in the boot, where it may be subjected to extremes of temperature and possible shock damage. Do not place the read-out against anything hot (e.g., gas extraction pipe, car body or in an unattended car during the summer) as this will cause a temperature wave through the read-out and may cause erroneous readings.

When moving around a site, protect the read-out from strong direct sunlight and heavy rain. Strong direct sunlight will quite quickly raise the temperature of the read-out beyond its operating range and the LCD display will appear almost black and the contrast setting cannot alter the contrast.

Always use the water trap! If the water trap becomes flooded, change the filter and ensure all tubes are clear before re-use.

### 4.2 Update Site Data

Prior to taking the readings at a particular site the site data should be updated (if programmed). This is accessed via the 'General' menu '⊙'. This function removes the need for the site conditions to be recorded manually.

A series of up to five questions can be pre-programmed with the use of Gas Analyser Manager software and answered at this time. The answers to these questions are stored and appended to each reading stored thereafter, until the site data is updated for another site.

### 4.3 Taking Readings - With ID

For this function to be used it is essential that the relevant ID and, if required, previous readings are uploaded to the analyser. A reading ID cannot be entered from the analyser.

- 1 When the 'Read Gas Levels' screen is displayed, option '⊕ Next ID' should be selected. A list of stored IDs is displayed for selection via the '∧' and '∨' cursor keys. The next ID on the list is automatically highlighted. To confirm selection press '↵'. The display may be toggled to display any relevant ID information; this may be a description of the borehole location, work to be carried

# GEM2000/GEM2000 Plus Gas Analyser

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- out, etc.
- 2 A prompt is displayed to ensure all tubes are disconnected, as a clean air purge will automatically be carried out at this point to ensure the previous sample is purged from the analyser. The time period for the purge is a user option and may be set via GAM software (default purge time is 30 seconds). Once '↵' is pressed the purge will start and the 'Read Gas Levels' screen will be displayed. The purge may be aborted via the '↵' key.
  - 3 The ID number selected and the pump run-time are displayed in the upper left corner of the 'Read Gas Levels' display.
  - 4 At this point connect the sample tube (with water trap) from the sample point to the inlet port of the analyser, ensuring the connector 'clicks' into place.
  - 5 As soon as the connection is made the relative pressure reading will be displayed, no sample is taken from the borehole at this time. When the reading has stabilised and the pump started, the relative pressure reading will be stored and remain displayed at the pressure last displayed.
  - 6 The pump will run for the pre-programmed time and a countdown timer will be displayed. The pump may be stopped or started at anytime by way of the '⊕' (pump) key. The reading may be stored at anytime with the use of the '↵' key, although when the pump automatically stops this should be used as prompt to store the reading. Whilst the pump is running the instrument continuously monitors the peak readings. These values are frozen when the pump stops. It is possible to reset the peaks and the previously recorded relative pressure reading by pressing key '⊕' effectively jumping back a stage.
  - 7 For the PLUS version of the analyser. After the store key is pressed the following question is displayed 'Are you using a H<sub>2</sub>S filter?'. Pressing the '↵' key confirms 'YES' a H<sub>2</sub>S filter is being used. The user is then given the opportunity to default this answer to subsequent readings. Assuming the answer was 'Yes' the user is taken through to a separate screen that allows the H<sub>2</sub>S filter to be removed so that a valid H<sub>2</sub>S reading can be taken. The current reading is displayed whilst all the other readings are frozen at their previous levels. Pressing the '↵' key again stores the complete reading set and continues to the next stage. If key '1-Exit' is pressed, this stage is skipped and the H<sub>2</sub>S reading is NOT stored.
  - 8 If the ID has the "record borehole flow" flag selected, the analyser will now give you the option of measuring the flow from the borehole. The GEM2000 and GEM2000Plus have the capability to measure the gas flow from a borehole without the need for an additional flow pod. Connect the sample tube from the borehole to the flow inlet port on the analyser (the lower of the two QRC connectors). Follow the on screen prompts. If key '1-Exit' is pressed, this stage is skipped and the flow reading is NOT stored.
  - 9 The next stage when storing a reading is to answer any pre-programmed questions that may require a numeric, alphanumeric, selectable comment or exclusive comment; the answer will be displayed for input. Only a maximum of eight selectable and exclusive comments may be entered in total for all questions requiring such input.
  - 10 Disconnect the sample tubing from the borehole and proceed from step 3 for the next borehole.

For each reading the following information will be stored:

- ID code
- Current time/date
- Technician ID code
- Site data (if entered)
- All gas readings and balance (CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>, H<sub>2</sub>S, CO or additional secondary Cells)
- Approximate Hydrogen level (Plus versions only)
- Peak CH<sub>4</sub>
- Peak CO<sub>2</sub> and minimum O<sub>2</sub> (Plus versions only)
- LEL CH<sub>4</sub>
- Barometric pressure
- Relative pressure
- Borehole specific questions/comments



# GEM2000 / GEM2000 Plus Gas Analyser

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- Temperature (if connected)
- Flow from borehole (optional)
- External gas pod (if connected)
- Anemometer (if connected)

When the analyser is switched off a clean air purge is automatically started for a pre-determined time. This ensures that the analyser is free from gas and ready for the next measurement. This may be aborted with the use of the '↵' key, although we do not recommend this action.

A flashing bell will be displayed next to the appropriate gas reading value if a pre-set alarm condition has been passed.

## 4.4 Taking Readings – Without ID

- 1 From the ID list select '⊕ Select No ID', or if ID information has not been uploaded to the analyser an ID list will not be available; in either case the ID will be displayed and stored as '- - - - -'.
- 2 A prompt is displayed to ensure all tubes are disconnected, as a clean air purge will automatically be carried out at this point to ensure the previous sample is purged from the analyser. The time period for the purge is a user option and may be set via GAM software (default purge time is 30 seconds). Once '↵' is pressed the purge will start and the 'Read Gas Levels' screen will be displayed. The purge may be aborted via the '↵' key.
- 3 At this point connect the sample tube (with water trap) from the sample point to the inlet port of the analyser, ensuring the connector 'clicks' in to place.
- 4 As soon as the connection is made the relative pressure reading will be displayed; no sample is taken from the borehole at this time. When the reading has stabilised and the pump started, the relative pressure reading will be stored and remain displaying the pressure that was last displayed.
- 5 The pump will run for the pre-programmed time and a countdown timer will be displayed. The pump may be stopped or started at anytime by way of the '⊕' (pump) key. The reading may be stored at anytime with the use of the '↵' key, although when the pump automatically stops this should be used as a prompt to store the reading. Whilst the pump is running the instrument continuously monitors the peak readings this values are frozen when the pump stops. It is possible to reset the peaks and the previously recorded relative pressure reading by pressing key '⊕', effectively jumping back a stage.
- 6 For the PLUS version of the analyser. After the store key is pressed the following question is displayed 'Are you using a H<sub>2</sub>S filter?'. Pressing the '↵' key confirms 'YES' a H<sub>2</sub>S filter is being used. The operator then gets a chance to default this answer to subsequent readings. Assuming the answer was 'Yes' the user is taken through to a separate screen that allows the H<sub>2</sub>S filter to be removed so that a valid H<sub>2</sub>S reading can be taken. The current reading is displayed whilst all the other readings are frozen at their previous levels. Pressing the '↵' key again stores the complete reading set and continues to the next stage. If key '1-Exit' is pressed, this stage is skipped and the H<sub>2</sub>S reading is NOT stored.
- 7 The analyser will now give you the option of measuring the flow from the borehole. The GEM2000 and GEM2000Plus have the capability to measure the gas flow from a borehole without the need for an additional flow pod. Connect the sample tube from the borehole to the flow inlet port on the analyser (the lower of the two QRC connectors). Follow the on screen prompts. If key '1-Exit' is pressed, this stage is skipped and the flow reading is NOT stored.
- 8 Upon storing the reading a virtual keyboard will be displayed for any alphanumeric comments to be entered.
- 9 Disconnect the sample tubing from the borehole and proceed from step 1 for the next borehole.

Except for the ID code information, which will be stored as '- - - - -', and borehole questions, for

# GEM2000/GEM2000 Plus Gas Analyser

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each reading the information stored will be the same as that for a reading with an ID.

A flashing bell will be displayed next to the appropriate gas reading value if a pre-set alarm condition has been passed.

## 4.5 Temperature Probe Reading (GA and GEM mode)

The GEM2000 and GEM2000Plus have the facility to automatically display and record the borehole temperature via an optional temperature probe.

When a temperature probe is fitted to external port 1 (RS232 port), the temperature will be displayed in the 'Read Gas Levels' screen and recorded with all other data.

The temperature probe is part of the GEM2000/GEM2000Plus Ex certification and is therefore certified for use under the same conditions as the analyser.

Note that the operation of the temperature probe will differ slightly depending on whether the instrument is in GA or GEM mode.

## 4.6 External Gas pod Reading

The GEM2000 can read external gas pods provided it does not have the two internal cells fitted. The GA 2000 Plus has the facility to read any external gas pod in addition to its internal chemical cells.

When a gas pod is fitted to the analyser's external port 1 (RS232 port), the gas type and reading will be displayed in the 'Read Gas Levels' screen and recorded with all other data. Please note when using an external pod with the same gas type as an internal cell the external cell always overrides the internal. The same value will be displayed and stored.

The gas pod is NOT part of the analyser Ex certification and is therefore NOT certified for use in potentially explosive atmospheres.

## 4.7 Anemometer Probe Reading

The GEM2000 and GEM2000 Plus have the facility to automatically display and record high flow via an optional anemometer probe.

When an anemometer probe is fitted to the analyser's external port 2 (charger socket), the flow will be displayed in the 'Read Gas Levels' screen and recorded with all other data.

Flow can be measured in either m/s (gas velocity) or m<sup>3</sup>/Hr (volume flow rate). In order to calculate the volume flow rate the pipe diameter will need to be entered into the instrument, either manually or via the Gas Analyser Management software.

The anemometer probe is NOT part of the analyser Ex certification and is therefore NOT certified for use in a potentially explosive atmosphere.

Note that the operation of the anemometer will differ slightly depending on whether the instrument is in GA or GEM mode.

## 4.8 Flow Pod Reading

An external flow pod can be used to take a flow reading.

## 4.9 Cross-Gas Effects

### Methane, Carbon Dioxide and Oxygen

Methane is measured using dual beam infra-red absorption. Analysers are calibrated using certified methane mixtures and will give correct readings provided there are no other hydrocarbon gasses present within the sample (e.g. ethane, propane, butane, etc.). If there are other hydrocarbons present, the methane reading will be higher (never lower) than the actual methane concentration being monitored.

The extent to which the methane reading is affected depends upon the concentration of the methane in the sample and the concentration of the other hydrocarbons. The effect is totally non-linear and difficult to predict.

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 usually found on landfill sites.

The oxygen sensor is a galvanic cell type and suffers virtually no influence from CO<sub>2</sub>, CO, H<sub>2</sub>S, NO<sub>2</sub>, SO<sub>2</sub> or H<sub>2</sub>, unlike many other types of oxygen cell.

The infrared sensors will not be "poisoned" by other hydrocarbons and will revert to normal operation as soon as the gas sample has been 'purged'.

### CO measurement

For a GEM2000Plus the CO measurement is compensated for hydrogen cross sensitivity up to a concentration of 1% hydrogen. If a hydrogen concentration above 1% is present, the CO reading will become inaccurate.

The CO measurement is sensitive to hydrogen sulphide. The presence of hydrogen sulphide will cause the CO reading to be too high. If the presence of hydrogen sulphide is suspected, then it is recommended that the external hydrogen sulphide filter is used to obtain the CO measurement. The GA 2000 Plus incorporates a procedure to make both the CO reading, with the H<sub>2</sub>S filter in place, and the H<sub>2</sub>S reading without the filter.

### H<sub>2</sub>S Measurement

The H<sub>2</sub>S measurement can be affected by other gases. The main cross gas effects are:

- SO<sub>2</sub>: 20% effect
- NO<sub>2</sub>: 20% effect

Other cross sensitivities are possible. If you suspect a cross sensitivity problem please contact your supplier for additional information.

# GEM2000/GEM2000 Plus Gas Analyser

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## 5. Taking Extraction Well Readings (GEM Mode)

The GEM2000/GEM2000Plus may be configured as a Gas Extraction Monitor (GEM mode) for the purpose of sampling wells and obtaining flow measurements.

To access this function from the gas 'Read' screen press '⊕' and scroll down to 'Mode of Operation', press the '↵' key and highlight 'Gas Extraction Monitor', pressing the '↵' key again will select GEM mode of operation.

### 5.1 Preliminary Checks

Prior to going to site, it is good practice to ensure:

- All necessary ID codes and readings have been uploaded via the Gas Analyser Manager software
- The time and date are correct
- The water trap has a clean and dry filter fitted
- The inlet port particulate filter is clean and dry
- A supply of spare filters is available in case of accidental water blockage or contamination
- The battery has a good charge (minimum 25% charge, even if only a few readings are required)
- The memory has sufficient space available.
- The CH<sub>4</sub>, CO<sub>2</sub> and O<sub>2</sub> readings have been auto-zeroed without gas concentration present
- Check the span calibration with a known concentration calibration gas

Travel to the site with the analyser in the vehicle's interior - not in the trunk or truck bed, where it may be subjected to extremes of temperature and possible shock damage. Do not place the analyser against anything hot (e.g. gas extraction pipe, car body or in an unattended car during the summer). This may cause erroneous readings.

