GEM5000 Gas Analyzer

Operating Manual

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GEM5000 Gas Analyzer

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1.0   Manual guidelines

1.1 Hazard warnings and safety symbols

⚠ Warning	Information in this manual that may affect the safety of users and others is preceded by the warning symbol. Caution - Failure to follow the correct information may result in physical injury which in some cases could be fatal. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

General product label symbols are listed as follows:

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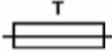
1.2 Notes

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

✍ Note: For further information please contact Technical Support at (800) 968-2026 or email landtec_support@qedenv.com

2.0   Introduction

This manual explains how to use the GEM5000 landfill gas analyzer. The GEM5000 has additional functionality to the GA5000 gas analyzer. The GA5000 measures gas concentrations only, whereas the GEM5000 measures flow and gas concentrations. The GEM5000 measures flow and calculates the calorific values of the gas as well as being a useful tool for balancing the gas field. The GEM5000 gas analyzer may be used to monitor, calculate, adjust and record the flow at each monitoring point.

This instrument may also be used in GA5000 mode of operation if required. The operator may change the analyzer between a gas extraction monitor (a GEM5000 gas analyzer) or a landfill gas analyzer (a GA5000 gas analyzer). The mode of operation can be changed from the 'Special Action' menu. Please refer to section '8.0 – Taking Readings' for further instruction.

The 5000 series of gas analyzers complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1)   This device may not cause harmful interference.

2)   This device must accept any interference received, including interference that may cause undesired operation.

2.1 Safety instructions

⚠ **Warning**	The 5000 series of gas analyzers can be used for measuring gases from landfill sites and other sources as described in this manual.
	The operator may be exposed to harmful gases during the use of the instrument. 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 analyzer 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.
	The instrument has been designed to be used in explosive atmospheres as defined by the classification. The instrument can be configured to measure low levels of several gases, but may not be certified for use in potentially explosive atmospheres of these gases. It is the responsibility of the operator to determine the protection concept and classification of equipment required for a particular application and whether these gases create a potentially explosive atmosphere.

✎ Note: Gas analyzers are a sensitive piece of scientific equipment, and should be treated as such. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired.

2.2 Instructions for safe use

For ATEX and IECEx the 5000 series of gas analysers are certified to Hazardous Area Classification

 II 2G   Ex ib IIA T1 Gb (Ta = -10ºC to +50ºC)

It is vital instructions are followed closely. It is the responsibility of the operator to determine the protection concept and classification required for a particular application.

(Reference European ATEX directive 2014/34/EU)
The following instructions apply to equipment covered by certificate numbers SIRA 11ATEX2197X and IECEx SIR 11.0089X:

- The equipment may be used with flammable gases and vapours with apparatus group IIA and temperature class T1.

- The equipment can contain gas sensing heads for the detection of particular gases. The inclusion of a sensor does not infer that the equipment is suitable for the use of gases with a temperature class of less than T1.

- The equipment is only certified for use in ambient temperatures in the range -10°C to +50°C and should not be used outside this range.

- The equipment must not be used in an atmosphere of greater than 21% oxygen.

- Repair of this equipment shall be carried out in accordance with the applicable code of practice.

- When used in a hazardous area only use GF5.2 temperature probe (SIRA 11ATEX2197X and IECEx SIR11.0089X). For connector C, the GF5.4 anemometer (BVS 04ATEXE194) for use with ATEX only. The analyser should not be connected to any other devices in the hazardous area including the GF-USB lead (connector A) or GF3.9 battery charger (connector B) supplied with the analyzer.
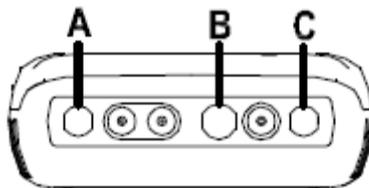
Do not charge, recharge or open in a potentially explosive atmosphere.
In hazardous area only use "Temperature Probe GF5.2" in Connector B.
Connector C (Uo=10V,Io=5mA,Po=50mW,Ci=0,Li=0,Co=100uF,Lo=1000mH),
Connector B (Uo=5V,Io=6mA,Po=7mW,Ci=0,Li=0,Co=100uF,Lo=1000mH)

MAXIMUM NON-HAZARDOUS SUPPLIES:
Connector A - Um=6V   Connector B - Um=10.1V

- The safe area apparatus that is to be connected to the USB Port shall be a Safety Extra Low Voltage (SELV) or Protective Extra Low Voltage (PELV) circuit.

- Only a Geotechnical Instrument battery pack part number 20087 or 2011113 is permitted as a replacement. This battery pack is not field replaceable and shall only be changed in a safe area by QED personnel.

- Only Battery Charger type GF3.9 shall be used to recharge the batteries via Connector 'B'.

- 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 relative pressure range is +/-500 mbar. Note, however, that the input pressure should not exceed +/- 500 mbar relative to atmospheric pressure and the output pressure should not exceed +/- 100 mbar relative to atmospheric pressure.

For CSA (Canada) the 5000 series of gas analysers are certified to Hazardous Area Classification

CLASS 2258 03 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe and Non-Incendive Systems - For Hazardous Locations

Ex ib IIA:

Model GA 5000, GEM 5000 and BIOGAS 5000 Methane Detectors; portable, battery powered with non-field-replaceable Battery Pack P/N 20087 or 2011113; intrinsically safe and providing intrinsically safe circuits **("[ib]" for Zone 1)** to Model GF5.2 Temperature Probe (Connector B) and with entity output parameters as tabulated below; Temperature Code T1; -10 °C ≤ Tamb. ≤ +50°C.

Connector	Entity Parameters						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5.0	6	7	100	1000	0	0
C	10.0	5	50	100	1000	0	0

✎ Note: This device has been investigated for electrical safety features only.

For CSA (USA) the 5000 series of gas analysers are certified to Hazardous Area Classification

CLASS 2258 83 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe and Non-Incendive Systems – For Hazardous Locations - CERTIFIED TO U.S. STANDARDS

AEx ib IIA:

Model GA 5000, GEM 5000 and BIOGAS 5000 Methane Detectors; portable, battery powered with non-field-replaceable Battery Pack P/N 20087 or 2011113; intrinsically safe and providing intrinsically safe circuits **("[ib]" for Zone 1)** to Model GF5.2 Temperature Probe (Connector B) and with entity output parameters as tabulated below; Temperature Code T1; -10 °C ≤ Tamb. ≤ +50°C.

Connector	Entity Parameters						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5.0	6	7	100	1000	0	0
C	10.0	5	50	100	1000	0	0

✎ Note: This device has been investigated for electrical safety features only.

2.3 MCERTS

MCERTS is the UK Environment Agency's Monitoring Certification Scheme. The scheme provides a framework within which environmental measurements can be made in accordance with the Agency's quality requirements. The scheme covers a range of monitoring, sampling and inspection activities.

MCERTS promotes public confidence in monitoring data and provides industry with a proven framework for choosing monitoring systems and services that meet the Environment Agency's performance requirements.

The Environment Agency has established its Monitoring Certification Scheme (MCERTS) to deliver quality environmental measurements. The MCERTS product certification scheme provides for the certification of products according to Environment Agency performance standards, based on relevant CEN, ISO and national standards.

MCERTS certified instruments have been tested by an independent body to ensure that they meet certain performance requirements. In addition the manufacturer of an MCERTS product is regularly audited to ensure that the performance requirements of the certification are being continually met.

The 5000 series of gas analyzers have been certified to Version 3.1 of the 'Performance Standards for Portable Emission Monitoring Systems'.

2.4 CIRIA

The CIRIA guideline 'Assessing the risks posed by hazardous ground gases to buildings' proposes that gas concentrations and flow rates should be monitored.

As an example methodology, they suggest using a gas analyser to first measure flow and pressure and then afterwards to measure gas concentration.

The logging profile option offers frequency of data to be collected within a timed period which, in return, identifies a gas profile of the sample point being monitored, information about whether the sample point is performing correctly, when the peaks occur and whether air is drawn in after a certain period. This logging option is available on firmware software version 1.6.5
Versions of the GA5000 analyzer range with internal flow on firmware version 1.6.5 and above have the ability to take measurements according to the CIRIA guidelines, while still allowing other users to take the measurements as before.

GEM5000 Gas Analyzer

3.0 The GEM5000 Gas Analyzer

3.1 The GEM5000

The GEM5000 gas analyzer is designed to monitor landfill gas extraction systems.

Benefits:

- Allows balancing of gas extraction site.
- Maximize power generation from site.
- Field proven.
- Standardizes monitoring routines.
- Easy transfer of data.
- GPS for compliance.

Features:

- ATEX certified.
- MCERTS certified.
- H_2 compensated CO.
- Calculates flow (m^3/hr) and calorific value (kW or BTU).
- Technician log-in.
- Event log.
- Two instruments in one (GA and GEM mode).
- Measures static and differential pressure.
- Simultaneous display of gases.
- Storage of changes in set-up of gas field.
- Data logging.

Applications:

- Gas extraction fields.
- Flare monitoring.
- Landfill sites.

3.2 GEM5000 standard product

Reference:

A   Hard carry case

B   In-line water trap tubing & filter

C   Gas analyser instrument

D   H2S filter (optional – if the compensated CO cell is fitted)

E   5000 series safety manual

F   Mains battery charger and adaptors:
- UK
- Europe
- US
- Australia

4.0   GEM5000 Optional Products and Accessories

4.1 Optional products

The GEM5000 gas analyzer has a number of optional products for purchase which enhance the usability and enable further analysis of data and reading information.