When moving around a site, protect the instrument from strong direct sunlight, heavy rain or wind-chill. Strong direct sunlight can raise the temperature of the instrument beyond its operating range. If this occurs, the LCD display will appear almost black and the contrast setting cannot alter the contrast.

Always use the water trap! If the water trap becomes flooded, change the filter immediately and ensure all tubes are clear before re-use.

### 5.2 Update Site Data

Prior to taking the readings at a particular site, the site data should be updated (if programmed). This is accessed via the 'General' menu '⊕'. This function removes the need for the site conditions to be recorded manually. A series of up to five questions can be pre-programmed with the use of the Gas Analyser Manager and answered at this time. The answers to these questions are stored and appended to each reading stored thereafter, until the site data is updated for another site.

### 5.3 Taking Gas and Flow Readings (GEM Mode)

The GEM mode of operation is designed to allow for gas flow (SCFM or m<sup>3</sup>) and energy measurements (BTU or Kw) to be calculated at the wellhead. This function requires the use of an ID that has been uploaded from the Gas Analyser Manager software with the type of flow device defined.

<b>Note</b>	Gas flow and BTU (Kw) will not be calculated if this action has not been performed.
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- 1 When the 'Gas Read' screen is displayed select '⊙ Next ID'. A list of stored IDs will be displayed for selection via the '↑' and '↓' cursor keys, the next ID is automatically highlighted,

## GEM2000 / GEM2000 Plus Gas Analyser

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- to confirm the selection press the '↵' key. The screen may be toggled to display any relevant ID information such as a description of the well location, work to be carried out, etc.
- 2 A reminder is displayed to disconnect sample tubes, as a clean air purge will automatically remove the previous sample from the instrument. Purge time may be set via the Gas Analyser Manager (default is 30 seconds). Once the '↵' key is pressed, purge will begin and the 'Read Gas Levels' screen will be displayed upon completion. The purge may be aborted by pressing the 'EXIT' key.
  - 3 Connect the sample tubes (with water trap filter) to the wellhead ensuring the gas sample tube and impact pressure tubes are properly oriented. Insert the temperature probe if used.
  - 4 Press the '☺' key to start the sample pump; a countdown timer will be displayed in the upper left area of the display. The pump may be stopped and restarted at any time by pressing the '☺' key. The pump run-time is set in the Gas Analyser Manager software. Allow the gas readings to stabilise and press 'Measure Flow' key; this will store the gas level readings and display the 'Pressure Readings' screen. A flashing bell will be displayed next to the appropriate gas and a beeping tone will be heard, if a preset alarm condition has been exceeded.
  - 5 The 'Pressure Readings' screen will prompt the user to disconnect the sample tubes and allow the pressure to stabilise. Once the pressure has stabilised press '↵ Zero Transducers'. If Accu-Flo wellheads are used this zero function may be performed prior to connecting the sample tubes to the well head by selecting 'Menu' and highlighting 'Zero Transducers'. This eliminates the need to disconnect and re-connect the sample tubes on the same wellhead.
  - 6 Reconnect the sample tubes to your pressure measuring device (Accuflo wellhead / pitot tube / orifice plate) and the GEM will begin recording the pressure readings. Wait for the pressure to stabilise and then press '1' to continue
  - 7 If a temperature probe is not connected, the user is prompted to manually input the gas temperature, press the '↵' key when entry is finished.
  - 8 The 'Gas Flow and Energy' screen is now displayed showing all the gas level readings taken in the 'Gas Read' screen as well as the level of gas flow (SCFM) and power (BTU). In addition, 'Adjusted', 'Current' and 'Previous' (if downloaded) readings are displayed so modifications may be made to the well if required.
  - 9 Pressing '↵ Store' will save the readings to memory. Then, the 'Comments' screen (if comments were loaded) will display and allow the user to answer questions or select comments about the condition of the well. A total of seven comments and one exclusive comment may be stored with each ID.
  - 10 Press 'Next ID' and proceed to the next wellhead. An automatic purge will be performed at this time to ensure the sample has been exhausted from the instrument.

For each reading, the following information will be stored:

- ID code
- Current time/date
- Site data (if entered)
- All gas readings and balance gas (CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>)
- Barometric pressure
- Temperature
- Gas pod (if connected)
- Gas flow (SCFM) and power (BTU)
- Comments and exclusive comment

When the instrument is switched off, a clean air purge is automatically started for a pre-determined global period. This may be aborted by pressing the '↵' key, although we do not recommend this action.

# GEM2000/GEM2000 Plus Gas Analyser

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## 6. Modem operation (GA and GEM mode)

The GEM2000 plus can be connected to a modem for remote access and download of data. This is of use where the operator is remote from the location where the data is required. There are two modes of operation.

### Operator initiated

This mode allows the instrument operator to download data to a remote computer.

The following equipment is required:

At analyser location:     GEM2000Plus  
                              Compatible modem (landline or GSM)

At central location:     PC with Windows 2000/ME/XP  
                              Gas Analyser Manager software  
                              Modem connected to PC

The following procedure should be followed.

- 1     At the central location the Gas Analyser Manager software should be started on the PC. This can be left running even if the PC is required for other tasks.
- 2     At the analyser location the analyser should be connected to the modem. If the modem is a landline type, then it will need to be plugged into a telephone socket. If it is a GSM type then a suitable signal strength must be present.
- 3     Switch the analyser on.
- 4     From the instrument menu select "download data via modem". Upon entering the download screen the instrument will initialize the modem using a pre-stored string. The screen will show 'modem NOT CONNECTED', the initialization string, the current time and date and the phone number to be dialed along with a brief description.
- 5     At this point the user has three options -:

Change the number to be dialed using the cursor keys. To create a list of phone numbers you will need to use Gas Analyser Manager to enter and upload the information to the instrument prior to selecting this option.

Prior to dialing you must ensure the computer attached to the modem at the remote end is running Gas Analyser Manager and that the software is configured to listen for incoming calls (Listener option on the Remote tab).

Dial the number shown using the enter key. The instrument will then attempt to connect to the modem at the other end. The modem status will change from NOT CONNECTED to CONNECTED (00:00.00) or FAILED ERROR (00). If the attempt fails the instrument screen will remain unchanged otherwise a further sub-menu will be displayed. The instrument will maintain and update the connection time every few seconds.

Exit using key 0. The instrument will return to the main reading screen.

- 3     Upon a successful connection the user will have the following options available -:

**Download readings.** This option will download all readings to the central PC via the modem connection. A "sending data" message will appear on the screen before returning to the menu screen. The user will be informed if there have been any errors.

**Clear readings.** After successfully downloading data the user can clear those readings from the instrument. After the user acknowledges an on-screen warning the readings will be cleared. The user will be informed if there have been any errors.

# GEM2000 / GEM2000 Plus Gas Analyser

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**Get tomorrows data.** This option allows a set of Ids, questions and comments to be sent from Gas Analyser Manager to the analyzer. Gas Analyser Manager must first be configured to define a 'route' to be uploaded.

**Drop connection.** This will disconnect the modem and return the user to the previous screen. If the PC end or local telecom's drops the connection a "connection lost message" will appear and the instrument will return to the previous screen.

## Central location initiated

This mode allows a central location to initiate the download process.

The following equipment is required:

At analyser location:     GEM2000Plus  
                                  Compatible modem (landline or GSM)

At central location:     PC with Windows 2000/ME/XP  
                                  Gas Analyser Manager software  
                                  Modem connected to PC

The following procedure should be followed.

- 1     At the analyser location, connect the analyser to the modem. If the modem is a landline type, then it will need to be plugged into a telephone socket. If it is a GSM type then a suitable signal strength must be present.
- 2     Switch the analyser and modem on.
- 3     Enter the 'DOWNLOAD VIA MODEM' menu option. The screen will show the modem status (NOT CONNECTED) plus the modem initialisation string, current time and date, and the phone number list.
- 4     Press key 3 auto answer mode.
- 5     The analyser can be left in this configuration until the central location has downloaded the data. It is recommended that the analyser is connected to the charger if it is to be left in this configuration for some time (eg overnight).
- 6     The analyser is now waiting to be called by the central PC.
- 7     At the central location the Gas Analyser Manager software should be started on the PC.
- 8     Gas Analyser Manager can then be used to remotely access the analyser and download the data.

More information on using this remote access facility can be found in the Gas Analyser Manager manual, or contact your supplier for further information. Contact your supplier for information on compatible modems.

# GEM2000/GEM2000 Plus Gas Analyser

## 7. Calibration (GA and GEM mode)

### 7.1 Introduction

The Geotechnical Instruments range of Gas Analysers are carefully calibrated at manufacture and when returned for service.

However, it is sometimes desirable to be able to carry out a calibration process between services. This section sets out the correct procedures for the user to calibrate their own Gas Analyser.

If this calibration is completed incorrectly it may decrease the accuracy of the Gas Analyser.

CH<sub>4</sub>, CO<sub>2</sub> and O<sub>2</sub> can be measured by all GEM2000 and GEM2000Plus analysers as standard; these channels can be user calibrated. The analysers have other gas channel options that are specified at manufacture; these too can be calibrated. This section will describe in detail how to calibrate the three standard gas channels plus the CO channel.

The GEM2000 Plus has a H<sub>2</sub> compensated CO channel. This option requires that H<sub>2</sub> is used in the calibration process, this is also set out within this section.

For the other gas channel options contact Geotechnical Instruments (UK) Ltd. for advice.

Two important terms that are used within this manual are “Zero” and “Span”.

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

Span: The point at which the Gas Analyser is calibrated when a known quantity of the target gas is present.

### 7.2 Calibration Gases

User calibration of a Gas Analyser will chiefly improve the data accuracy in the range of the calibration gases used. This may cause less accurate readings of concentrations outside this calibrated range. Users should select the correct calibration gas for the expected gas levels on their particular application.

- To improve calibration at lower levels requires the use of gas mixtures 1 and 2.
- To improve higher levels use gas mixture 3.
- For standard CO only 100ppm CO gas is needed.
- For CO (H<sub>2</sub> compensated) (GEM2000Plus only) both CO 100ppm and H<sub>2</sub> 1000ppm gases are needed.

Calibration gas	CH <sub>4</sub>	CO <sub>2</sub>	O <sub>2</sub>
Mixture 1	5%	5%	6%
Mixture 2	5%	10%	0%
Mixture 3	60%	40%	0%

Calibration gas for CO	CO 100ppm
Calibration gas for H <sub>2</sub> compensated CO	H <sub>2</sub> 1000ppm

These are for general use but other gas concentrations can be used.

*Note:* The above gases and most other gas concentrations can be supplied by Geotechnical Instruments (UK) Ltd.



# GEM2000 / GEM2000 Plus Gas Analyser

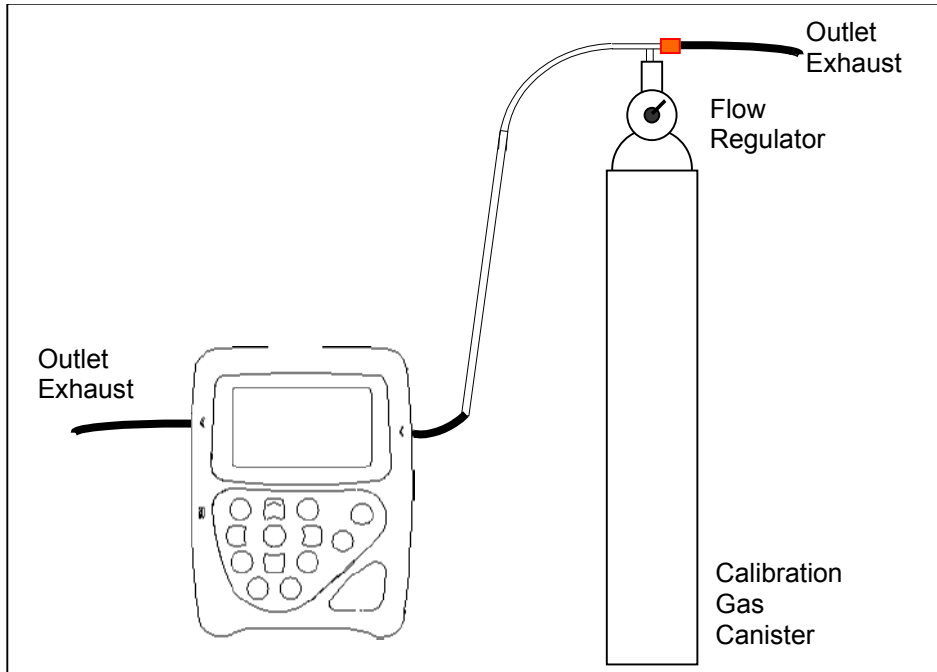
## Warning

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

## 7.3 Set-Up

### Important

Do NOT attach the gas supply to the Gas Analyser before putting it into the "Field Calibration Screen" by selecting 'FIELD CALIBRATION'.



The regulator's flow is factory set. It only requires a few turns to open, but no adjustment is necessary.

## Warning

### Exhaust port

When the Gas Analyser is being calibrated, there are two possible exits for the gas, via the usual manner out of the exhaust port of the analyser or in cases of over-pressurisation the 1/16" port on the pressure relief valve.

It is recommended that both ports have exhaust tubing attached.

The exhaust tubing must emerge in a well-vented area. Ensure there are no leaks in the tubing and connections.

The calibration of the Gas Analyser should be carried out in a safe area with all necessary precautions taken when using potentially dangerous, explosive or toxic gases.

*For each gas used the appropriate material data sheet should be read and understood before proceeding.*

# GEM2000/GEM2000 Plus Gas Analyser

## 7.4 Equipment

Calibration gas mixtures as specified as above in 58 litre gas canisters.

The regulator supplied by Geotechnical Instruments is recommended as flow and pressure rates are factory set.

## 7.5 Gas Analyser

To achieve the processes set out below, users need to be able to navigate through the analyser's menu system.

For the GA 2000 range of Gas Analysers, the calibration options can be found in the main menu under "Field Calibration".

The first screen to appear ("Check Calibration") provides the option of checking the gas channels against known calibration gases before proceeding to re-calibration.

**CHECK CALIBRATION**

1. Allow a certified gas mixture into the inlet port at 200cc/min
2. Wait until the reading is stable
3. Select required calibration option using the calibration menu

R = Current reading, S = Span target

	N/A	H2	CO	H2S	CH4	CO2	O2
R	--.-	0000	0000	0000	00.0	00.1	20.9
S	--.-	0000	0000	0000	05.0	05.0	20.7

1 Exit

3 Edit target  
Concentrations

↵ Calibration  
Menu

Readings on the line "a" are the current gas measurements of the unit. The figures displayed in line "b" are the span calibration gas levels that will need to be set to the concentration of the calibration gas.

*Note:* Certain gas channels may not be active and will be shown as "N/A".

Ensure the unit is stabilised at its working temperature before performing any of the calibration operations.

# GEM2000 / GEM2000 Plus Gas Analyser

## 7.6 Low Level Calibration - Mixtures 1 and 2

The previous sections explain the calibration options available and the equipment required to perform the calibration operations.

When using the two gas mixes 1 and 2 to perform a full user-calibration of the Gas Analyser it is advisable to follow this sequence of operations.

Step ↓	Calibration gas required ↓	Operator action proceed from left to right →		
Step One	Ambient air	Zero CH <sub>4</sub> channel	-	-
Step Two	Calibration Mixture 2	Zero O <sub>2</sub> channel	Calibrate CH <sub>4</sub> channel	Calibrate CO <sub>2</sub> channel
Step Three	Calibration Mixture 1	Calibrate O <sub>2</sub> channel at 6%	-	-
Step Four	Ambient air	Calibrate O <sub>2</sub> channel at 20.9%	-	-

### Step One

It is probably easiest at this point to set the span values of the different gases that will be used to calibrate the instrument. The span value is the concentration of the calibration gas.

From the "CHECK CALIBRATION" screen:

- Press **3** to edit target concentrations.
- Scroll using **2** **8** and press **↓** to select required gas channel
- Enter the appropriate value for the highlighted channel then press **↓**.
- When using gas mixtures 1 and 2 set CH<sub>4</sub> at 5%, CO<sub>2</sub> at 10% and O<sub>2</sub> at 6%.
- **↓**

### Zero Methane

In addition to the calibration process the Gas Analyser should have the Methane and any auxiliary channel zeroed prior to taking readings at the start of monitoring session. For this zeroing operation none of the calibration equipment is required. Remove gas source if attached.

*Ensure this operation is performed in clean fresh air.*

From the "CHECK CALIBRATION" screen,

- Press **⊗** allow the pump to run for approximately two minutes or until reading stabilises; this purges the unit of gas.
- Press **⊗** to switch off the pump.
- Press **↓** to select "CALIBRATION MENU".
- Press **↓** to select "ZERO CHANNEL(S)".
- Press **↓** to select "ZERO CH4".
- "USER ZERO COMPLETE." should be displayed.
- Repeat for other channels if required (except O<sub>2</sub>)

NOTE: Alternatively, the option 'ZERO All' is available from the 'ZERO CHANNELS' menu. Selecting this option will zero all of the channels except CO<sub>2</sub> & O<sub>2</sub>

### Step Two

#### Zeroing the Oxygen channel

Unlike zeroing the Methane or auxiliary channels, the Oxygen channel can not be zeroed with air, mixture 2 can be used. The Methane and Carbon Dioxide can be calibrated with gas mixture 2 at the same time.

# GEM2000/GEM2000 Plus Gas Analyser

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From the "CHECK CALIBRATION" screen:

- Attach the calibration equipment as pictured above with gas mixture 2 and turn on gas at regulator. Do not run the pump.
- Allow the gas to flow through the unit for approximately two minutes or until reading stabilises.
- Press  $\downarrow$  to select "CALIBRATION MENU".
- Press  $\downarrow$  to select "ZERO CHANNEL(S)".
- Scroll  $\leftarrow$  $\rightarrow$  to "ZERO O2".
- Press  $\downarrow$  to select "ZERO O2".
- "USER ZERO COMPLETE." should be displayed.

When the Oxygen channel has been zeroed, the Methane and Carbon Dioxide channels can be calibrated with the same gas mixture flowing through the unit.

## Span Calibrate Methane Channel

NOTE: Always ensure that the CH<sub>4</sub> channel has been zeroed before performing the Methane calibration operation, see above.

From the "CHECK CALIBRATION" screen:

- The calibration gas is already flowing through the Gas Analyser; the Methane reading should be approximately 5% and stable.
- Do not run the pump.
- Press  $\downarrow$  to enter the calibration menu.
- Scroll  $\leftarrow$  $\rightarrow$  to "SPAN CHANNEL(S)".
- Press  $\downarrow$  to select "SPAN CHANNEL(S)".
- Scroll  $\leftarrow$  $\rightarrow$  to "SPAN CH4 @ 05.0%" (the value set previously).
- Press  $\downarrow$  to select "SPAN CH4 @ 05.0%".
- "CALIBRATION COMPLETE" should be displayed.

## Calibrate Carbon Dioxide Channel

The Carbon Dioxide channel can also be calibrated while the same gas mixture 2 is flowing through the unit. *The Carbon Dioxide channel cannot be zeroed.*

From the "CHECK CALIBRATION" screen:

- Press  $\downarrow$  to enter the calibration menu.
- Scroll  $\leftarrow$  $\rightarrow$  to "SPAN CHANNEL(S)".
- Press  $\downarrow$  to select "SPAN CHANNEL(S)".
- Scroll  $\leftarrow$  $\rightarrow$  to "SPAN CO2 @ 10%" (the value set previously).
- Press  $\downarrow$  to select "SPAN CO2 @ 10%".
- "CALIBRATION COMPLETE" should be displayed.

## Step Three

### Calibrate O<sub>2</sub> Span with gas mixture 1

From the "CHECK CALIBRATION" screen:

- Attach the calibration equipment as pictured above with gas mixture 1 and turn on at the regulator. Do not run the pump.
- Allow the gas to flow through the unit for approximately two minutes or until reading stabilises.
- Press  $\downarrow$  to enter the calibration menu.
- Scroll  $\leftarrow$  $\rightarrow$  to "SPAN CHANNEL(S)".
- Press  $\downarrow$  to select "SPAN CHANNEL(S)".
- Scroll  $\leftarrow$  $\rightarrow$  to "SPAN O2 @ 6%" (the value set previously).
- Press  $\downarrow$  to select "SPAN O2 @ 6%".
- "CALIBRATION COMPLETE" should be displayed.

# GEM2000 / GEM2000 Plus Gas Analyser

## Step Four

### Calibrate O<sub>2</sub> Span with air

Calibration equipment is not required to perform this operation. Remove gas source if attached.

From the "CHECK CALIBRATION" screen:

- Press **3** to edit target concentrations.
- Scroll using **2**/**8** and press **↓** to select O<sub>2</sub> channel
- Enter 20.9%(air) then press **↓**.
- Press **☰** to switch on pump.
- Allow the pump to run for approximately two minutes or until reading stabilises; this purges the unit of gas.
- Press **☰** to switch off pump.
- Allow the reading to stabilise; this should be approximately 20.9%.
- Press **↓** to enter "CALIBRATION MENU".
- Scroll **2**/**8** to "SPAN CHANNEL(S)".
- Press **↓** to select "SPAN CHANNEL(S)".
- Scroll **2**/**8** to "SPAN O<sub>2</sub> @ 20.9%" (the value set previously).
- Press **↓** to select "SPAN O<sub>2</sub> @ 20.9%".
- "CALIBRATION COMPLETE" should be displayed.

## 7.7 Span Multi Gas

The 'Span Multi gas' option must only be used when the calibration gas being used is a combination of CH<sub>4</sub>, Co<sub>2</sub> and O<sub>2</sub> i.e. Mixture 1.

Using the Span Multi gas option when using mixture 2 (or similar) will result in a calibration failure.

## 7.8 High Level Calibration - Mixture 3

If the analyser were required to be calibrated with better accuracy around 60% CH<sub>4</sub> 40% CO<sub>2</sub>, gas mixture 3 would be recommended.

Step ↓	Calibration gas required ↓	Operator action proceed from left to right →		
Step One	Ambient air	Zero CH <sub>4</sub> channel	-	-
Step Two	Calibration Mixture 3	Zero O <sub>2</sub> channel	Calibrate CH <sub>4</sub> channel	Calibrate CO <sub>2</sub> channel
Step Three	Ambient air	Calibrate O <sub>2</sub> channel at 20.9%	-	-

## Step One

It is probably easiest at this point to set the span values of the different gases that will be used to calibrate the instrument. The span value is the concentration of the calibration gas.

From the "CHECK CALIBRATION" screen:

- Press **3** to edit target concentrations.
- Scroll using **2**/**8** and press **↓** to select required gas channel
- Enter the appropriate value for the highlighted channel then press **↓**.
- When using gas mixture 3 set CH<sub>4</sub> at 60%, CO<sub>2</sub> at 40% and O<sub>2</sub> at 20.9% (air).
- **↓**

# GEM2000/GEM2000 Plus Gas Analyser






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## Zero Methane

In addition to the calibration process the Gas Analyser should have the Methane and any auxiliary channel zeroed prior to taking readings at the start of monitoring session. For this zeroing operation none of the calibration equipment is required. Remove gas source if attached.

*Ensure this operation is performed in clean fresh air.*

From the "CHECK CALIBRATION" screen:

- Press  to switch on pump.
- Allow the pump to run for approximately two minutes or until reading stabilises; this purges the unit of gas.
- Press  to switch off the pump.
- Press  to select "CALIBRATION MENU".
- Press  to select "ZERO CHANNEL(S)".
- Press  to select "ZERO CH4".
- "USER ZERO COMPLETE." should be displayed.
- Repeat for other channels if required (except O2)






NOTE: Alternatively, the option 'ZERO All' is available from the 'ZERO CHANNELS' menu. Selecting this option will zero all of the channels except O2

## Step Two

### Zeroing the Oxygen channel

Unlike zeroing the Methane or auxiliary channels, the Oxygen channel can not be zeroed with air, mixture 3 must be used. The Methane and Carbon Dioxide can be calibrated with gas mixture 3 at the same time.

From the "CHECK CALIBRATION" screen:








- Attach the calibration equipment as pictured above with gas mixture 3 and turn on gas at regulator.
- Do not run the pump.
- Allow the gas to flow through the unit for approximately two minutes or until reading stabilises.
- Press  to select "CALIBRATION MENU".
- Press  to select "ZERO CHANNEL(S)".
- Scroll   to "ZERO O2".
- Press  to select "ZERO O2".
- "USER ZERO COMPLETE." should be displayed.

When the Oxygen channel has been zeroed, the Methane and Carbon Dioxide channels can be calibrated with the same gas mixture flowing through the unit.

### Span Calibrate Methane Channel

NOTE: Always ensure that the CH<sub>4</sub> channel has been zeroed before performing the Methane calibration operation, see above.








From the "CHECK CALIBRATION" screen

- The calibration gas is already flowing through the Gas Analyser, the Methane reading should be approximately 60% and stable.
- Do not run the pump.
- Press  to enter the calibration menu.
- Scroll   to "SPAN CHANNEL(S)".
- Press  to select "SPAN CHANNEL(S)".
- Scroll   to "SPAN CH4 @ 60.0%" (the value set previously).
- Press  to select "SPAN CH4 @ 60.0%".
- "Calibration Complete" should be displayed.

## Calibrate Carbon Dioxide Channel

The Carbon Dioxide channel can also be calibrated while the same gas mixture 3 is flowing through the unit. The Carbon Dioxide channel cannot be zeroed.

From the "CHECK CALIBRATION" screen:

- Press  to enter the calibration menu.
- Scroll   to "SPAN CHANNEL(S)".
- Press  to select "SPAN CHANNEL(S)".
- Scroll   to "SPAN CO2 @ 40%" (the value set previously).
- Press  to select "SPAN CO2 @ 40%".
- "CALIBRATION COMPLETE" should be displayed.










NOTE: The 'Span Multi Gas' option cannot be used with this gas.

## Step Three

### Calibrate O<sub>2</sub> Span with air

Calibration equipment is not required to perform this operation. Remove gas source if attached.