? Note: For more information on the features listed in this section please contact Sales at (800) 624-2026 or email info@qedenv.com

4.1.1   Pitot tube (optional)

The GEM5000 gas analyzer enables the use of a pitot tube to aid accurate flow measurement. The pitot tube is used for gas extraction systems and the pressure readings are taken in mbar. High gas flow is calculated in the analyzer in m^3/hr (metres cubed per hour).

4.1.2   Orifice plate (optional)

QED recommends the use of orifice plates as good practice when using the GEM5000 gas analyzer, enabling repeatability in flow measurement via a fixed method. Contact Sales at (800) 624-2026 or email info@qedenv.com if the use of Orifice plates is required.

4.1.3   Temperature probe (optional)

The GEM5000 gas analyzer has the facility to automatically display and record the borehole temperature via an optional temperature probe.

When a temperature probe is fitted the temperature reading will be displayed on the **'Main Gas Read Screen' and recorded with all other data.**

? Note: Temperature probes with an Ex label are part of the GEM5000 Ex certification SIRA 11ATEX2197X and IECEx SIR11.0089X, and therefore certified for use under the same conditions as the analyzer.

4.1.4   Anemometer (optional)

The GEM5000 gas analyzer has the facility to automatically display and record high flow via an optional anemometer probe. It is designed to plug into the instrument and instantly provide a flow indication. An anemometer probe adds flow measurements to the professional reporting ability of the GEM5000 range along with gas concentrations, pressure and temperature.

The anemometer has a simple connection, a narrow diameter measurement head (11mm), a wide temperature operating range (up to 80°C) and indicates flows up to 40 m/sec.

When an anemometer probe is fitted to the analyzer the flow will be displayed in the **'Main Gas Read Screen' and recorded with all o**ther data.

Flow can be measured in either m/s (gas velocity) or m^3/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 Landtec Systems Gas Analyser Manager, (LSGAM), software.

? Note: The anemometer probe is ATEX certified for use in a potentially explosive atmosphere under Ex certificate BVS 04ATEXE194.

4.1.5 H₂S filter (optional)

The GEM5000 gas analyzer has the capability to use an H_2S filter and is required as standard if the compensated CO cell is fitted and configured at the time the instrument is manufactured. H_2S gas can have a cross-gas effect on the CO reading. By using a filter, the H_2S is removed from the gas sample, therefore providing a more accurate CO reading.

The filter only needs to be used when you are trying to get rid of any possible cross gas effects H_2S might have on other gases. Do not use the filter on all boreholes.

4.1.6 Landtec Systems Gas Analyzer Manager – LSGAM

Landtec Systems Gas Analyzer Manager (LSGAM) enables the operator to maximize the operation of the gas analyzer. It enables direct communication with the unit, features a simple upload and download **facility and is fully compatible with the latest Microsoft™** operating systems.

Features:

- Organization and transfer of borehole IDs and readings to and from the gas analyzer.
- Configuration of the gas analyzer.
- Flexible grouping of the IDs.
- Structured organization of transferred data.
- Automatic detection of instrument type and available options.
- Secure data mode to prevent tampering.
- First time set-up wizard.
- Enable flow measurements for GEM5000 gas analyzers.

4.1.7 GPS (optional)

An optional GPS feature is available for the GEM5000 gas analyzer. It enables the site engineer to automatically locate borehole IDs using GPS satellite signal from predefined borehole IDs uploaded from LSGAM or set on the analyzer when out in the field prior to taking a reading. The GPS reading data is stored for each measurement reading providing an audit trail confirming that a reading was taken.

4.1.8 Bluetooth

The analyzers are fitted with a Bluetooth receiver which enables the operator to download readings and upload IDs without the need to connect the analyzer to a PC via a USB cable.

5.0   GEM5000 Instrument Features

5.1 Physical characteristics of the instrument panel

Front view:

Reference:

A   Main Gas Read Screen

B   Soft-keys

C   Backlight Key

D   Menu Key

E   Pump key

F   LED Light

G   On/Off Key

H   Assistance key

I   Enter Key

J   Scroll up key

K   Scroll down key

L   Key 0 – Space key

Back view:

Reference:

M   Model Number

N   Serial number

O   Part number

P   Certificate number

Q   Recalibrated date

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5.2 Analyzer features and keys

A	Main Gas Read Screen	Start and end screen when using the instrument.
B	Soft-keys	**The function of the three 'soft-keys' on the front of** the instrument panel is determined by menu options taken. Functions vary from screen to screen.
C	Backlight key	Enables the operator to turn the backlight on/off on the analyzer display panel.
D	Menu key	**Press the 'Menu' key to view and maintain User,** Device and Operation settings.
E	Pump key	**Press the 'Pump' key to start or stop the pump.**
F	LED light	LED power light is visible on the front of the analyzer when the instrument is powered on.
G	On/Off key	**Press the 'On/Off' key for 2 seconds to switch** the instrument on and off.
H	Assistance key	Press for on-screen assistance and help.
I	Enter key	Use to accept changes, options, user inputted answers etc.
J	Key 2 – Page Up	**Also 'Key 2'. Press scroll up to view further** information on the instrument screen.
K	Key 8 – Page down	**Also 'Key 8'. Enables the operator to scroll down** to display more information.
L	Key 0 – Space key	**Also 'Key 0'. Press to enter a space when entering** text on the instrument screen.
M	Model Number	Instrument model type identification.
N	Serial Number	Unique identification for the instrument. Verification of the serial number will be required if Technical Support assistance is needed.
O	Part Number	**Manufacturer's part number.**
P	Certification Number	Displays instrument certification information.
Q	Recalibrated Date	The date displayed is the date the instrument is due to be calibrated.

5.3 Instrument connection points

Top view:
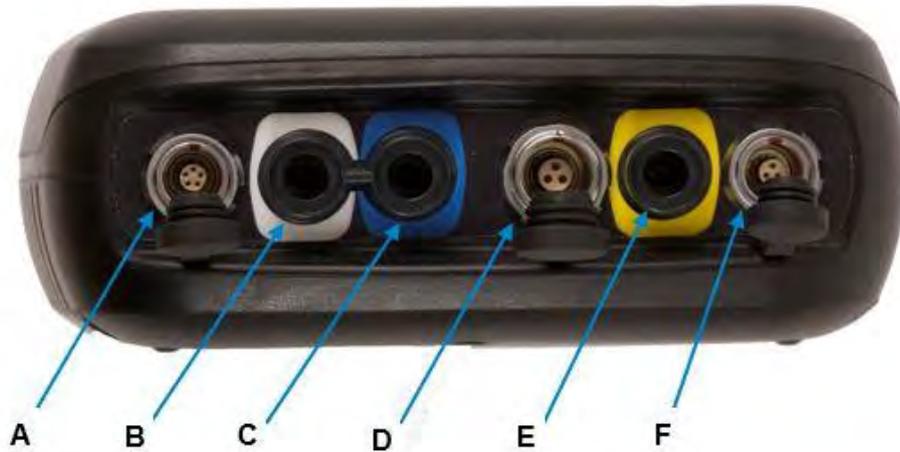
Ref:	Connection Point:	Function:
A	Connector A	Attach the USB cable for PC-to-analyzer connectivity.
B	Inlet Port & Static Pressure Port (White port)	Attach the sample tube to take a gas sample. Also used to measure the static pressure.
C	Differential Pressure Port (Blue port)	Attach the sample tube to measure differential pressure.
D	Connector B	Attach the temperature probe and also used to attach the mains charger to the analyzer for charging.
E	Gas Outlet Port (Yellow port)	The gas outlet port is the point at which the sample gas is expelled. Tubing may also be attached to the port.
F	Connector C	Attach the anemometer.

GEM5000 Gas Analyzer

6.0   General Operational Instructions

6.1   Switching the instrument on

1) To switch on the analyzer, press and hold the 'On/Off' key. The Landtec logo will display followed by the instrument warm up.

2) Following the instrument warm up, the 'Date and Time' screen is displayed prompting the technician to set the date and time and required format.

3) When complete, select the soft-key to 'Exit' and the 'Power On Self-test' screen is displayed followed by instrument status. Instrument status displays the instruments service due date, serial number, options, service scheme and software version. Text will also display stating 'Self-test complete'.

4) Select the soft-key 'Next' to move onto the next screen and the 'Technician Login' screen is displayed.

5) Use the cursor keys to move through the list of ID's. Select either the required 'Technician ID' from the list followed by the soft-key 'Accept', or select 'Default'' followed by the soft-key 'Accept' to continue to the 'Main Gas Read Screen'.

   ✍ Note: The selected technician ID is displayed at the top left corner of the Main Gas Read Screen.

6.1.1 Power on self-test

When switched on, the read-out will perform a pre-determined self-test sequence. During this time many of the analyzer's functions are tested, including:

- General operation
- Gas flow measurement
- Calibration
- Battery charge level

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

- Manufacturer's service due date
- The last gas check date
- Software version programmed
- Date format
- Serial number
- Operating language
- The currently enabled sales option

   ✍ Note: The self-test should only be done with the analyzer sampling fresh air.

6.2 Switching the instrument off

1) To switch off the analyzer, press and hold the 'On/Off' key, at which point a clean air purge will be carried out and the instrument will then switch off.

2) If for any reason the analyzer 'locks up' and will not switch off in this manner, press and hold the 'On/Off' key for 15 seconds; this will force the instrument to switch off.