From the "CHECK CALIBRATION" screen:

- Press  to switch on pump.
- Allow the pump to run for approximately two minutes or until reading stabilises; this purges the unit of gas.
- Press  to switch off pump.
- Allow the reading to stabilise, this should be approximately 20.9%.
- Press  to enter Calibration Menu.
- Scroll   to "SPAN CHANNEL(S)".
- Press  to select "SPAN CHANNEL(S)".
- Scroll   to "SPAN O2 @ 20.9%" (the value set previously).
- Press  to select "SPAN O2 @ 20.9%".
- "CALIBRATION COMPLETE" should be displayed.






## 7.9 Calibration of the CO Channel

Step ↓	Calibration gas required ↓	Operator action
Step One	Ambient air	Zero CO channel
Step Two	100ppm CO	Span CO channel

### Step One

It is probably easiest at this point to set the span values of the different gases that will be used to calibrate the instrument. The span value is the concentration of the calibration gas.

From the "CHECK CALIBRATION" screen":








- Press  to edit target concentrations.
- Scroll using   and press  to select the CO channel.
- Enter the appropriate value for the highlighted channel then press .
- When using CO gas mixture, set CO at 100ppm.

# GEM2000/GEM2000 Plus Gas Analyser

## Zero CO

For this zeroing operation none of the calibration equipment is required. Remove gas source if attached. *Ensure this operation is performed in clean fresh air.*

From the “CHECK CALIBRATION” screen:









- Press  allow the pump to run for approximately two minutes or until reading stabilises; this purges the unit of gas.
- Press  to switch off the pump.
- Press  to select “Calibration Menu”.
- Press  to select “Zero Channel(s)”.
- Scroll   to “ZERO CO”.
- Press  to select “ZERO CO”.
- “USER ZERO COMPLETE.” should be displayed.

## Step Two

### Span Calibrate CO Channel

NOTE: Always ensure that the CO channel has been zeroed before performing the CO calibration operation, see above.

From the “CHECK CALIBRATION” screen:

- Attach the calibration equipment as pictured above with 100ppm CO mixture and turn on at the regulator.
- Do not run the pump.
- Allow the gas to flow through the unit for approximately two minutes or until reading stabilises.
- Press  to enter the calibration menu.
- Scroll   to “SPAN CHANNEL(S)”.
- Press  to select “SPAN CHANNEL(S)”.
- Scroll   to “SPAN CO @ 100ppm” (the value set previously).
- Press  to select “SPAN CO @ 100ppm”.
- “CALIBRATION COMPLETE” should be displayed.
- Press  allow the pump to run for one minute; this purges the unit of gas.

## 7.10 Calibration of the CO Channel (H<sub>2</sub> compensated) in GEM2000 Plus

*The H<sub>2</sub> reading is only for compensation purposes and should not be used to take measurements.*

Step ↓	Calibration gas required ↓	Operator action proceed from left to right →	
Step One	Ambient air	Zero CO channel	Zero H <sub>2</sub>
Step Two	100ppm CO	Span CO	-
Step Three	1000ppm H <sub>2</sub>	Span H <sub>2</sub>	-

To calibrate the H<sub>2</sub> compensated CO channel, both the CO and H<sub>2</sub> need to be zeroed and then spanned separately.



## Step One

It is probably easiest at this point to set the span values of the different gases that will be used to calibrate the instrument. The span value is the concentration of the calibration gas.

From the "CHECK CALIBRATION" screen:

- Press **3** to edit target concentrations.
- Scroll using **2** **8** and press **↓** to select the required gas channel.
- Enter the appropriate value for the highlighted channel then press **↓**.
- When using CO gas mixture, set CO to 100ppm and H<sub>2</sub> to 1000ppm.
- **↓**

### Zero CO and H<sub>2</sub>

For this zeroing operation none of the calibration equipment is required. Remove gas source if attached. *Ensure this operation is performed in clean fresh air.*

From the "CHECK CALIBRATION" screen:

- Press **⊗** allow the pump to run for approximately two minutes or until reading stabilises; this purges the unit of gas.
- Press **⊗** to switch off the pump.
- Press **↓** to select "Calibration Menu".
- Scroll **2** **8** to "ZERO CO".
- Press **↓** to select "ZERO CO".
- "USER ZERO COMPLETE." should be displayed.
- Press **↓** to select "CALIBRATION MENU".
- Press **↓** to select "ZERO CHANNEL(S)".
- Scroll **2** **8** to "ZERO H<sub>2</sub>".
- Press **↓** to select "Zero H<sub>2</sub>".
- "USER ZERO COMPLETE." should be displayed.

## Step Two

### Span Calibrate CO Channel

NOTE: Always ensure that the CO channel has been zeroed before performing the CO calibration operation, see above.

From the "CHECK CALIBRATION" screen:

- Attach the calibration equipment as pictured above with 100ppm CO mixture and turn on at the regulator.
- Do not run the pump.
- Allow the gas to flow through the unit for approximately two minutes or until reading stabilises.
- Press **↓** to enter the calibration menu.
- Scroll **2** **8** to "SPAN CHANNEL(S)".
- Press **↓** to select "SPAN CHANNEL(S)".
- Scroll **2** **8** to "SPAN CO @ 100ppm" (the value set previously).
- Press **↓** to select "SPAN CO @ 100ppm".
- "CALIBRATION COMPLETE" should be displayed.

## Step Three

### Span Calibrate H<sub>2</sub> Channel








Note: Always ensure that the H<sub>2</sub> channel has been zeroed before performing the H<sub>2</sub> calibration operation, see above.

From the "CHECK CALIBRATION" screen:

- Attach the calibration equipment as pictured above with 1000ppm H<sub>2</sub> mixture and turn on at the regulator.

## GEM2000/GEM2000 Plus Gas Analyser

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- Do not run the pump.
- Allow the gas to flow through the unit for approximately two minutes or until reading stabilises.
- Press  to enter the calibration menu.
- Scroll   to "SPAN CHANNEL(S)".
- Press  to select "SPAN CHANNEL(S)".
- Scroll   to "SPAN H2 @ 1000ppm" (the value set previously).
- Press  to select "SPAN H2 @ 1000 ppm".
- "CALIBRATION COMPLETE" should be displayed.

## 7.11 Trouble Shooting

Error message	Remedy
"User Zero failed"	<p>A possible reason for this is because the Gas Analyser is trying to zero to a level which is outside the pre-determined range set when the unit was first calibrated at the factory. To rectify this, first ensure the unit contains absolutely none of the gas which is being zeroed. For all but O<sub>2</sub> (which requires O<sub>2</sub> free gas) run the pump to purge with fresh air and repeat zeroing process.</p> <p>If it will not zero, then refer to the instructions given in the 'Factory Settings' section.</p> <p>If the Gas Analyser continues to fail in zeroing then the unit must be returned to Geotechnical Instruments (UK) Ltd for investigation.</p>
"Calibration failed"	<p>Check the span is set to the correct value, if not, correct and retry spanning the channel.</p> <p>Repeat the entire procedure, including zeroing the channel and then calibrate the span. Ensure the reading is stable before spanning the channel.</p> <p>This message may also appear if attempting to use the 'Span Multi Gas' option when not using a gas containing concentrations of CH<sub>4</sub>, CO<sub>2</sub> and O<sub>2</sub>.</p>

## 7.12 Confirm Calibration

This feature allows the operator to store the accuracy of the instrument in the events log.

### Confirm Multi-Gas

The 'Span Multi gas' option must only be used when the calibration gas being used is a combination of CH<sub>4</sub>, Co<sub>2</sub> and O<sub>2</sub> i.e. Mixture 1.

It is probably easiest at this point to set the span values of the different gases that will be used to confirm the calibration of the instrument. The span value is the concentration of the calibration gas.

From the "CHECK CALIBRATION" screen:

- Press **3** to edit target concentrations.
- Scroll using **2** **9** and press **4** to select required gas channel
- Enter the appropriate value for the highlighted channel then press **4**.
- When using gas mixture 1 set CH<sub>4</sub> at 5%, CO<sub>2</sub> at 5% and O<sub>2</sub> at 6%.
- **4**

From the "CHECK CALIBRATION" screen:

- Attach the calibration equipment as pictured above with mixture 1 and turn on at the regulator.
- Do not run the pump.
- Allow the gas to flow through the unit for approximately two minutes or until reading stabilises.
- Press **4** to enter the calibration menu.
- Scroll **2** **9** to "CONFIRM CALIBRATION".
- Press **4** to select "CONFIRM CALIBRATION".
- Press **4** to select "CONFIRM MULTI-GAS".
- Press **1** Finished.

This information will then be stored in the events log and can be downloaded and viewed using G.A.M (Gas Analyser Manager).

### Confirm Channels Independently

# GEM2000/GEM2000 Plus Gas Analyser

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This option can be used if the gas being used is not a combination of CH<sub>4</sub>, Co<sub>2</sub> and O<sub>2</sub> i.e. Mixture 1 or if the confirmation of a single channel is required.

It is probably easiest at this point to set the span values of the different gases that will be used to confirm the calibration of the instrument. The span value is the concentration of the calibration gas.

From the "CHECK CALIBRATION" screen:

- Press **3** to edit target concentrations.
- Scroll using **2**/**8** and press **↓** to select required gas channel
- Enter the appropriate value for the highlighted channel then press **↓**.
- Repeat for other channels.

From the "CHECK CALIBRATION" screen:

- Attach the calibration equipment as pictured above with target gas and turn on at the regulator.
- Do not run the pump.
- Allow the gas to flow through the unit for approximately two minutes or until reading stabilises.
- Press **↓** to enter the calibration menu.
- Scroll **2**/**8** to "CONFIRM CALIBRATION".
- Press **↓** to select "CONFIRM CALIBRATION".
- Scroll **2**/**8** to "CONFIRM CH<sub>4</sub> @ 'target gas'".
- Press **↓** to select "CONFIRM CH<sub>4</sub> @ 'target gas'".
- Press **1** Finished.
- Repeat for other channels if required.

This information will then be stored in the events log and can be downloaded and viewed using G.A.M (Gas Analyser Manager).

## 7.13 Factory Settings

This option will reset the Gas Analyser to all of its factory programmed characteristics and will clear ALL the user defined calibration points.

If in any doubt contact Geotechnical Instruments (UK) Ltd.

From the main "CHECK CALIBRATION" screen:

- Press **↓** to enter the calibration menu.
- Scroll **2**/**8** to "FACTORY SETTINGS".
- Press **↓** to Select "FACTORY SETTINGS".
- Two messages will follow, "Resetting please wait." and "Factory settings restored."

## 7.14 Last Field Calibration


This option can be found in the calibration menu of the 'field calibration' section. When selected, this option will display the time and date that the last field calibration was performed on the instrument.

# GEM2000 / GEM2000 Plus Gas Analyser

## 8. Service

Your GEM2000/GEM2000Plus analyser should be regularly serviced to ensure correct and accurate operation. Geotechnical Instruments recommends a service and recalibration every 6 months.

The GEM2000/GEM2000Plus analyser is ATEX certified for use in potentially explosive areas. As such it should be serviced only by qualified engineers. Failure to observe this will result in the warranty becoming invalid and could invalidate the ATEX certification.

 <b>Warning</b>	If the GEM2000/GEM2000 Plus analyser is serviced by unqualified engineers the ATEX certification may be invalidated and the instrument may be unsafe for use in a potentially explosive atmosphere.
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### User serviceable parts

There are no user serviceable parts within the instrument.

The following parts can be user serviced

In line water filter	This should be regularly inspected for obstructions or damage and changed if needed. The instrument should never be operated without the in line water filter as this may result in water entering the instrument.
Particulate filter	The particulate filter is located on the underside of the instrument and is accessed by removing the plastic plug. This can be removed by unscrewing using a suitable sized coin. The filter should be replaced if it is contaminated. Never operate the instrument without the particulate filter. When replacing the plug be sure not to over tighten it - finger tight is adequate.
Sample tubing	Always ensure that sample tubes are not contaminated or damaged.
QRC connectors	Periodically check that the O-rings on the QRC gas connectors are not damaged. A damaged O-ring can let air into the sample gas and result in incorrect readings. If the O-ring is damaged the complete QRC connector should be replaced.
H <sub>2</sub> S filter material	When the filter material changes colour to a <i>light gray</i> colour then the filter should be replaced.

# GEM2000/GEM2000 Plus Gas Analyser

## 9. Technical Specification

POWER SUPPLY	
<b>Battery type</b>	Rechargeable Nickel Metal Hydride battery pack containing six 4AH cells (not user replaceable)
<b>Battery life</b>	Typical use 10 hours from fully charged
<b>Battery lifetime</b>	Up to 1000 charge/discharge cycles
<b>Battery charger</b>	Separate intelligent 2A battery charger powered from mains supply (100-240V 47-63Hz)
<b>Charge time</b>	Approximately 2 hours from complete discharge
<b>Alternative power</b>	Can be powered externally for fixed in place applications. Contact Geotechnical Instruments (UK) Ltd for further information
<b>Memory backup battery</b>	Lithium Manganese for data retention.