6.3 Instrument status icons

The following icons may be displayed on the instrument screen:

Icon	Description	Icon	Description
	Battery charge state Gives the operator an estimation of the battery charge state. For example 100% gives about 8 hours use in the field and 50% would mean that there is approximately 4 hours battery life remaining.		**Battery charge state** Indicates less than 2 hours of charge remaining.
	Pump status This icon is displayed along with a counter showing the pump run-time. This counts down where the operator has specified the pump run-time; if not it counts up; the icon turns red when stalled.		**Pump stalled** This icon is displayed when the pump stalls. The instrument's gas inlet (or outlet) may be blocked. This warning is most commonly caused by a water-logged or dirty sample filter. Change the sample filter and check for obvious blockages in the sample tubes. Alternatively, a small amount of adjustment can be made to the low flow detection point to compensate for minor changes in the performance of the pump fitted to the instrument.
	GPS signal strength This icon shows the signal strength the analyzer's GPS module is able to provide. Full, okay and fair strength respectively.		**GPS failure** The GPS was unable to get a line of sight lock on enough satellites. Or, it may be that it hasn't had time to get a lock.
	This indicates when Bluetooth has been enabled. The color changes from gray to blue when connected.		**Language** This icon indicates the currently selected operating language. This can be changed via the main menu.
	Data logging This icon indicates that the data logging feature is in operation.		**Service overdue** This icon indicates that the analyzer is overdue for service
	Legacy mode This icon indicates that the analyzer is in legacy mode and hence is ready to connect to a PC.		**USB disabled** This icon indicates that the analyzer has reached a battery critical state, and hence has turned off its USB connectivity.

6.4 Instrument LED power states

When the instrument is powered on a LED power light is visible on the front of the analyzer, located above the 'On/Off' key. The following LED power light states are as follows:

Steady yellow	Unit turning on. This will extinguish when software has loaded correctly.
Flashing (rapid)	Unit is powering off.
Flashing (slow)	Power off is being delayed for purge/shutdown handling.
Flashing yellow	Unit is turning off due to power button being pressed.
Flashing red	Unit is turning off due to critically low battery.

✎ Note: Pressing and holding the power button for ~20s resets the analyser.

6.5 Changing between parameters

By default, the instrument displays the 'Main Gas Read Screen' (for gas measurement). The instrument will return to this screen after power on or when returning from the menus. The 'Scroll' keys can be used to switch to another measurement screen.

6.6 Entering data

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

When entering data into the instrument all fields are fixed format and are populated from the left.

Text:

Entering text uses similar multi-tap functionality as a mobile phone. Key the numeric/alpha key pad the required number of times to select the appropriate letter. To key numeric data continue to press the numeric/alpha key until the required number is displayed.

Numeric data:

To enter a new date 09/15/116 the operator would type in 091516 using the numeric keypad in the following sequence: -

```
* 0_/__/__
* 09/__/__
* 09/1_/__
* 09/15/__
* 09/15/1_
* 09/15/16
```

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

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

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

6.7 Instrument main gas read screen

The 'Main Gas Read Screen' is considered to be the normal operating screen and all operations are carried out from this starting point.

The actual data shown on this display will depend on the version of the instrument and the options that have been selected.

Main Gas Read Screen

You can also press key 2 and access a zoomed version of the main read screen, once you have entered this mode, simply use keys 4 and 6 to switch between the gases and pressures. Examples of both screens can be seen below:

Zoomed version

6.8 Storage

The analyzer should not be exposed to extreme temperature. For example, do not keep the analyzer in a hot car. When not in use, analyzers should be kept in a clean, dry and warm environment, such as an office. Protect the analyzer with either the soft carry case or store in the hard carry case provided with the instrument.

The instrument should be discharged and fully charged at least once every four weeks, regardless of indicated charge state.

6.9 Battery/charging

The battery used in the 5000 series of gas analyzers is nickel metal hydride and manufactured as a pack from six individual cells. This type of battery is not so susceptible to the top-off charging 'memory effects' as nickel cadmium batteries, although it is not recommended that the unit is given small top-off charges.

? Note: **To reach optimum charge, it is recommended that the instrument is switched off when being charged and remains switched off during the charging process.**

A full charge will take approximately 4 hours from a fully discharged battery.

⚠ **Warning**	The battery charger is NOT covered by the Ex certification. The battery must be charged only in a safe area.

The battery charger is intelligent and will indicate when the unit is charging and charged.

The instrument must be charged ONLY using the battery charger supplied with the instrument. The battery charger supplied is intended for indoor use only. Please ensure adequate ventilation while charging. Typically, a fully charged battery will last 7-8 hours. A quick 30 minute charge can be used to give approximately one hours use in the field but this may shorten the battery life. Temperature can dramatically affect the battery life; please take this into account when estimating battery life.

✍ Note: Connect the charger to the mains attaching the appropriate adaptor.

Power supply front and back drawing:

Charger: Input voltage: 100-240V AC +/- 10%
            Input frequency: 50-60Hz +/- 10%
            Input current: 0.4A@100VAC .. 0.2A@240VAC

            Output voltage: 10.1VDC max
            Output current: 1.5A max

✍ Note: This charger has been internally restricted to 1.5A

6.10 Cleaning instructions
Do NOT use any cleaning agents to clean the analyzer or battery charger as they may have an adverse effect on the safe use of these devices.

6.11   Memory

The analyzer's memory is stored in a readings and configuration database. The analyzer will prompt when its memory is full, and you will not be able to store any further readings. Please download your readings via LSGAM or the Basic Download Software and then clear the memory.

? Note: The analyzer should never be stored for prolonged periods with valuable data in its memory. It is advisable to download all readings to LSGAM at the end of each day's monitoring. To clear the memory, please refer to the LSGAM operating manual.

6.12   Warning and error codes

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

? Note: For further information please refer to **section '10.0 Problem Solving'.**

7.0   Operator Settings

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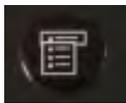
The **'Menu' key** enables the operator to select options to set up specific parameters and perform operational tasks prior to sample readings being taken or to view data and information stored in the instrument.

1)   **Select the 'Menu' key on the front of the analyz**er and the following screen is displayed:

2)   Press the relevant numeric key on the analyzer keypad to select the required option.

3)   To exit this menu, select the soft-**key 'Exit'** on the front of the analyzer and the operator is returned to Main Gas Read Screen.

7.2 Operation settings

To access the 'Operation settings' menu, select the 'Menu' key on the front of the analyzer. The following menu is displayed:

7.2.1 Timers

The timers function enables the operator to set standard purge times and set auto-power off if the unit is untouched for the period of time specified.

1) Select 'Key 1 – Timers' and the following screen is displayed:

1) Select 'Key 1' to edit the purge time. Enter the 'Pump Running Time' in seconds; this is the length of time you wish to run the pump to draw the sample, e.g. key in **030 then press the 'Enter' key to accept.**

2) Select 'Key 2' to edit the auto power off time. Enter the 'Auto power off' in minutes; the instrument will automatically power off to preserve the battery life after the specified time if no activity has occurred on the instrument. Press the 'Enter' key to accept.

3) Select the soft-key 'Exit' key to exit the screen and return to the 'Operation settings' menu.

✍ Note: Setting the purge time and auto power off functions to zero, disables the option. It is not recommended to reduce the purge time to below 30 seconds.

7.2.2 Gas Check

 This option displays the 'Gas Check' menu and enables the operator to zero and span the gas channels on the instrument. Historical/previous gas checks data can also be viewed and factory settings can be restored.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft key to display 'Operation Settings'.

2) Select 'Key 2 – Gas Check' and the following menu is displayed:

3) For more information about the Gas Check Menu please refer to section 9.0 – Calibration.

4) Select soft-key 'Exit' to exit operation settings and return to the main screen.

7.2.3 View data

 This option enables the operator to view the readings collected and stored on the instrument. Readings many be downloaded to the optional LSGAM software if further analysis is required.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft-key to display 'Operation Settings'.

2) Select 'Key 3 – View Data' and the following screen is displayed:

3) Toggle through the reading by selecting 'Key 4 – Scroll left' and 'Key 6 – Scroll right' on the analyzer. Select 'Key 2 – Page up' and 'Key 8 – Page down' to page through the auxiliary channels listed.

4) Select the soft-key 'Filter' to filter the data by sample point ID, or specify before or after date. Press the soft-key 'Exit' to exit the filter menu and return to the 'View Data' screen.

5) Select the soft-key 'Delete' followed by the appropriate soft-key to delete a single reading or all filtered readings. Press soft-key 'Cancel' to cancel the deletion request.

6) Select the soft-key 'Exit' to exit the view data screen.

7.2.4 Set alarms

This option enables the operator to define the conditions for which an alarm/target will be triggered. These conditions apply to the general operation of the instrument and are not ID specific. A summary of the alarm settings can be found in 'Key 3 – Summary'.

Types of alarms
Common Alarms – Are non-ID specific alarms which apply to all the readings taken with the analyzer.

ID specific alarms – Are ID specific, i.e. they will only trigger when a certain Id is being used.

Tuning/targets – You can also set targets for your gas channels; these will highlight gas channels green as oppose to when they alarm (yellow). These can be common or ID specific.

Setting up alarms/targets
1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft key to display 'Operation Settings'.

2) Select 'Key 4 – Set Alarms' and the following menu is displayed:

3) Select the corresponding key to select the gas for which you wish to set an **alarm/target trigger for, followed by 'Key 1' to change the trigger condition of an alarm.**

4) To manually adjust the **alarm/target set press (<) 'Key 4 – Scroll left' or 'Key 6 – Scroll right' (>)** and enter the trigger value. Once you are happy, press the middle soft **key for 'save'.**

5) **For pressure, temperature and flow alarms, press the left soft key for 'Secondary' and** then select the corresponding key to select the channel for which you wish to set an alarm trigger for, followed by **'Key 1' to change the trigger condition of an alarm/target. Once you are happy, press the middle soft key for 'save'.**

6) To disable all alarm settings select key 0 – **'Disable All'**

> ✎ Note: ID specific alarms cannot be added/edited on the analyzer, to add/edit ID specific alarms, please use the optional LSGAM Software.

7.2.5 Adjust flow fail

This option enables the operator to adjust the flow fail tolerance of the instrument, i.e. the operator can adjust the sensitivity for when the pump will stop operating on the presence of a blockage or low flow.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft-**key to display 'Operation Settings'.**

2) Select 'Key 5 – Adjust Flow Fail' and the following screen is displayed:

3) Manual adjustment of the flow fail is available via this option and can be carried out with use of 'Key 4 – Scroll left' (<) less sensitive and 'Key 6 – Scroll right' (>) more sensitive.

4) Select the soft-key 'Save' to store the setting or select soft-key 'Exit' to exit the screen without saving the change.

5) The operator will return to the 'Operation settings' menu.

? Note: The default setting displays the bar in the centre. BEFORE altering this setting, please contact Technical Support at (800) 968-2026 or email landtec_support@qedenv.com

7.2.6 Technician login

This option enables the operator to select or change a pre-defined technician login and all subsequent readings will be tagged with this Technician Login ID. The technician ID must already have been created using the LSGAM software and uploaded to the instrument.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft key to display 'User Settings'.

2) Select 'Key 6 – Technician login' and the following screen is displayed:

3) Use the cursor keys to move throughout the list of IDs displayed; select the 'Enter' key to select choice of ID, default if no IDs are listed or soft-key 'Skip' to skip the selection.

4) The operator will return to the 'User settings' menu.

   ✍ Note: If no technicians are loaded via LSGAM, this section is skipped during
              start up and the 'Technician ID' icon is removed from the menu.

7.3 Device settings

To access the 'Device Settings' menu, select the 'Menu' key on the front of the analyzer to
display the 'Operating Settings' menu followed by the soft-key to display 'Device Settings'
menu. The following menu is displayed:

7.3.1 Date and time

This option enables the operator to set the instrument date and time or to
receive and update the settings automatically from satellite signal.

1) Select the 'Menu' key on the front of the analyzer to display the 'Device Settings'
    menu followed by 'Key 1 – Date and Time' and the following screen is displayed:

2) Select 'Key 1 – Set Date' and key in the required date. Type the date using the
    numeric keypad. Press the soft-key 'Date Format' to toggle and select the required
    date format i.e. dd/mm/yy. Press the 'Enter' key to confirm and update the date
    setting.

3) Select 'Key 2 – Set Time' and key in the required time (hh:mm). Type the time
    using the numeric keypad and press the 'Enter' key to confirm the update.

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4) The operator may also change the default time zone. Selecting the 'Key 4 Scroll-left' or 'Key 6 – Scroll right' to move through the different time zones. Press the 'Enter' key to confirm your default setting.

5) Select 'Key 3' to toggle between 'Manual Update' and 'Automatic Update' in order to choose how the date and time is set if updating from satellite signal.

    Manual   Used to manually obtain and update the date and time from the satellite signal when requested. Select soft-key 'Set now' to set date and time from satellite when available.

    Automatic   Used to automatically update the date and time received from the satellite signal when available. This option is only available when the GPS option is fitted to the analyser at the time of manufacture.

6) Select the soft-key 'Exit' to exit and return to the 'Device Settings' menu.

7.3.2 Bluetooth

This option enables the operator to set and utilize Bluetooth technology. This may be useful when downloading gas readings from the analyzer to the PC instead of connecting the analyzer to a PC via a USB cable. Bluetooth may also be used to transfer Site IDs to other 5000 series gas analyzers if required.

1) Select the 'Menu' key on the front of the analyzer to display the 'Device Settings' menu.

2) Select 'Key 2 – Bluetooth' and the following screen is displayed:

3) Enter the 'Pairing PIN' value when prompted by your computer for the device's pairing code.

4) Select soft-key 'Exit' to exit the screen and return to the 'Device Settings' menu.

7.3.3 Device information

This option displays default instrument information and settings such as serial number, service due date, last zero calibration date and last span calibration date.

1) **Select the 'Menu' key on the front of the analyser to display the 'Device Settings'** menu.

2) **Select 'Key 3 – Device Information' and the following screen** is displayed:

Device Information	12:23 - 17/06/14		
Serial Number	G500037	ID Count	7/2000
Version Number	1.11.9	Readings Count	142/4000
SB Version	1.19.400	Comms Mode	Serial
Last Check	----	SB Hardware	100
Last Cal	27/03/14	A5F Bias	Enabled
Manufacturer	--/--/--	A5F Status	Good
Agent Service	--/--/--		

This instrument is approved by the UK Environment Agency's Monitoring Certification Scheme, MCERTS.

Comms Mode   Exit

3) The information displayed on this screen is informational only and cannot be edited by the operator. The operator may be asked serial number, service due date and version number information when contacting QED.

> ✍ Note: The communications **setting 'Legacy' mode is for use with GAM >=v1.5.** GA5K mode is reserved for future applications **–** use with 5000 series updater tool

4) Select soft-**key 'Exit' to exit the screen and return to the 'Device Settings' menu**.

7.3.4 Diagnostics

This option enables the Technical Support Team to identify and resolve issues with the instrument and settings. If required, the operator may be asked to confirm the diagnostics displayed.

1) **Select the 'Menu' key on the front of the analyser to display the 'Device Settings'** menu.

2) **Select 'Key 4 – Diagnostics' and the following screen is displayed:**

3) Select soft-key 'Next' to display the next screen, 'Previous' to return to the previous screen, or select soft-key 'Exit' to exit this screen and return to the 'Device Settings' menu.

> ✍ Note: For further information please contact Technical Support at (800) 968-2026 or email landtec_support@qedenv.com

7.3.5 Navigation (optional)

This option enables the operator to switch the 'GPS Navigation' functionality on or off. (This is optional and dependent upon purchasing the navigation option).

Navigation is On

1) Select the 'Menu' key and the 'Device Settings' menu is displayed.

2) Select 'Key 5 – Navigation On' to switch on the GPS navigation functionality or 'Key 5 – Navigation Off' to switch the GPS navigation functionality off.

Navigation is On

Navigation is Off

> ✍ Note: For further information please refer to section '8.0 – Taking Readings'.

7.4 User settings

To access the 'User settings' menu, select the 'Menu' key on the front of the analyzer to display the 'Operating Settings' menu followed by the soft-key to display 'User Settings' menu. The following menu is displayed:

To exit the user settings menu select the soft-key 'Exit'.

7.4.1 Operating language

This option enables the operator to specify the operating language displayed for the instrument.

1) Select 'Key 1 – Operating Language' and the following screen is displayed:

Set the required language for the gas analyser by selecting the appropriate function key. Choose from, on the first page:

Key 1   English

Key 2   Spanish

Key 3   French

Key 4   German

Key 5   Italian

Key 6   Portuguese

Use the soft-keys to move to the next page for further language options, including simplified Chinese

2)   To exit this option, select the soft-key 'Exit' and the operator is returned to the 'User Settings' menu.

7.4.2 Units of measurement

This option enables the operator to specify the default units of measurement for the instrument.

Units of Measurement

1) Select 'Key 2 – Units of Measurement' and the following screen is displayed:

2) To set the required units of measurement toggle and choose from the following:

Key 1   Temperature ^{O}C
                              ^{O}F

Key 2   Flow   scfm
                          m3/hr

Key 3   Measurement   Inches
                          Millimetres

Key 4   Pressure   mb
                          "H2O

Key 5   Balance   Balance
                          Residual N2

3) Select soft-key 'Exit' to exit this screen and return to the 'User Settings' menu.

7.4.3 ID selection

The ID selection screen allows the operator to scroll through all IDs, including those uploaded from LSGAM and added directly onto the instrument, and then make a selection. Detailed information regarding the currently selected ID, such as flow device type and pump runtime, are displayed below: -

By selecting 'Key 5' the operator can toggle between showing 30 IDs and showing 5 IDs with more detailed information relating to the chosen ID.

The technician can scroll between the IDs using the following keys on the instrument keypad:

Two (2) and eight (8) move the selection up/down
Four (4) and six (6) move the selection left/right on the list view
One (1) and three (3) move the selection left/right a page in the list view only
Seven (7) and nine (9) move the selection to first/last ID

Five (5) toggles between the 'ID with information' and 'ID list'
Return/enter key selects the desired ID and proceeds to the navigation or reading screen.

If there are no IDs present the technician can either add a new ID or press the enter key on the instrument keypad to return to the previous screen.

Soft keys:

> Left - Select 'No ID' and go to the purge/reading screen.
> Center - Enabled when there is a list of IDs, allowing the technician to dynamically filter the IDs displayed in the list.
> Right - Allows the technician to add a new ID to the instrument 'in the field'.

? Note: If your analyzer has firmware version v1.12 or greater, used IDs will have a strikethrough.

Changing the sort order

By default the IDs are sorted in the order in which they were transferred to the instrument. To change the sort order between unsorted, sort by name or sorted by distance to travel press Key 0.

0 ⟨⁀⁀⟩	Sorted by original order (not sorted)
0 (A..Z)	Sorted alphabetically
0 ⟨▭⟩	Sorted by distance to travel

? Note: Only available when GPS is enabled

For analyzers with firmware v1.12 and above:

1)   Press the menu key

2)   Press the middle soft key for **'User Settings'**

3)   Press key 3 – **'ID options**

> a. Key 1 to change the sort order
> b. Key 2 to change how the IDs are displayed
> c. Key 3 to clear the line through on the current ID being used
> d. Key 4 to remove the line through on all IDs

7.4.4 Routes

Using the optional LSGAM Software, you can upload a route. This is a predefined list of IDs that you can go through in an order. This feature is useful if you have a certain order to complete your IDS in.