GAS RANGES				
<b>Gases measured</b>	CO <sub>2</sub> and CH <sub>4</sub>	By dual wavelength infrared cell with reference channel		
	O <sub>2</sub>	By internal electrochemical cell		
	CO	Internal measurement (GEM2000 only)		
	CO (hydrogen compensated)	Internal measurement (GEM2000 Plus only)		
	H <sub>2</sub> S 0-500ppm	By internal electrochemical cell		
	H <sub>2</sub> S 0-5000ppm	By external gas pod		
	NH <sub>3</sub> 0-1000ppm	By internal electrochemical cell (non standard option)		
	Other gases can be measured by internal electrochemical cells.			
	For the PLUS analyser a full range of gas pods can be used as well as the two internal cell positions.			
<b>Oxygen cell lifetime</b>	Approximately 3 years in air			
<b>Range</b>	CH <sub>4</sub> CO <sub>2</sub> O <sub>2</sub> CO H <sub>2</sub> S	0 - 70% to specification, 0-100% reading 0 - 40% to specification, 0-100% reading 0 - 25% GEM2000 0 - 500ppm GEM2000Plus 0 - 2000ppm 0 - 500ppm internal or 0 - 5000ppm external pod		
<b>Typical accuracy</b>	<b>Gas</b>	<b>0-5% vol</b>	<b>5-15% vol</b>	<b>15%-FS</b>
	CH <sub>4</sub>	±0.5%	±1.0%	±3.0%
	CO <sub>2</sub>	±0.5%	±1.0%	±3.0%
	O <sub>2</sub>	±1.0%	±1.0%	±1.0%
	<b>Gas</b>	<b>0-FS</b>		
	CO (0 - 500ppm version)	±10.0% FS		
	CO (0 - 2000ppm, H <sub>2</sub> compensated version)	±10.0% of reading or 15ppm, whichever is greater		
H <sub>2</sub> S (0 - 500 ppm)	±10.0% FS			
<b>Response time, T<sup>90</sup></b>	CH <sub>4</sub> CO <sub>2</sub> O <sub>2</sub> CO H <sub>2</sub> S	≤20 seconds ≤20 seconds ≤20 seconds ≤60 seconds ≤60 seconds		
<b>CO measurement (Plus version only)</b>	Compensated for interference from hydrogen up to 1% hydrogen. Cross sensitivity approx 1%.			

# GEM2000 / GEM2000 Plus Gas Analyser

<b>FACILITIES</b>	
<b>Temperature measurement</b>	With optional probe -10°C to +75°C
<b>Temperature accuracy</b>	±0.2°C (± probe accuracy)
<b>Flow from borehole</b>	Internal measurement. 0 - 20 L/Hr
<b>Visual and audible alarm</b>	User selectable CO <sub>2</sub> , CH <sub>4</sub> and O <sub>2</sub> alarm levels
<b>Communications</b>	RS232 protocol via download lead with variable baud rate
<b>Relative pressure</b>	±500 mbar from calibration pressure
<b>Relative pressure accuracy</b>	<ul style="list-style-type: none"> <li>• ±4mbar typically (should be zeroed before reading)</li> <li>• ±15mbar max</li> </ul>
<b>Available memory</b>	<ul style="list-style-type: none"> <li>• 1000 IDs</li> <li>• 2000 Readings</li> <li>• 1000 events</li> </ul>

<b>PUMP</b>	
<b>Flow</b>	300cc/min typically
<b>Flow fail point</b>	50cc/min approximately – user settable
<b>Flow with 200mbar vacuum</b>	250cc/min approximately
<b>Vacuum pull</b>	400mbar approximately

<b>ENVIRONMENTAL CONDITIONS</b>	
<b>Operating temperature range</b>	0°C - 40°C
<b>Relative humidity</b>	0 - 95% non condensing
<b>Case seal</b>	IP65
<b>Barometric pressure</b>	±200mbar from calibration pressure
<b>Barometric pressure accuracy</b>	±5mbar typically

<b>PHYSICAL</b>	
<b>Weight</b>	2 Kilograms
<b>Size</b>	L 63mm, W 190mm, D 252mm
<b>Case material</b>	ABS
<b>Keys</b>	Membrane panel
<b>Display</b>	<ul style="list-style-type: none"> <li>• Liquid crystal display, 40 x 16 characters</li> <li>• Fibre optic woven back-light for low light conditions</li> </ul>
<b>Gas sample filters</b>	User replaceable integral fibre filter at inlet port and an external PTFE water trap filter

<b>CERTIFICATION RATING</b>	
Certified to EEx ibd IIA T1	

# GEM2000/GEM2000 Plus Gas Analyser

## 10. EC Declaration of Conformity

<b>Products</b>	<ul style="list-style-type: none"><li>• GA2000 and GA2000Plus - Landfill Gas Analyser</li><li>• GEM 2000 and GEM2000Plus - Landfill Gas Analyser and Extraction Monitor</li></ul>
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Geotechnical Instruments (UK) Ltd declare that the item(s) described above are in compliance with the following standards:

### ATEX Directive 94/9/EC

<b>Certification body</b>	SIRA Certification Service
<b>Notified body number</b>	0518
<b>Address</b>	Rake Lane, Eccleston, Chester, CH4 9JN
<b>Certificate number</b>	Sira 06ATEX2202X
<b>Standards applied</b>	EN50014:1997 + Amds 1 and 2 EN50020:2002 EN50018:2000 + Amds 1

### EMC Directive 89/336/EEC

EN 61000-6-4:2001	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
EN 61000-4-3:2006	Electromagnetic compatibility (EMC). Testing and measurement techniques. Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-2:1995	Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrostatic discharge immunity test.
EN 61000-4-6:1996	Electromagnetic compatibility (EMC). Testing and measurement techniques. Immunity to conducted disturbances, induced by radio-frequency fields
EN 50270:1999	Electromagnetic compatibility - Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen. Tests carried out according to ENV 50204:1996 Radiated electromagnetic field from digital radio telephones. Immunity test

Signed:



Dr. Roger Riley  
NPI Manager and Authorised Person



# GEM2000 / GEM2000 Plus Gas Analyser

## 11. Appendix 1 Event Log

The table below lists all of the events stored in the event log. For all events the date and time of the event is stored.

	Event Type	Data Stored
0	Unspecified Event	
1	Cold Start	0=Manual or 1=Via RS232
2	Manufacturers Calibration	Needs new command
3	Official Gas Check	Needs new command
5	Return to Factory settings	0=Manual or 1=Via RS232
6	Successful User zero Ch4	Readings before and after
7	Successful User span Ch4	Target Value, Readings before and after
8	Successful User zero Co2	Readings before and after
9	Successful User span Co2	Target Value, Readings before and after
10	Successful User zero O2	Readings before and after
11	Successful User span O2	Target Value, Readings before and after
12	Successful User zero CELL1	Readings before and after
13	Successful User span CELL1	Target Value, Readings before and after
14	Successful User zero CELL2	Readings before and after
15	Successful User span CELL2	Target Value, Readings before and after
16	Successful User zero CELL3	Readings before and After
17	Successful User span CELL3	Target Value, Readings before and after
18	Successful User zero internal flow	Readings before and after
19	Failed User zero Ch4	Reading
20	Failed User span Ch4	Target Value, Gas Reading
21	Failed User zero Co2	Reading
22	Failed User span Co2	Target Value, Gas Reading
23	Failed User zero O2	Reading
24	Failed User span O2	Target Value, Gas Reading
25	Failed User zero CELL1	Reading
26	Failed User span CELL1	Target Value, Gas Reading
27	Failed User zero CELL2	Reading
28	Failed User span CELL2	Target Value, Gas Reading
29	Failed User zero CELL3	Reading
30	Failed User span CELL3	Target Value, Gas Reading
31	Failed User zero internal flow	Reading
32	Confirm Ch4 calibration	Target, Factory and Actual gas values
33	Confirm Co2 calibration	Target, Factory and Actual gas values
34	Confirm O2 calibration	Target, Factory and Actual gas values
35	Set Clock via RS232	Tme before and after
36	Clear Memory via RS232	Cleared 1=readings, 2=ID's, 3=Comments, 4=Site Questions, 5=All memory and 6=Event Log.
37	Downloaded readings from instrument	No. of readings
38	Upload readings to instrument	No. of readings
39	Download ID's from instrument	No of ID's
40	Upload ID's to instrument	No. of ID's
41	Technician login	ID code
42	Auto-Purge	Time in seconds
43	Power-off auto-purge	Time in seconds
44	Over-pressurised Warning	Pressure reading
45	Keyboard locked	1=locked and 0=unlocked
46	Mode of operation changed	0=Manual or 1=Via RS232 & 0=GA or 1=GEM
47	Download event log	No. of events
48	Download technician list	No. of entries
49	Upload technician list	No. of entries
50	Download phone directory	No. of entries
51	Upload phone directory	No. of entries
52	Download modem initialisation string	
53	Upload modem initialisation string	
54	Tried to store reading with memory full	0=Abort store, 1=Overwrite existing reading or 2=Unable to overwrite existing reading
55	Download comments	
56	Upload comments	
57	Download alarm levels	
58	Upload alarm levels	
59	Download logging parameters	
60	Upload logging parameters	
61	Download site questions	

# GEM2000/GEM2000 Plus Gas Analyser

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62	Upload site questions	
64	Modem status reports...	0=Not Connected, 1=Ringin, 2=Connected, 3=Busy, 4=No Carrier, 5=No Dial tone, 6=Dialling
70	Static pressure transducer zeroed	Reading before and after
71	Differential pressure transducer zeroed	Reading before and after
72	Update site questions	number of questions
73	Data logging mode selected	Pump run time and logging interval
74	Operate via modem selected	
75	View data selected	
76	Print data selected	0=complete, 1=aborted and -1=comms error
77	Adjust contrast	Contrast offset
78	Gas Alarm triggered	For the channels Ch4, Co2 and O2 where 1=alarming and 0=not alarming.

The following event types are primarily instrument error or warning events. As before each event contains the time/date and up to 12 bytes of event specific data :-

100	Lo-flow warning		Target and actual raw flow readings
101	Battery low warning (<20%)		
102	Reading memory nearly full warning		
103	Variable(s) in RAM out-of-range / corrupt		
104	Clock invalid / corrupt		
105	Service overdue		
106	Secondary sensor reads error at start-up		Channel
107	Chemical cell reads error at start-up		Cell type code
108	Primary sensor reads error at start-up		
109	Event log nearly full or full		0=nearly full or 1=full

## 12. Instructions for safe use – Italian Language

### Istruzioni per un uso sicuro


#### 12.1 Istruzioni specifiche per le installazioni in aree pericolose

(Vedere la direttiva europea ATEX 94/9/EC, Allegato II, 1.0.6.)

Le seguenti istruzioni valgono per le apparecchiature coperte dai numeri di certificato Sira 06ATEX2202X:

- L'apparecchiatura va usata con gas e vapori infiammabili con il gruppo di macchinari IIA e la classe di temperatura T1
- Questa apparecchiatura è certificata unicamente per l'uso con temperature ambiente comprese nell'intervallo da 0 °C a +40 °C e va usata con temperature al di fuori di questo intervallo
- L'installazione va effettuata nel rispetto del codice di pratica applicabile e a cura di personale specializzato
- La riparazione di questa apparecchiatura va eseguita nel rispetto del codice di pratica applicabile.
- Il produttore specificherà quali materiali sono importanti per il tipo di protezione necessario.
- Quando il rilevatore di metano GA2000, GA2000 Plus, GEM2000 o GEM2000 Plus si trova in un'area pericolosa, sarà collegato solo esternamente mediante il connettore A ai dispositivi che sono contrassegnati con il numero di certificati Sira 06ATEX2202X.
- Se si prevede che l'apparecchiatura venga a contatto con sostanze aggressive, ad esempio liquidi o gas acidi che potrebbero attaccare i metalli, oppure solventi che potrebbero agire sui materiali polimerici, è responsabilità dell'utente prendere le dovute precauzioni, come ad esempio effettuare controlli regolari nell'ambito dei controlli di routine o verificando nella documentazione tecnica se essa è resistente a determinati prodotti chimici che evitano che subisca ripercussioni negative, garantendo quindi l'integrità del tipo di protezione.


**L'analizzatore di gas GA2000/GA2000 Plus/GEM2000/GEM2000 Plus è stato certificato per la classificazione nell'area pericolosa**

 **II2G EEx ibd IIA T1 (Ta = da 0°C a +40°C)**

È essenziale attenersi scrupolosamente alle istruzioni contenute in questo manuale.

È responsabilità dell'operatore determinare il concetto di protezione e classificazione necessario per una particolare applicazione.


#### 12.2 Informazioni di questo manuale relative alla sicurezza

Le informazioni contenute in questo manuale che potrebbero influenzare la sicurezza degli utenti e delle altre persone sono precedute dal seguente simbolo:  **Avvertenza**.

Il mancato rispetto delle informazioni qui contenute potrebbe determinare lesioni personali che in alcuni casi potrebbe essere fatale.