Furthermore if your GA5000 has v1.12 or higher firmware it will strike through your IDs once you have used them.

> ✍ Note: If the analyzer is set to "route mode" (v1.12 and above), the filter box will no longer be there, as you cannot filter in this mode. It will be replaced by "Route" and the route name.

7.4.5 Adjust backlight

This option enables the operator to adjust the backlight (brightness). Having this set to a darker setting will help preserve the battery power

1) Select 'Key 4 – Adjust Backlight' and the following screen is displayed:

2) Keys 4 and 6 can be used to adjust the brightness of the display screen.

   'Manual' disables the backlight timeout.

3) Select the soft-key 'Save' to store the setting or select soft-key 'Exit' to exit the screen without saving the change.

4) The operator will return to the 'User settings' menu.

Selecting 'Key 1' allows the operator to configure the dimmer settings from 'Auto Dim' to 'Auto Off' in order to help preserve power consumption when data logging.

This icon represents 'Auto Dim' – this enables the backlight idle timeout, which means the backlight will go dim after a specified period of inactivity. This will help save battery life.

This icon represents 'Auto Off' – this switches the backlight off, saving power.

✍ Note: The manually set contrast setting is retained when the read-out is switched off and may require resetting when next switched on.

7.4.6 Adjust volume

This option enables the operator to adjust the volume for the internal speaker, for example the alarm tone. A lower setting will help preserve the battery power.

1)   Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft-key to display 'User Settings'.

2)   Select 'Key 5 – Adjust Volume' and the following screen is displayed:

3)   Manual adjustment of the volume is available via this option and can be carried out with use of 'Key 4 - Scroll left' (<) volume down and 'Key 6 - Scroll right' (>) volume up.

4)   Select the soft-key 'Save' to store the setting or select soft-key 'Exit' to exit the screen without saving the change.

5)   The operator will return to the 'User settings' menu.

7.4.7 User Prompts

This option enables the operator to either turn on or off the context-sensitive user prompts which are displayed during the gas sample process. The analyzer will have the user prompts on when it is first used, so if they are no required they can be switched off by selecting soft-key '6' and this will now be its default setting. Prompts can be switched back on at any time by returning to this menu and selecting soft-key '6'.

7.5 Exit menu

1) Press the 'Menu' button on the front of the analyzer to exit settings.

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8.0 Taking Readings

8.1 Preliminary checks before taking readings (best practice)

```
        ┌─────────┐
        │  Start  │
        └─────────┘
             │
          Step 1
             ▼
   ┌──────────────┐           ┌──────────────────┐
   │ ID codes and │  Step 2   │ Check mode of    │
   │ information  │──────────▶│ operation is     │
   │ uploaded     │           │ correct (GEM /GA)│
   └──────────────┘           └──────────────────┘
                                       │
                                    Step 3
                                       ▼
                              ┌──────────────────┐
                              │ Analyser has     │
                              │ correct time and │
                              │ date set         │
                              └──────────────────┘
                                       │
                                    Step 4
                                       ▼
                              ┌──────────────────┐
                              │ Water trap filter│
                              │ is clean and dry │
                              └──────────────────┘
                                       │
                                    Step 5
                                       ▼
                              ┌──────────────────┐
                              │ Battery has      │
                              │ good charge      │
                              └──────────────────┘
                                       │
                                    Step 6
                                       ▼
                              ┌──────────────────┐
                              │ Gases            │
                              │ zeroed           │
                              └──────────────────┘
                                       │
                                    Step 7
                                       ▼
                              ┌──────────────────┐
                              │ Check span       │
                              │ calibration      │
                              └──────────────────┘
                                       │
                                    Step 8
                                       ▼
                              ┌──────────────────┐
                              │  Take readings   │
                              └──────────────────┘
```
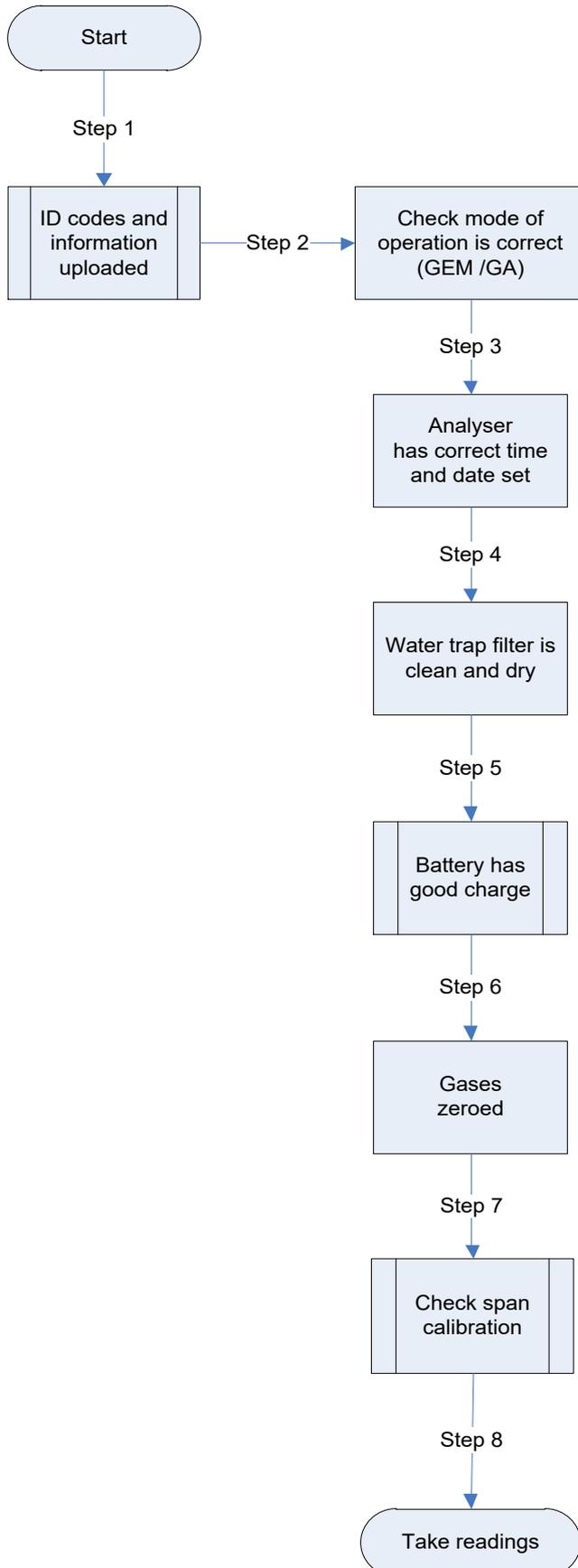
Prior to use, it is good practice to ensure that:

Step 1   If using LSGAM - all necessary ID codes and information have been uploaded from LSGAM to the analyzer. Please see section 8.1.1 for more information on this.

Step 2   Check the 'Mode of Operation' is correct. Choose either GEM5000 for gas extraction monitoring analyzer or GA5000 for landfill gas **analyzer. Change using 'Special Actions'.**

Step 3   The instrument has the correct time and date set.

Step 4   The water trap filter is fitted and is clean and dry.

Step 5   The battery has a good charge (minimum 25% charge, even if only a few readings are required).

Step 6   The gas channels have been zeroed, without gas concentration present.

Step 7   If necessary check the span calibration with a known concentration calibration gas.

Step 8   Take readings.

⚠ **Warning**	Inhaling hydrogen sulphide gas (H_2S) or other harmful gases 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_2S and other harmful gases. 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.

Good practice

- Travel to site with the gas analyzer 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 gas analyzer against anything hot (e.g. gas extraction pipe, car body or in an unattended car during the summer) as this will cause a temperature increase in the gas analyzer and may cause erroneous readings.

- When moving around a site, protect the gas analyzer from strong direct sunlight and heavy rain.

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

  ✍ Note: If the exhaust of a 5000 series gas analyzer is connected to a pressurized system then this results in a flow of gas out of the inlet flow port.

8.2 Change screen layout

Use key 2 to toggle between 2 different ways of viewing the gas reading screen:

Default view

You can use key 4 and key 6 to switch between the gases page and the pressure & flow page. This feature is only available on analyzers running on firmware version 1.11 or later.

8.3 Answering site questions

Prior to taking the readings at a particular site, the site questions should be populated, this is only necessary when using site questions, if not, please proceed with the reading as normal. This is accessed via the 'Special Action' menu. The answers to these questions are then stored and appended to each reading stored thereafter, until the site questions are updated for another site. You will need LSGAM software to create site questions and if you are using LSGAM, this data will be uploaded to LSGAM along with the reading data.

8.4 Answering ID questions

Prior to, or after, you have taken the reading, the ID questions should be populated, this is only necessary when using ID questions, if not, please proceed with the reading as normal. When you have uploaded IDs with ID questions assigned to them (LSGAM software required), you will be prompted to answer these questions at the end of the reading, this means that the answer only equates to that reading.

8.5 Special action

This menu enables the operator to perform the additional following functions out of sequence if so desired.

1) From the 'Main Gas Read Screen' select the soft-key 'Special Action' and the following menu is displayed:
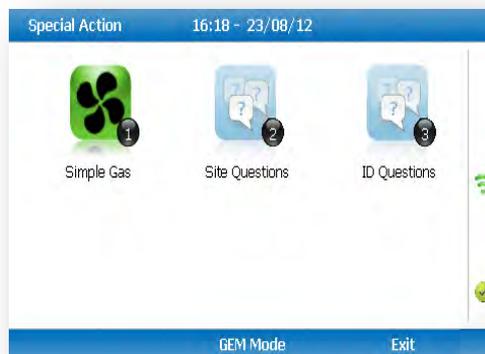
? Note: The list of special action options displayed on the special action menu is dependent upon device type and sequence.