# GEM2000/GEM2000 Plus Gas Analyser

## 12.3 Informazioni sulla sicurezza

 <b>Avvertenza</b>	Il GA2000/GA2000 Plus/GEM2000/GEM2000Plus può essere usato per misurare i gas che fuoriescono dalle discariche e da altre fonti, come descritto in questo manuale. L'inalazione di questi gas potrebbe essere pericolosa per la salute e, in alcuni casi, fatale. È responsabilità dell'utente assicurarsi che sia adeguatamente formato in merito agli aspetti della sicurezza dei gas usati e relativamente alle procedure adeguate cui attenersi. In particolare, quando vengono usati gas pericolosi, il gas esausto che fuoriesce dall'analizzatore va convogliato verso un'area in cui è sicuro scaricarlo. I gas pericolosi possono essere espulsi anche dallo strumento durante la fase di spurgo con aria pulita.
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## 12.4 Visualizzazione di avvertenze ed errori

Durante l'auto-test, se un parametro operativo non soddisfa le specifiche della taratura consigliata preprogrammata o se la data prevista per la manutenzione è passata, potrebbero venire visualizzati degli errori o delle avvertenze. Possono essere visualizzate solo tre avvertenze o errori. Per visualizzare se sono stati visualizzati più errori, usare i tasti "v" e "^" per scorrere verso il basso o verso l'alto nell'elenco.

### Avvertenze visualizzate


Tutte le avvertenze visualizzate vengono precedute dalla parola AVVERTENZA seguita dalla relativa descrizione.

Il motivo più probabile per il verificarsi di errori è una taratura dell'utente errata, oppure un sensore guasto. Se una taratura errata dell'utente ha determinato la visualizzazione di un'avvertenza, il problema potrebbe risolversi ripristinando lo strumento sulle impostazioni di fabbrica, impostandolo su zero o effettuando una calibrazione personalizzata a seconda delle necessità, per la relativa funzione.

### Errori visualizzati

Tutti gli errori visualizzati sono preceduti dalla parola ERRORE seguita da un codice di errore. Gli errori rilevati dall'auto-test di solito dipendono dalla taratura dell'utente che non rientra nelle specifiche oppure da un possibile danneggiamento della memoria e influenzeranno le funzioni dello strumento e pertanto vanno corrette prima dell'uso, ad esempio 01-User cal data (dati taratura utente), CH<sub>4</sub> reading out of specification (lettura CH<sub>4</sub> fuori intervallo), 02-User cal data (dati calibrazione utente), CO<sub>2</sub> reading out of specification (lettura CO<sub>2</sub> fuori dalle specifiche), 04-User cal data (dati taratura utente), Cell 1 reading out of specification (lettura Cell 1 fuori dalle specifiche).

## 12.5 Batteria/ricarica

 <b>Avvertenza</b>	Il caricabatterie NON è coperto dalla certificazione Ex. La batteria va caricata solo in un'area sicura.
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La batteria è all'idruro di nickel metallico ed è costituita da un gruppo incapsulato a sei celle. La ricarica completa dovrebbe durare circa due ore.

## 12.6 Lettura del rilevatore della temperatura

Il rilevatore della temperatura fa parte della certificazione Instrument Ex e pertanto è certificato per l'uso nelle stesse condizioni dell'analizzatore.


## 12.7 Accessori che non possono essere usati in un'atmosfera potenzialmente esplosiva.

I seguenti accessori non vengono trattati dalla valutazione Ex dello strumento e non sono certificati per l'uso in un'atmosfera potenzialmente esplosiva.

# GEM2000 / GEM2000 Plus Gas Analyser

Tutti i serbatoi di gas  
Rilevatore dell'anemometro  
Serbatoio di flusso esterno


## 12.8 Taratura

 <b>Avvertenza</b>	<b>Foro di scarico</b> <p>Quando l'analizzatore del gas viene tarato, ci sono due possibili uscite per il gas, o nel modo consueto mediante il foro di scarico dell'analizzatore, oppure, nei casi di pressurizzazione eccessiva, mediante la porta da 1/16 poll. sulla valvola regolatrice della pressione.</p> <p>È consigliabile che a entrambi i fori abbiano siano collegati i tubi di scarico.</p> <p>Il tubo di scarico deve emergere in un'area ben ventilata. Assicurarsi che non vi siano perdite nelle tubazioni e nei collegamenti.</p> <p>La taratura dell'analizzatore del gas va effettuata in un'area sicura con tutte le necessarie precauzioni da prendere quando si utilizzano gas potenzialmente pericolosi, esplosivi o tossici.</p> <p><i>Per ciascun gas utilizzato, prima di procedere è opportuno leggere e comprendere tutta la documentazione tecnica appropriata.</i></p>
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## 12.9 Manutenzione

L'analizzatore va sottoposto a regolare manutenzione, per garantire un funzionamento corretto e accurato. Geotechnical Instruments consiglia di effettuare la manutenzione e la taratura ogni 6 mesi.

L'analizzatore gode della certificazione ATEX per l'uso nelle aree potenzialmente esplosive. Di conseguenza, va sottoposto a manutenzione esclusivamente da parte di tecnici qualificati. Il mancato rispetto di questa indicazione renderà non valida la garanzia e potrebbe rendere nulla la certificazione ATEX.

 <b>Avvertenza</b>	Se l'analizzatore viene sottoposto alla manutenzione da parte di tecnici qualificati, la certificazione ATEX potrebbe venire resa nulla e lo strumento potrebbe essere non sicuro per l'uso in un'atmosfera potenzialmente esplosiva.
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### Componenti sottoponibili a manutenzione da parte dell'utente

In questo strumento non ci sono componenti sottoponibili a manutenzione.

I seguenti componenti possono essere sottoposti a manutenzione da parte dell'utente.

Filtro dell'acqua in linea	Va regolarmente controllato per verificare la presenza di ostruzioni o danni e, se necessario, sostituito. Lo strumento non viene mai utilizzato senza il filtro dell'acqua in linea, in quanto questo potrebbe far sì che l'acqua penetri nello strumento.
Filtro antiparticolato	Il filtro antiparticolato si trova sul fondo dello strumento e vi si può accedere rimuovendo il tappo di plastica. Se è sporco, il filtro va sostituito. Non usare mai lo strumento senza il filtro antiparticolato. Durante la sostituzione del tappo, fare attenzione a non serrarlo eccessivamente; è sufficiente stringerlo con le dita.
Tubo campione	Assicurarsi sempre che i tubi campione non siano sporchi né danneggiati.
Connettori QRC	Controllare periodicamente che le guarnizioni ad anello dei connettori del gas QRC non siano danneggiate. Una guarnizione ad anello può lasciar

# GEM2000/GEM2000 Plus Gas Analyser

	entrare l'aria nel gas campione e determinerà delle letture errate dei valori. Se la guarnizione ad anello è danneggiata è necessario sostituire tutto il connettore QRC.
Materiale del filtro H <sub>2</sub> S	Quando il materiale del filtro cambia colore passando a un colore <i>grigio chiaro</i> , è necessario sostituirlo.

## 12.10 Dichiarazione di conformità EC

<b>Prodotti</b>	<ul style="list-style-type: none"><li>• GA 2000/GA2000 Plus - Analizzatore gas Landfill</li><li>• GEM 2000/GEM2000 Plus - Analizzatore gas e monitor di estrazione Landfill</li></ul>
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Geotechnical Instruments (UK) Ltd dichiara che gli elementi sopra descritti sono conformi ai seguenti standard:

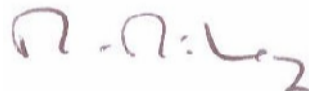
### Direttiva ATEX 94/9/EC

<b>Ente certificatore</b>	Assistenza certificazione SIRA
<b>Numero ente notificato</b>	0518
<b>Indirizzo</b>	Rake Lane, Eccleston, Chester, CH4 9JN, Regno Unito
<b>Numero certificato</b>	Sira 06ATEX2202X
<b>Standard applicati</b>	EN50014:1997 + Amds 1 e 2 EN50020:2002 EN50018:2000 + Amds 1

### Direttiva EMC 89/336/EEC

EN 61000-6-4:2001  
EN 61000-4-3:2006  
EN 61000-4-2:1995  
EN 61000-4-6:1996  
ENV 50204:1996  
EN 50270:1999

Firmato



Dr. Roger Riley

## 13. Instructions for safe use – German language

### Anweisungen für den sicheren Gebrauch


#### 13.1 Anweisungen für Installationen in Gefahrenbereichen

(Referenz: Europäische ATEX-Richtlinie 94/9/EG, Anhang II, 1.0.6)

Die folgenden Anweisungen gelten für Geräte, die durch die Zertifikatsnummern Sira 06ATEX2202X abgedeckt sind:

- Das Gerät kann mit brennbaren Gasen und Dämpfen mit Gerätegruppe IIA und Temperaturklasse T1 verwendet werden
- Das Gerät ist nur zertifiziert für den Einsatz bei Umgebungstemperaturen im Bereich von 0 °C bis +40 °C und sollte außerhalb dieses Bereichs nicht eingesetzt werden
- Die Installation wird in Übereinstimmung mit dem anwendbaren Merkblatt durch entsprechend geschultes Personal vorgenommen
- Die Reparatur dieses Geräts wird in Übereinstimmung mit dem anwendbaren Merkblatt vorgenommen
- Der Hersteller legt die Materialien fest, die für den Schutztyp wichtig sind
- Wenn sich der Methan-Detektor GA2000, GA2000 Plus, GEM2000 oder GEM2000 Plus im Gefahrenbereich befindet, wird er extern nur über Anschluss A mit Geräten verbunden, die mit der Zertifikatsnummer Sira 06ATEX2202X versehen sind.
- Besteht die Wahrscheinlichkeit, dass das Gerät in Kontakt mit aggressiven Stoffen gelangt, z. B. saure Flüssigkeiten oder Gase, die Metalle angreifen können, oder Lösungen, die Polymerstoffe schädigen können, liegt es in der Verantwortung des Benutzers, geeignete Vorkehrungen zu treffen, z. B. regelmäßige Prüfungen als Bestandteil von Routineinspektionen oder Überprüfungen anhand des Materialdatenblatts, dass das Material gegenüber bestimmten Chemikalien beständig ist und nicht beeinträchtigt werden kann. So stellt er sicher, dass der Schutztyp erhalten bleibt.

**Der Gasanalysator GA2000/GA2000 Plus/GEM2000/GEM2000 Plus ist zertifiziert anhand der Klassifizierung für Gefahrenbereiche**

 **II2G EEx ibd IIA T1 (Ta = 0 °C bis +40 °C)**

Es ist unerlässlich, dass die Anweisungen in diesem Handbuch sorgfältig befolgt werden.

Es liegt in der Verantwortung des Bedieners, das Schutzkonzept und die für einen bestimmten Einsatzzweck erforderliche Klassifikation festzulegen.


#### 13.2 Sicherheitsrelevante Informationen in diesem Handbuch

Informationen in diesem Handbuch, die die Sicherheit von Benutzern und anderen Personen betreffen, sind durch folgendes Symbol gekennzeichnet:  **Warnung**.

Eine Nichtbeachtung dieser Information kann zu Personenschäden führen, in manchen Fällen auch mit Todesfolge.

# GEM2000/GEM2000 Plus Gas Analyser

## 13.3 Sicherheitsinformation

 <b>Warnung</b>	Der GA2000/GA2000 Plus/GEM2000/GEM2000Plus kann – wie in diesem Handbuch beschrieben – zur Messung der Gasentwicklung an Mülldeponien sowie an anderen Quellen eingesetzt werden. Das Einatmen dieser Gase kann gesundheitsschädlich und in manchen Fällen tödlich sein. Es liegt in der Verantwortung des Benutzers, dafür zu sorgen, dass er hinsichtlich der Sicherheitsaspekte der eingesetzten Gase angemessen geschult wird und dass geeignete Prozeduren eingehalten werden. Im Besonderen müssen dort, wo gesundheitsgefährdende Gase eingesetzt werden, die vom Analysator abgegebenen Gase mit Schläuchen in einen Bereich transportiert werden, wo sie sicher abgelassen werden können. Auch beim Spülen mit sauberer Luft können gesundheitsgefährdende Gase aus dem Instrument entweichen.
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## 13.4 Warn- und Fehleranzeige

Wenn während des Selbsttests Betriebsparameter außerhalb des spezifizierten Bereichs liegen oder das vorprogrammierte empfohlene Kalibrierungs-/Wartungsdatum vergangen ist, können Fehler- oder Warnmeldungen angezeigt werden. Es können immer nur drei Warn-/Fehlermeldungen gleichzeitig angezeigt werden. Um festzustellen, ob weitere Meldungen vorhanden sind, blättern Sie mit den Tasten „v“ und „^“ in der Liste nach oben und unten.

### Anzeige von Warnmeldungen


Allen angezeigten Warnmeldungen wird das Wort „WARNING“ vorangestellt, dem eine relevante Beschreibung folgt.

Der wahrscheinlichste Grund für die Fehlermeldungen ist entweder eine falsche Benutzerkalibrierung oder ein Sensordefekt. Falls eine falsche Benutzerkalibrierung die Warnmeldung verursacht hat, sollte sie dadurch behoben werden können, dass das Instrument je nach Notwendigkeit für die relevante Funktion auf die Werkseinstellungen zurückgesetzt oder genullt wird oder eine Benutzerkalibrierung durchgeführt wird.

### Anzeige von Fehlermeldungen

Allen angezeigten Fehlermeldungen wird das Wort „ERROR“ vorangestellt, dem ein Fehlercode folgt. Die während der Selbsttests erkannten Fehlermeldungen werden normalerweise dadurch verursacht, dass eine Benutzerkalibrierung außerhalb der Spezifikation liegt, oder durch eine Speicherbeschädigung. Dadurch wird die Funktion des Instruments beeinträchtigt, und der Fehler sollte vor Einsatz des Gerätes behoben werden, z. B. 01 – Benutzerkal.-daten, CH<sub>4</sub>-Wert außerhalb der Spezifikation, 02 – Benutzerkal.-daten, CO<sub>2</sub>-Wert außerhalb der Spezifikation, 04 – Benutzerkal.-daten, Wert von Zelle 1 außerhalb der Spezifikation.

## 13.5 Akku/Ladevorgang

 <b>Warnung</b>	Das Akkuladegerät ist NICHT Ex-zertifiziert. Der Akku darf nur in einem sicheren Bereich aufgeladen werden.
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Beim Akku handelt es sich um ein Nickel-Metallhydrid-Modell, in dem sechs Einzelzellen verkapselt sind. Ein vollständiger Ladevorgang sollte etwa zwei Stunden dauern.

## 13.6 Temperaturfühler

Der Temperaturfühler gehört zur Ex-Zertifizierung des Instruments und ist daher für den Einsatz unter denselben Bedingungen wie der Analysator zertifiziert.




## 13.7 Zubehör, das in einem explosionsgefährdeten Bereich nicht eingesetzt werden darf.

Das folgende Zubehör ist von der Ex-Einstufung des Instruments nicht abgedeckt und damit für den Einsatz in einem explosionsgefährdeten Bereich nicht zertifiziert.

Alle Gaskapseln  
Anemometer-Fühler  
Externer Durchsatzfühler


## 13.8 Kalibrierung

 <b>Warnung</b>	<p><b>Auslassöffnung</b></p> <p>Wenn der Gasanalysator kalibriert wird, gibt es für das Gas zwei Auftretsmöglichkeiten: der übliche Austritt über die Auslassöffnung des Analysators oder bei einer Überdrucksituation die 1/16"-Öffnung am Überdruckventil.</p> <p>Es wird empfohlen, an beiden Öffnungen Auslassschläuche anzubringen.</p> <p>Die Auslassschläuche müssen in einen gut gelüfteten Bereich geführt werden. Überprüfen Sie, dass es an Schläuchen und Verbindungen keine Undichtigkeiten gibt.</p> <p>Die Kalibrierung des Gasanalysators sollte in einem sicheren Bereich stattfinden, und beim Einsatz potenziell gefährlicher, explosiver oder giftiger Gase müssen alle notwendigen Sicherheitsvorkehrungen getroffen werden.</p> <p><i>Vor der Durchführung der Arbeiten muss für jedes eingesetzte Gas das entsprechende Materialdatenblatt gelesen und verstanden werden.</i></p>
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## 13.9 Wartung

Der Analysator sollte zur Wahrung des korrekten und präzisen Betriebs regelmäßig gewartet werden. Geotechnical Instruments empfiehlt alle sechs Monate eine Wartung und Neukalibrierung.

Der Analysator ist für den Einsatz in explosionsgefährdeten Bereichen ATEX-zertifiziert. Deshalb sollte er nur von entsprechend qualifizierten Technikern gewartet werden. Wird dies nicht beachtet, wird seine Garantie hinfällig und seine ATEX-Zertifizierung könnte ungültig werden.

 <b>Warnung</b>	<p>Wird der Analysator von nicht entsprechend qualifizierten Technikern gewartet, kann seine ATEX-Zertifizierung ungültig werden und das Instrument ist möglicherweise beim Einsatz in explosionsgefährdeten Bereichen unsicher.</p>
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### Teile, die vom Benutzer gewartet werden können

Das Instrument enthält keine Teile, die vom Benutzer gewartet werden können.

Die folgenden Teile können vom Benutzer gewartet werden

Zwischengeschalteter Wasserfilter	Er sollte regelmäßig auf Hindernisse oder Beschädigung überprüft und bei Bedarf ausgewechselt werden. Das Instrument sollte niemals ohne den zwischengeschalteten Wasserfilter betrieben werden, da andernfalls Wasser in das Instrument eintreten kann.
Partikelfilter	Der Partikelfilter befindet sich an der Unterseite des Instruments und ist

# GEM2000/GEM2000 Plus Gas Analyser

	durch Entfernen des Kunststoffstopfens zu erreichen. Der Filter sollte ersetzt werden, wenn er verschmutzt ist. Betreiben Sie das Instrument niemals ohne Partikelfilter. Achten Sie bei dem Wiedereinsetzen des Stopfens darauf, ihn nicht zu fest zu ziehen. Es reicht, wenn er handfest angezogen ist.
Messschläuche	Achten Sie immer darauf, dass Messschläuche nicht verschmutzt oder beschädigt sind.
QRC-Anschlüsse	Überprüfen Sie regelmäßig, dass die O-Ringe an den QRC-Gasanschlüssen nicht beschädigt sind. Ein beschädigter O-Ring kann Luft in das gemessene Gas eintreten lassen, was zu falschen Messwerten führt. Wenn der O-Ring beschädigt ist, sollte der gesamte QRC-Anschluss ausgewechselt werden.
H <sub>2</sub> S-Filtermaterial	Wenn sich die Farbe des Filtermaterials zu <i>hellgrau</i> ändert, sollte der Filter ersetzt werden.

## 13.10 EG-Konformitätserklärung

<b>Produkte</b>	<ul style="list-style-type: none"><li>• GA 2000/GA2000 Plus – Gasanalysator für Mülldeponien</li><li>• GEM 2000/GEM2000 Plus – Gasanalysator für Mülldeponien und Extraktionsüberwachungsgerät</li></ul>
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Geotechnical Instruments (UK) Ltd. erklärt, dass der/die oben genannten Artikel mit den folgenden Normen konform sind:

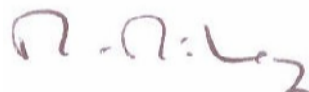
### ATEX-Richtlinie 94/9/EG

<b>Zertifizierungsbehörde</b>	SIRA Certification Service
<b>Nummer der Behörde</b>	0518
<b>Adresse</b>	Rake Lane, Eccleston, Chester, CH4 9JN, Großbritannien
<b>Zertifikatsnummer</b>	Sira 06ATEX2202X
<b>Angewandte Normen</b>	EN50014:1997 + Nachträge 1 und 2 EN50020:2002 EN50018:2000 + Nachtrag 1

### EMV-Richtlinie 89/336/EWG

EN 61000-6-4:2001  
EN 61000-4-3:2006  
EN 61000-4-2:1995  
EN 61000-4-6:1996  
ENV 50204:1996  
EN 50270:1999

Unterschrift:



Dr. Roger Riley

## 14. Instructions for safe use – French language

### Instructions pour une utilisation sûre

#### 14.1 Instructions spécifiques pour les installations dans des emplacements dangereux

(Référence Directive européenne ATEX 94/9/CE, Annexe II, 1.0.6.)

Les instructions suivantes s'appliquent au matériel couvert par le numéro de certificat Sira 06ATEX2202X :

- Le matériel est utilisable avec des gaz et des vapeurs inflammables avec des appareils de groupe IIA et classe de température T1
- Le matériel est certifié uniquement pour une utilisation à température ambiante entre 0 °C et +40 °C et ne doit pas être utilisé en-dehors de cette plage
- L'installation devra être effectuée conformément au code de pratique applicable et par un personnel qualifié
- Ce matériel devra être réparé conformément au code de pratique applicable
- Le fabricant devra spécifier les matériaux importants pour le type de protection
- Dans l'emplacement dangereux, le détecteur de méthane GA2000, GA2000 Plus, GEM2000, ou GEM2000 Plus ne devra être raccordé extérieurement par le raccord A qu'à des appareils portant la marque de numéro de certificat Sira 06ATEX2202X.
- Si le matériel est amené à être en contact avec des substances agressives, par exemple des liquides ou des gaz acides susceptibles d'attaquer les métaux, ou des solvants susceptibles d'affecter des polymères, il incombe alors à l'utilisateur de prendre des précautions appropriées, par exemple des contrôles réguliers dans le cadre d'inspections systématiques ou des vérifications sur la fiche technique de la résistance du matériel à des produits chimiques spécifiques, ceci afin de préserver l'intégrité de la protection.


**L'analyseur de gaz GA2000/GA2000 Plus/GEM2000/GEM2000 Plus a été certifié à la Classification Emplacement dangereux**

 **II2G EEx ibd IIA T1 (Ta = 0°C à +40°C)**

Il est absolument indispensable de respecter les instructions contenues dans le présent manuel.

Il incombe à l'opérateur de déterminer le type et la classification de protection requise pour une application spécifique.


#### 14.2 Informations en matière de sécurité contenues dans le présent manuel

Dans le présent manuel, les informations relatives à la sécurité des utilisateurs et autres personnes sont précédées par le symbole :  **Avertissement.**

Le non-respect de ces informations peut être à l'origine de blessures corporelles qui, dans certains cas, peuvent être mortelles.

# GEM2000/GEM2000 Plus Gas Analyser

## 14.3 Informations en matière de sécurité

 <b>Avertissement</b>	Le GA2000/GA2000 Plus/GEM2000/GEM2000Plus peut être utilisé pour mesurer les gaz émis par les sites d'enfouissement et autres sources, comme décrit dans le présent manuel. L'inhalation de ces gaz peut être dangereuse, voire mortelle dans certains cas. L'utilisateur doit veiller à avoir reçu une formation appropriée en matière de sécurité concernant les gaz utilisés et à observer les procédures appropriées. En particulier, dans le cas de présence de gaz dangereux, le gaz émis par l'analyseur doit être évacué vers un emplacement permettant une évacuation sûre. Il peut y avoir également évacuation de gaz dangereux lors de la purge de l'appareil avec de l'air propre.
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## 14.4 Affichage d'avertissements et d'erreurs

Pendant l'essai automatique, il peut y avoir affichage d'erreurs ou d'avertissements en cas de non-conformité des paramètres opérationnels ou de dépassement de la date de l'étalonnage/de l'entretien recommandée préprogrammée. Seulement trois avertissements/erreurs peuvent être affichés simultanément. Pour vérifier s'il y a eu d'autres avertissements/erreurs, utiliser la touche «  $\vee$  » et «  $\wedge$  » pour faire défiler la liste.

### Affichage d'avertissements


Tous les avertissements affichés seront précédés par le mot « AVERTISSEMENT [WARNING] » suivi d'un texte approprié.

Le plus souvent, les avertissements sont affichés en raison d'un étalonnage incorrect par l'utilisateur, ou d'une défaillance des capteurs. Un étalonnage incorrect peut être rectifié en remettant l'appareil sur les valeurs réglées en usine, en effectuant une remise à zéro ou l'étalonnage requis pour la fonction pertinente.

### Affichage d'erreurs

Toutes les erreurs affichées seront précédées par le mot « ERREUR [ERROR] » suivi d'un code d'erreur. En général, les erreurs détectées par l'essai automatique sont dues à un étalonnage non-conforme par l'utilisateur ou quelquefois à la corruption de la mémoire de l'appareil et affecteront le fonctionnement de l'appareil. Les erreurs affichées, par exemple 01-User cal data, CH<sub>4</sub> reading out of specification, 02-User cal data, CO<sub>2</sub> reading out of specification, 04-User cal data, Cell 1 reading out of specification. [01-Données cal. utilisateur, mesure CH<sub>4</sub> non conforme, 02-Données cal. utilisateur, mesure CO<sub>2</sub> non conforme, 04-Données cal. Utilisateur, Mesure Cellule 1 non-conforme] devront être rectifiées avant d'utiliser l'appareil.

## 14.5 Batterie/Mise en charge

 <b>Avertissement</b>	Le chargeur de la batterie n'est PAS couvert par la certification Ex. La batterie doit être chargée uniquement dans un emplacement sûr.
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La batterie est de type Nickel Métal Hydride à six cellules intégrées. La durée de charge complète est d'environ deux heures.

## 14.6 Sonde de mesure de température


La sonde de température est couverte par la certification Ex de l'appareil et est donc certifiée pour une utilisation dans les mêmes conditions que l'analyseur.

## 14.7 Accessoires non utilisables en atmosphères potentiellement explosives

Les accessoires suivants ne sont pas couverts par la certification Ex de l'appareil et ne sont donc pas certifiés pour une utilisation en atmosphères potentiellement explosives.

Sondes de gaz  
 Sonde d'anémomètre  
 Sonde de débit


## 14.8 Etalonnage

 <b>Avertissement</b>	<p><b>Orifice d'évacuation</b></p> <p>Lors de l'étalonnage de l'analyseur de gaz, le gaz peut être évacué par deux orifices d'évacuation, à savoir par l'orifice d'évacuation de l'analyseur, ou, en cas de surpression, par l'orifice 1/16" sur la soupape de surpression.</p> <p>Il est recommandé de raccorder des tuyaux d'évacuation aux deux orifices.</p> <p>Le tuyau d'évacuation doit sortir dans un emplacement bien ventilé. Contrôler l'étanchéité des tuyaux et des raccords.</p> <p>L'étalonnage de l'analyseur de gaz doit être effectué dans un emplacement sûr, en observant toutes les précautions nécessaires en présence de gaz potentiellement dangereux, explosifs ou toxiques.</p> <p><i>Pour chaque gaz utilisé, lire attentivement la fiche technique appropriée avant d'exécuter la tâche.</i></p>
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## 14.9 Entretien

Pour un fonctionnement correct et précis, l'analyseur de gaz doit faire l'objet d'un entretien régulier. Geotechnical Instruments recommande un entretien et un réétalonnage tous les 6 mois.