The following actions may be available:

Action	Function
Key 1 – Simple Gas	This action enables the operator to take a quick gas reading. The pump will start running automatically when this key is selected. The operator can stop the pump by pressing the pump key on the keypad at any time and the reading can then be stored by selecting soft-key **'Store'.**
Key 2 – Site Questions	This action enables the operator to update site questions prior to taking a reading.
Key 3 – ID Questions	This action enables the operator to update ID questions specific to sample points prior to taking a reading.
Key 4 – Flow	This action enables the operator to measure internal flow first when taking a reading. Connect the blue hose to the sample point. The yellow hose can be vented a safe distance from the sample point or re-circulated back into the system. Select either soft-**key 'Zero Flow',' Flow Options' or 'Start' to commence internal flow. Select** soft-**key 'Store' to store and record the reading.**
Key 5 – Enter Temperature	This action enables the operator to manually enter a temperature reading if not using a temperature probe prior to taking a gas measurement.
Key 6 – Start Logging	This action enables the operator to leave the analyzer unattended to take samples at a predetermined time. The reading interval and pump run times may be edited prior to commencing the logging cycle.

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8.5.1 Configuration of the data logging option

1) Connect the gas inlet (white port) to the sample point. The yellow exhaust hose can be vented a safe distance from the sample point; do NOT re-circulate back into the system.
2) By selecting 'Next ID' the operator can select the ID which is being sampled at present.
3) Once the ID has been chosen the analyzer will commence and complete its clean air purge cycle.
4) To gain access to the data logging option the operator will be required to select the 'Special Action' key to obtain the special user options. The data logging option can then be selected via 'Key 6' to configure the logging parameters.
5) Once the operator has confirmed the logging parameters, select soft-key 'Start Logging'.
6) Once the logging function has been activated the analyzer will carry out a 30 second warm-up (displayed below the temperature read out at the right of the main gas read screen) and begin the first sample.
7) If for any reason during the logging cycle the inlet port becomes blocked, the analyzer will sense this as a 'Flow Fail' and the pump will automatically retry until the reading can be obtained. As such care must be taken when positioning the sample tubing to ensure water/moisture ingress does not occur.
8) Select soft-key 'Stop Logging' to stop logging if required.

8.5.2 Profiling option

1) The 'Logging Mode' center soft-key toggles between 'Logging Mode' and 'Profiling Mode' and pressing it will change the mode to the one the soft-key describes. For example, when on the profiling page the key will display as 'Logging Mode' and when on the logging page the key will display as 'Profiling Mode'.

2) To edit the parameter the operator will be required to select 'Key 3' to select the number of reading required. Once the number of readings has been updated press the return key to confirm parameter setting.
3) By selecting 'Key 2' the operator can edit the logging interval of their logging preferences and then confirm the amendments by pressing the return key.
4) Once the logging parameters are confirmed, commence the logging by selecting the 'Start Logging' key.
5) If for any reason during the logging cycle the inlet port becomes blocked, the analyzer will sense this as a 'Flow Fail' and the pump will automatically retry until the reading can be obtained. As such care must be taken when positioning the sample tubing to ensure water/moisture ingress does not occur.
6) Select soft-key 'Stop Logging' to stop logging if required.

Select the soft-key 'Exit' to exit this menu and return to the 'Main Gas Read Screen'.

8.6 GEM analyzer in GA mode

The operator may toggle between GEM (a gas extraction monitor) and GA (a landfill gas analyzer) mode of operation if required. From the 'Special Action' menu, select the middle soft-key to toggle between GEM and GA Mode.
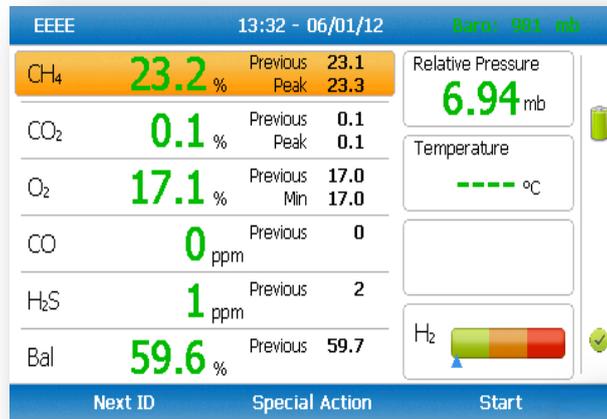
✒ Note: For operating instructions on how to use the GA5000 mode of operation, please refer to the GA5000 gas analyzer operating manual.

8.7 The gas flow measurement screen

The GEM5000 gas analyzer enables gas and flow measurements to be recorded by using:

- A flow device i.e. a PITOT tube, Orifice plate, Accu-Flo or anemometer.
- A temperature probe.

The GEM5000 instrument has the extra functionality to measure the calculated calorific value of the gas. The site engineer uses the information recorded by the analyzer to make adjustments to the gas flow for specific boreholes. The initial and adjusted flow rates are recorded.

8.8 How to use an anemometer (optional)

The GEM5000 gas analyzer has the facility to attach an anemometer device enabling the site engineer to measure the flow of gas within an extraction system. The anemometer can be set to display two values; m/s (meters per second) and m^3/hr (metres cubed per hour).

It is best practice to take the gas reading first before taking the flow reading with the anemometer attached.

If using a 'borehole ID' the internal pipe diameter can be predetermined in the optional LSGAM software. Once set, the site engineer cannot edit the pipe diameter setting.

If the site engineer is not using a borehole ID or the pipe diameter is not set in LSGAM the operator will be prompted to enter a pipe diameter with a new ID on the analyzer. Select soft-key 'Next ID' from the Main Gas Read screen, followed by soft-key 'Add' and add a new borehole location.

In order to use the anemometer it is important to know the internal diameter (ID) of the pipe if you want to calculate the flow in m^3/hr (metres cubed per hour). This must be the internal diameter not the outer diameter (OD) i.e. pipe outer diameter minus twice the pipe wall thickness.

For example:
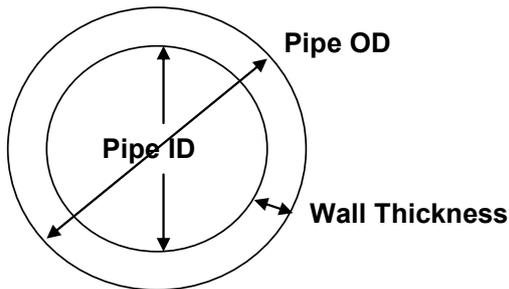
If you do not have any suitable monitoring points you will need to drill **(tap of ¾″ BSP pipe thread)** a hole in the piping of between 25mm and 30mm in diameter to seat the conical fitting on the anemometer (which is roughly between 20mm to 34mm). When not in use the hole can be re-sealed with a ¾″ BSP male bung.

? Note: When the anemometer is not in use the conical fitting should be placed over the probe to protect it.

The anemometer must fit centrally (the conical fitting must be set on the probe to half the pipe ID before insertion). The arrow on the tip of the probe must point in the direction of the gas flow.

? Note: Use the thumb screw to help align the direction of the probe into the gas stream.

Flow readings are most accurate when there is laminar flow (not turbulent). Turbulence can be caused by a change in pipe direction or restriction. Ideally, upstream you want at least 20 times the pipe ID along the length of the pipe without restriction or bend. Downstream, you want at least five times the pipe ID along the length of the pipe i.e. for a 100mm ID you need 2000mm of clear pipe upstream, 500mm downstream.

Example to show anemometer fitting into the sample point:
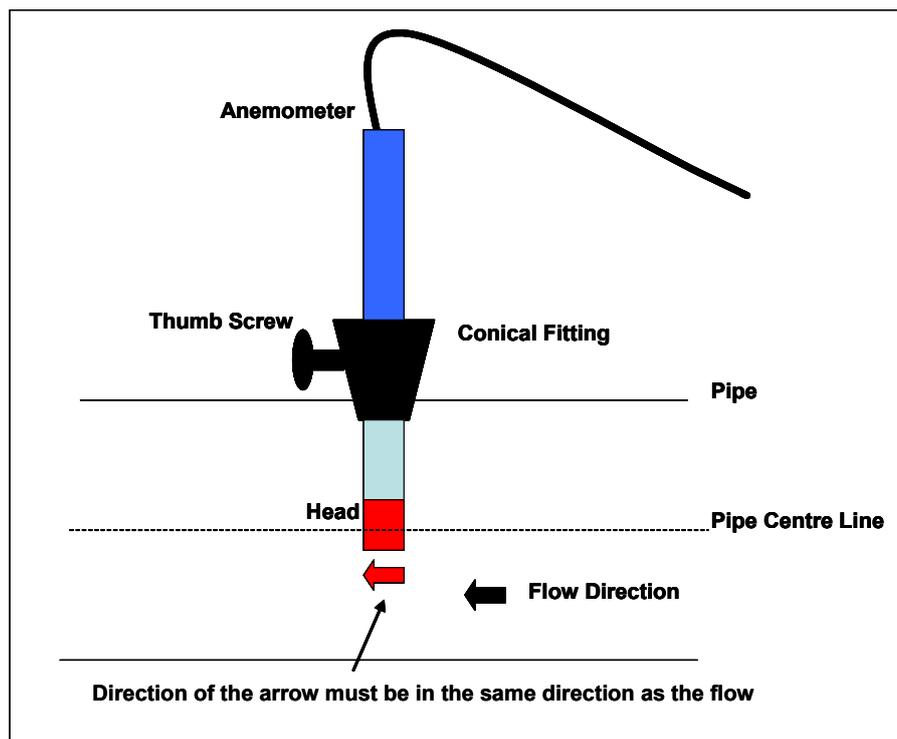
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Instructions for use:

1) Attach the anemometer to 'Connector C' (refer to section 5.3 – Instrument connection points).