L'analyseur est certifié ATEX pour une utilisation en atmosphères potentiellement explosives. A ce titre, son entretien doit être effectué uniquement par des techniciens qualifiés. Le non-respect de cette prescription entraînera l'annulation de la garantie et risque d'annuler la certification ATEX.

 <b>Avertissement</b>	<p>Si l'analyseur fait l'objet d'un entretien par des techniciens non qualifiés la certification ATEX risque d'être annulée et l'appareil peut ne pas être sûr en cas d'utilisation en atmosphères potentiellement explosives.</p>
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### Composants pouvant faire l'objet d'un entretien par l'utilisateur

L'appareil ne contient aucun composant interne pouvant faire l'objet d'un entretien par l'utilisateur.

Les composants suivants peuvent faire l'objet d'un entretien par l'utilisateur

Filtre à eau en ligne	Contrôler ce filtre régulièrement pour rechercher la présence d'obstructions ou de dommages; remplacer si besoin est. L'appareil ne doit jamais être utilisé sans le filtre à eau en ligne pour prévenir la pénétration d'eau dans l'appareil.
Filtre à particules	Le filtre à particules est situé sur la face inférieure de l'appareil ; ôter l'obturateur en plastique pour y accéder. Remplacer tout filtre contaminé. Ne jamais utiliser l'appareil sans le filtre. Veiller à ne pas trop serrer l'obturateur – un serrage à main est suffisant.
Tuyau d'échantillonnage	Toujours s'assurer que les tuyaux d'échantillonnage ne sont ni contaminés ni abîmés.
Raccords rapides	Contrôler périodiquement l'état des joints toriques des raccords de gaz rapides. Un joint torique défectueux peut entraîner la pénétration d'air dans l'échantillon de gaz et des lectures incorrectes. Remplacer le raccord complet si le joint torique est défectueux.

# GEM2000/GEM2000 Plus Gas Analyser

Matériau du filtre H <sub>2</sub> S	Remplacer le filtre lorsque la couleur du matériau du filtre devient <i>gris clair</i> .
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## 14.10 Déclaration de conformité CE

<b>Produits</b>	<ul style="list-style-type: none"><li>GA 2000/GA2000 Plus – Analyseur de gaz de sites d'enfouissement</li><li>GEM 2000/GEM2000 Plus – Analyseur de gaz de sites d'enfouissement et moniteur d'extraction</li></ul>
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Geotechnical Instruments (UK) Ltd déclare que l'(es) article(s) décrit(s) ci-dessus est (sont) conforme(s) aux normes suivantes :

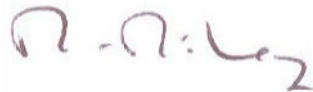
### Directive ATEX 94/9/CE

<b>Organisme de certification</b>	SIRA Certification Service [ <i>Service de certification SIRA</i> ]
<b>Numéro d'organisme notifié</b>	0518
<b>Adresse</b>	Rake Lane, Eccleston, Chester, CH4 9JN
<b>Numéro de certificat</b>	Sira 06ATEX2202X
<b>Normes appliquées</b>	EN50014:1997 + Amds 1 et 2 EN50020:2002 EN50018:2000 + Amds 1

### Directive CEM 89/336/CEE

EN 61000-6-4:2001  
EN 61000-4-3:2006  
EN 61000-4-2:1995  
EN 61000-4-6:1996  
ENV 50204:1996  
EN 50270:1999

Signature :



Dr. Roger Riley

## 15. Instructions for safe use – Spanish language

### Instrucciones para la utilización segura

#### 15.1 Instrucciones Específicas para Instalaciones en Áreas de Peligro

(Directiva Europea de Referencia ATEX 94/9/EC, Anexo II, 1.0.6.)

Las siguientes instrucciones son aplicables para los equipos cubiertos por los certificados Sira N° 06ATEX2202X:

- El equipo puede utilizarse con vapores y gases inflamables con aparatos del grupo IIA y temperatura clase T1
- El equipo sólo está certificado para utilizarlo a temperatura ambiental entre 0°C y +40°C y no debe utilizarse fuera de estos rangos.
- La instalación debe ser efectuada de acuerdo con el código de práctica aplicable y por personal debidamente formado.
- La reparación de este equipo debe ser efectuada de acuerdo con el código de práctica aplicable.
- El fabricante deberá especificar los materiales que son importantes para el tipo de protección.
- Cuando los detectores de metano GA2000, GA2000 Plus, GEM2000, o GEM2000 Plus estén en el área de peligro, sólo se podrán conectar externamente mediante el conector A a dispositivos marcados con el certificado Sira N° 06ATEX2202X.
- Si existe la posibilidad de que el equipo entre en contacto con sustancias agresivas como por ejemplo gases o líquidos ácidos que puedan atacar a los metales, o disolventes que puedan afectar a los materiales poliméricos, será responsabilidad del usuario tomar las medidas adecuadas, es decir, comprobaciones regulares como parte de las inspecciones de rutina o determinando a partir de las hojas de datos de los materiales, o la resistencia a los productos químicos específicos para asegurar que el tipo de protección no se vea adversamente afectada.


**El Analizador de Gas GA2000/GA2000 Plus/GEM2000/GEM2000 Plus ha sido certificado de acuerdo a la Clasificación de Área de Peligro**

 **II2G EEx ibd IIA T1 (Ta = 0°C a +40°C)**

Es de vital importancia cumplir con las instrucciones de este manual.

Es responsabilidad del operario determinar el concepto de protección y la clasificación necesaria para una aplicación determinada.


#### 15.2 Información relacionada con la seguridad en este manual.

En este manual, la información que puede afectar a la seguridad de los usuarios y terceros está precedida por el siguiente símbolo:  **Advertencia**.

El incumplimiento de esta información podría provocar lesiones físicas que en algunos casos, podrían resultar fatales.

# GEM2000/GEM2000 Plus Gas Analyser

## 15.3 Información de seguridad

 <b>Advertencia</b>	Los GA2000/GA2000 Plus/GEM2000/GEM2000Plus pueden utilizarse para medir gases en vertederos y otras fuentes, como se describe en este manual. La inhalación de estos gases puede ser nociva para la salud y en algunos casos puede resultar fatal. Es responsabilidad del usuario asegurar que él/ella esté debidamente formado/a en los aspectos de seguridad de los gases utilizados y de tomar las medidas correspondientes. En particular, al utilizar gases peligrosos, el gas expulsado del analizador debe ser canalizado hacia un área donde la descarga sea segura. El gas peligroso también puede ser expulsado del instrumento al purgar con aire limpio.
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## 15.4 Advertencia y visualización de error

Durante la prueba automática, si los parámetros operativos se encuentran fuera de lo especificado o si se ha superado la fecha de revisión/calibración preprogramada recomendada, se pueden visualizar errores o advertencias. Hay tres errores/advertencias que pueden visualizarse en cualquier momento. Para asegurarse de que no se han producido más, utilice las teclas 'v' y '^' para desplazarse hacia arriba/abajo de la lista.

### Advertencias visualizadas


Todas las advertencias visualizadas irán precedidas por la palabra 'ADVERTENCIA' y seguidas por la descripción correspondiente.

La razón más probable de los errores es la calibración de usuario incorrecta o el fallo del sensor. Si la calibración de usuario es incorrecta y ha provocado la advertencia, debe corregirse corrigiendo el instrumento a los ajustes de fábrica, poniéndolo a cero o efectuando una calibración de usuario adecuada para la función correspondiente.

### Errores visualizados

Todos los errores visualizados irán precedidos por la palabra 'ERROR' y seguidos por un código de error. Normalmente, los errores detectados por la prueba automática son provocados porque la calibración del usuario es distinta a la especificada o por una posible corrupción de la memoria que afectará al funcionamiento del instrumento y por lo tanto, debe corregirse antes de utilizarlo. Por ejemplo: 01- User datos de cal, CH<sub>4</sub> lectura fuera de lo especificado, 02- User datos de cal, CO<sub>2</sub> lectura fuera de lo especificado, 04- User datos de cal, Cel 1 lectura fuera de lo especificado.

## 15.5 Batería/Carga

 <b>Advertencia</b>	El cargador de batería NO está cubierto por el certificado Ex. La batería sólo debe cargarse en un área segura.
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La batería es de Hidruro de Níquel-Metal y está fabricada como un paquete encapsulado de seis celdas individuales. Una carga completa debería tardar aproximadamente dos horas.

## 15.6 Lectura de la sonda de temperatura

La sonda de temperatura forma parte de la certificación Ex del instrumento y por lo tanto, está certificada para la utilización en las mismas condiciones que el analizador.

## 15.7 Accesorios que no pueden utilizarse en una atmósfera potencialmente explosiva

Los siguientes accesorios no están cubiertos por la clasificación Ex del instrumento y no están certificados para utilizarse en una atmósfera potencialmente explosiva.


Todos los gas pods



# GEM2000 / GEM2000 Plus Gas Analyser

Sonda del anemómetro  
Pod de flujo externo


## 15.8 Calibración

 <b>Advertencia</b>	<b>Terminal de escape</b> <p>Cuando se está calibrando el analizador de gas, hay dos posibles salidas del gas: mediante la forma usual por el terminal de escape del analizador o en los casos de sobrepresión, a través del terminal de 1/16" de la válvula de seguridad.</p> <p>Es recomendable que en ambos terminales se monten tubos de escape.</p> <p>Los tubos de escape deben emerger hacia un área bien ventilada. Asegúrese de que no hay fugas en los tubos o conexiones.</p> <p>La calibración del analizador de gas debe efectuarse en una zona segura tomando todas las precauciones necesarias cuando se utilizan gases tóxicos, explosivos o potencialmente peligrosos.</p> <p><i>Para cada gas utilizado, deben leerse y comprenderse las hojas de datos del material correspondiente antes de proceder.</i></p>
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## 15.9 Revisión

El analizador debe ser regularmente revisado para asegurar el funcionamiento correcto y preciso. Geotechnical Instruments recomienda una revisión y recalibración cada 6 meses.

El analizador cuenta con un certificado ATEX para su utilización en áreas potencialmente explosivas. Como tal, sólo debe ser revisado por técnicos cualificados. El incumplimiento de esta norma anulará la garantía y podría invalidar la certificación ATEX.

 <b>Advertencia</b>	Si el analizador es revisado por técnicos no cualificados, la certificación ATEX podría quedar invalidada y el instrumento podría no ser seguro para su utilización en una atmósfera potencialmente explosiva.
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### Piezas utilizables por el usuario

No hay piezas utilizables por el usuario dentro del instrumento.

Las siguientes piezas pueden ser revisadas por el usuario

Filtro de agua en línea	Debería comprobarse regularmente que el filtro no presente obstrucciones ni esté dañado y cambiarlo cuando sea necesario. El instrumento no debe utilizarse nunca sin el filtro de agua en línea ya que podría entrar agua en el instrumento.
Filtro de partículas	El filtro de partículas está situado en la parte inferior del instrumento y se accede quitando el tapón de plástico. El filtro debe cambiarse cuando está contaminado. Nunca debe utilizarse el instrumento sin el filtro de partículas. Al volver a poner el tapón asegúrese de no apretarlo demasiado, el apriete con los dedos es suficiente.
Tubos para muestras	Asegúrese de que los tubos para muestras no estén contaminados ni dañados.
Conectores QRC	Compruebe periódicamente que las juntas tóricas de los conectores de gas QRC no estén dañadas. Una junta tórica dañada puede permitir la entrada de aire al gas de muestra y provocaría lecturas incorrectas. Si la junta tórica está dañada, debe cambiarse el conector QRC completo.

# GEM2000/GEM2000 Plus Gas Analyser

Material del filtro H <sub>2</sub> S	Cuando el material del filtro cambia de color y pasa a <i>gris claro</i> , el filtro debe cambiarse.
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## 15.10 Declaración de Conformidad CE

<b>Productos</b>	<ul style="list-style-type: none"><li>GA 2000/GA2000 Plus – Analizador de gas para vertederos</li><li>GEM 2000/GEM2000 Plus - Analizador de gas para vertederos y Monitor de Extracción</li></ul>
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Geotechnical Instruments (UK) Ltd declara que los elementos arriba descritos cumplen con las siguientes normas:

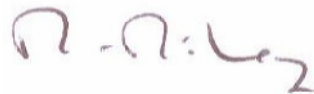
### Directiva ATEX 94/9/EC

<b>Organismo de Certificación</b>	Servicio de Certificación SIRA
<b>Nº del Organismo Notificado</b>	0518
<b>Dirección</b>	Rake Lane, Eccleston, Chester, CH4 9JN
<b>Nº de Certificado</b>	Sira 06ATEX2202X
<b>Normas aplicadas</b>	EN50014:1997 + Enmiendas 1 y 2 EN50020:2002 EN50018:2000 + Enmienda 1

### Directiva EMC 89/336/EEC

EN 61000-6-4:2001  
EN 61000-4-3:2006  
EN 61000-4-2:1995  
EN 61000-4-6:1996  
ENV 50204:1996  
EN 50270:1999

Firmado:



Dr. Roger Riley