2) Place the anemometer into the pipe (sample point) ready to take the reading.

3) To take a flow measurement when using an anemometer, follow the instructions displayed on the analyzer. When the reading has stabilized press the 'Enter' key to store the reading.

Anemometer cleaning instructions:

General handling tips:

- Protect the probes against severe vibration.
- Do not kink the connector cable (risk of cable breakage).
- Never allow hard objects to contact rotating impellers.
- Always carry out probe cleaning according to the cleaning instructions.
- Never immerse probes in solvent.
- Never blow probes through with compressed air.
- Allow hot probes to cool slowly, never cool by plunging them in cold water etc.

Cleaning instructions:

- Instrument and probe must be switched off or disconnected prior to cleaning.

Vane probes:

- As the probes are highly sensitive measuring instruments, they must be cleaned with great care.
- Fibres or other foreign bodies can be carefully removed with fine tweezers. When doing so, take care not to bend or otherwise damage the vanes or the spindle.
- The adjustment of the bearing screws must never be changed. This can result in an erroneous measurement.
- Never allow hard objects to contact rotating impellers.
- Cleaning agents that extract the plasticizer from the plastic are never to be used for plastic probes (practically all solvents).

Cleaning the probes – best practice:

✍ Note: Use soapy water.

Cleaning example:

1) Carefully, swish the top part of the impeller back and forth in clean soapy water for approximately 10 minutes. Then swish the top part of the impeller back and forth in clean soapy water. If soapy water is used as a cleaning agent it is advisable to wash out the soap solution thoroughly with distilled water.

2) After cleaning the probe, rub it dry with a clean, dry cloth.

8.9 How to use a pitot tube (optional)

The GEM5000 gas analyzer enables the site engineer to take gas measurements using a pitot tube. The pitot tube is used for gas extraction systems and the pressure readings are taken in mbar. Gas flow is calculated in the analyzer in m^3/hr (metres cubed per hour).
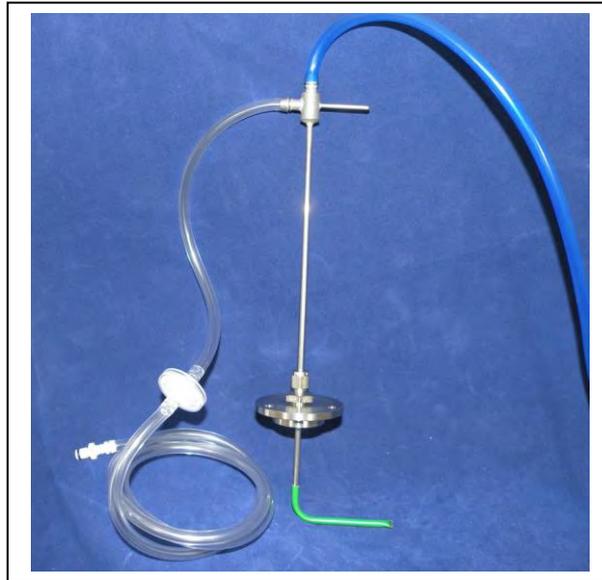
Example of a pitot tube

Fitting a pitot tube to the analyzer:

1) It is important to seat the pitot tube into the monitoring point with the tip facing into the gas flow. The pitot tube should also be housed half way down the monitoring pipe. (Please refer to the anemometer instructions, which detail how to calculate the pipe diameter correctly).

2) Make sure that the sample tubing attached to the pitot tube fits correctly.

3) Attach the sample tube from the top connection of the pitot tube to the 'blue port' (the differential port) on the analyser making sure that the gas port connector secure into place.

4) Attach the sample tube from the side of the pitot tube to the 'white port' (inlet port/static pressure port) on the analyser making sure that the gas port connector secures into place.

5) House the pitot gland correctly onto the monitoring point.

6) When taking a gas reading and flow measurement follow the instruction as displayed on the front of the instrument.

   ✎ Note: Please refer to the following section for a diagram showing how to fit the tubing to the pitot tube.

8.10 How to use an H$_2$S filter (optional)

8.10.1 Cross gas effects on chemical cells

Measurements of CO are important in landfill management. The GEM5000 analyzer incorporates an improved CO measurement.
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 GEM5000 analyzer uses a technique that is hydrogen compensated. Hydrogen compensation is achievable up to a level of around 2000ppm. Above this level the CO reading will not be compensated for.

In order to assist the operator the GEM5000 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 H$_2$S filter.

CO measurement

The CO measurement is sensitive to hydrogen sulphide. The presence of hydrogen sulphide can cause the CO reading to elevate (not to be the true value due to the interfering gas). If the presence of hydrogen sulphide is suspected to be causing false CO readings, then it is recommended that the external hydrogen sulphide filter is used while obtaining the CO measurement.

The **H$_2$S** filter only needs to be used when you are trying to remove of any possible cross gas effects H$_2$S might have on other gas channels. <u>Do not</u> use the filter on all boreholes.

When using the H$_2$S filter you will need to increase the gas sample and clean air purge run-time, as using an H$_2$S filter decreases the response time of the analyzer.

✎ Note: There is an internal H$_2$S filter incorporated in the chemical cell that removes the H$_2$S; however this has a limited life span.

The electrochemical cells used to measure H$_2$S and CO do suffer from cross-gas effects. Such effects are not accurately specified. However, the following table may be useful as a guide; it represents how many ppm would be read by a cell if 100 ppm of the interfering gas were applied, with no other cross-contaminates being present in the sample.

GEM5000

		Interfering Gas				
		CO	H$_2$S	SO$_2$	NO$_2$	H$_2$
Chemical Cell	CO (H2 compensated	100	0 / ~300*	0	0	<1
	CO	100	<4 /~300*	0	-20 to +5	<60
	H2S	<4	100	20	<-25	<0.2

*after internal filter depleted.

✎ Note: Other gases could cause cross-gas effects. If you suspect a cross sensitivity problem please contact Technical Support (800) 968-2026 or email landtec_support@qedenv.com

8.10.2   Cross-gas effects on methane, carbon dioxide and oxygen

Methane is measured using dual beam infrared absorption. Analyzers are calibrated using certified methane mixtures and will give correct readings provided there are no other hydrocarbon gases present within the sample (e.g. ethane, propane, butane, etc.). If there are other hydrocarbons present, the methane reading will be elevated (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.

✍ Note: The effect can be reduced by using an H_2S filter as it can reduce higher order hydrocarbons. When using the H_2S filter you will need to increase the gas sample and clean air purge run-time, as using an H_2S filter increases the response time of the analyzer.

Carbon dioxide is measured by infrared absorption at a wavelength specific to carbon dioxide. Therefore, the carbon dioxide reading will not be affected by any other gases usually found on landfill sites.

The oxygen sensor is a galvanic cell type and suffers virtually no influence from CO_2, CO, H_2S, NO_2, SO_2 or H_2, unlike many other types of oxygen cell.

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'.

H_2S filter:

Instructions for use:

The following diagram shows how to modify the standard water trap and sample tubing to fit the H_2S filter.
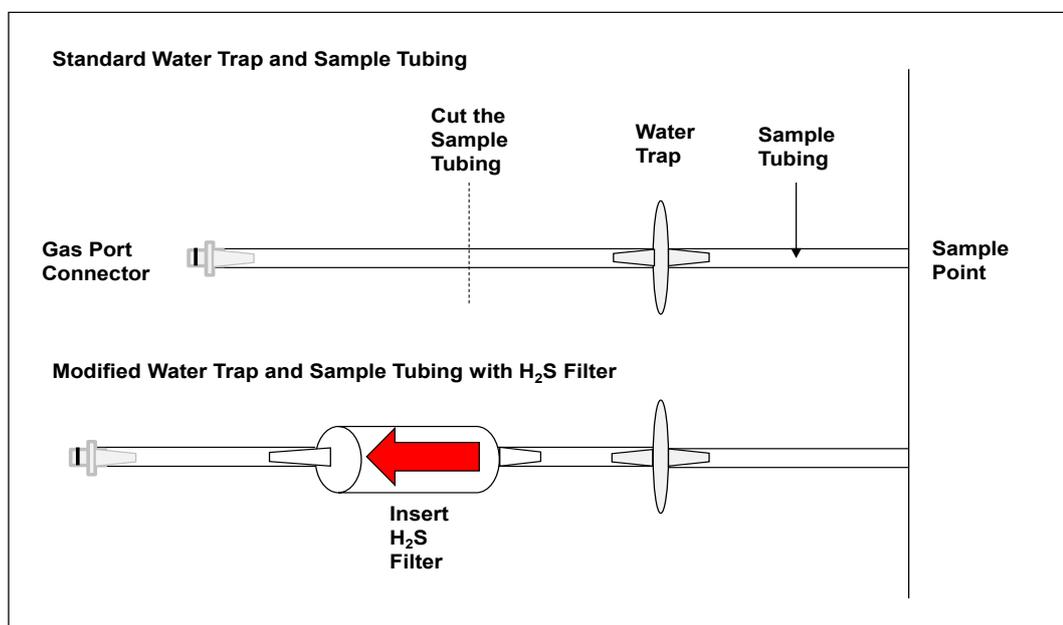
✎ Note: When onsite the site engineer must have an unmodified water trap assembly in addition to the modified water trap with a H_2S filter in order to take readings with and without a filter.

1)   Once the H_2S filter is fitted follow the instructions as detailed on the front of the gas analyser displayed when taking readings using a H_2S filter.

   ✎ Note: This is only for analysers fitted with the CO compensated cell.

Fitting a pitot tube to a sample point when using an H_2S filter:
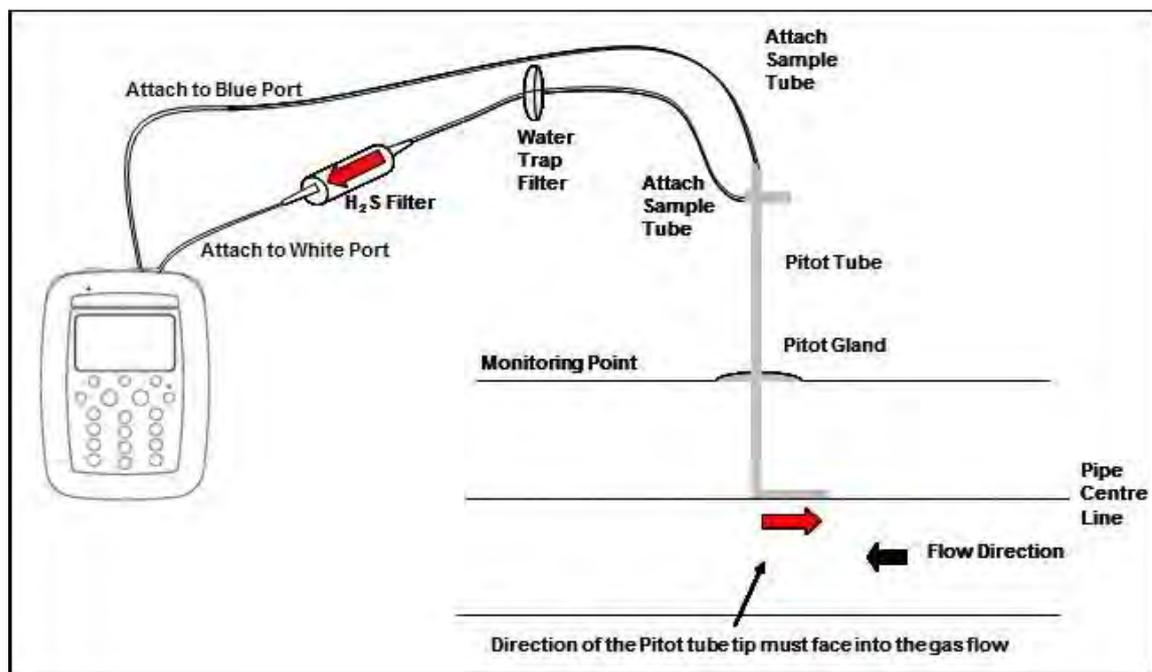
2)   Make sure the water trap filter is fitted as close as possible to the pitot tube. This will help protect and trap moisture before it reaches the H_2S filter. Make sure that the water trap filter is clean and dry.

3)   Attach the sample tubing into the analyzer.

4)   To take flow readings using a pitot tube, please follow the instructions displayed on the front of the instrument. The user will be prompted to complete each step and should follow the instructions on screen.

   ✎ Note: It is important to fit the pitot tube central and parallel with the pipe.

8.11 How to use a temperature probe (optional)

The temperature probe enables the site engineer to measure the temperature of the gas within a sample point. The GEM5000 gas analyzer uses the temperature of the gas to give more accurate flow measurement readings as part of the instrument calculation.

Instructions for use:

1) The temperature probe reading is taken along with the gas measurement reading.

2) The analyzer must be at the 'Main Gas Read Screen'.

3) Attach the temperature probe to 'connector B' (refer to section 5.3 – Instrument connections points).

4) Insert the temperature probe into the sample point (borehole) at the same time as you attach the sample tube to the sample point (two sample points are required for the borehole).

5) Follow the instructions on the front of the instrument when taking your gas and measurement reading.

6) At the point in which the operator presses 'Enter' to store the gas reading the temperature is recorded.

   ✎ Note: Temperature probe readings can be analysed further when downloaded to LSGAM.

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8.12 How to identify a borehole using the GPS feature (optional)

An optional GPS feature is available for the GEM5000 gas analyzer. It enables the site engineer to automatically locate borehole IDs using GPS satellite signal from predefined borehole IDs uploaded from LSGAM. The GPS reading data is stored for each measurement reading.

  ? Note: Borehole IDs may be uploaded from LSGAM with or without location information. If location details are not uploaded the location longitude and latitude coordinates can be stored when the borehole is located and downloaded to LSGAM with the reading measurements.

Screen navigation:

1)   Switch on the analyzer and wait for the self-test warm-up to complete and the analyser will display the 'Main Gas Read Screen'.

2)   In order to use the navigation function if configured, you must switch 'Navigation - On' on the analyzer. Select the 'Menu' key followed by 'Key 5' to toggle navigation to on. Select the 'Menu' key to exit and return to the 'Main Gas Read Screen'.

3)   Select the soft-key 'Next ID', then select a borehole ID from the list displayed and press the 'Enter 'key to continue.

⚠ **Warning**	Before entering the GPS Navigation Screen for the first time the following health and safety message will be displayed.
	"Please be aware of the terrain when using this screen. You are responsible for your own safety whilst walking on-site!"

4)   After reading the user warning message, select the soft-key 'Dismiss'. Use the tracking display to locate the borehole

  ? Note: There is often a wait time frame of between 30 seconds to two minutes while getting a satellite signal. Be aware that heavy rain, trees overhead etc. will give a bad fix.

5)   Once the operator selects a borehole ID the 'GPS Navigation' screen is displayed.

6) If required, select soft-key 'Options' to go to the 'Navigation Options' menu and the following screen is displayed:

Navigation options

Key 1	**Key 1 to toggle between 'Meters', 'Feet' or 'Yards' to** define the unit of measurement.
Key 2	**Key 2 to toggle between 'Manual Scaling' and 'Automatic Scaling' to locate a sample point** using a satellite signal.
Key 3	Key 3 to display sample point information:
Bearing:	Direction.
UTC time:	**'Universal Time Code' received from the** satellite and displays GMT.
Latitude:	Latitude displays as degrees, minutes, seconds and decimal seconds. The equator is 0.
Longitude:	E (East) or W (West) displays the longitude as degrees, minutes, seconds and decimal seconds. The Greenwich meridian defines the zero point.
Altitude:	Altitude displays in meters, feet or yards.
Satellite:	This is the number of satellites that the system can select. Four satellites will give reasonable position accuracy; eight or more satellites will increase accuracy.
Horizontal:	Estimate of horizontal error on the indicated position. The location is accurate to horizontal error 1.6m.
Vertical:	Estimate of vertical error on the indicated position.
HDOP:	**'Horizontal Dilution of Precision' which measures the** accuracy of the indicated position.

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Changing the selected ID

It is possible to change the currently selected ID (identified by green icon) by pressing the 2 and 8 and keys to move the cursor up and down the list of visible Ids. To change the selection press Enter. Notice that the selected ID moves to the top of the list and its icon turns green.

Changing the scale

You can change the display's scale by using the 4 and 6 keys to zoom in and out.

GPS signal strength:

  This icon shows the signal strength the analyzer's GPS module is able to provide. Full, okay and fair strength respectively.

  GPS failure - the GPS was unable to get a line of sight lock on enough satellites. Or, it may **be that it hasn't had time to get a lock.**

7) Select soft-**key 'Continue' and the operator is returned to the 'Main Gas Read Screen'.**

8.13 Taking gas and flow measurement

START → If using GAM Set up GAM & UPLOAD to analyser → Instrument warm up → Select Technician ID if required or soft-key 'Skip' → Select soft-key 'Next ID' → Select or Add Borehole Id and press the 'Enter' key → Air Purge Instrument screen

Select soft-key 'Exit' ← If required select soft-key 'Special Action' to update site & ID question (ii) ← Main Gas Read Screen ← Wait then select soft-key 'Continue' ← If configured - operator may locate sample point using GPS ← Wait for Pump to run (i) ← Disconnect all tubing and allow analyser to purge with fresh air. Select soft-key 'Next'

Taking a gas measurement reading

Main Gas Read Screen → Select soft-key 'Start' → Gas Measurement screen → Connect the clear sample tube to the sample point. The yellow exhaust tube should be vented a safe distance from the user or re-circulated back into the system. → Select soft-key 'Next' → Wait for the initial readings to stabilise → Select soft-key 'Next' → Initial Gas Readings Fixed

Are you using an anemometer? ← Input the temperature on the Main Gas Read Screen and press the 'Enter' key ← NO Select soft-key 'Temperature' ← Are you using a temperature probe?

YES → Attach anemometer & insert into the sample point

NO → Zero Transducers screen

Are you using a temperature probe? — YES → Attach temperature probe → Insert temperature probe into the sample point

Taking a flow reading

Disconnect all tubing from the sample points and wait for readings to stabilise. Select soft-key 'Next' to continue if readings return to zero, otherwise to remove an offset perform a zero

Select soft-key 'Next' ← Connect the clear tubing to the static pressure sample point. The blue tubing should be connected to the differential pressure sample point. The yellow exhaust tube must be vented to atmosphere, a safe distance from the user. DO NOT re-circulate back into the system.

Measure initial gas flow reading displayed in the Main Gas Read Screen

Wait for initial readings to stabilise on the Main Gas Read Screen → Select Soft-key 'Next' → Initial Flow Readings Fixed → Select Soft-key 'Next' → Attach temperature probe or key in temperature manually and press 'Enter' → Wait for adjusted readings to stabilise on the Main Gas Read Screen → Select soft-key 'Next' → Adjusted Flow Readings Fixed

Taking a system pressure reading

Select soft-key 'System Pressure' → System Pressure Screen (iii)

Pressure Readings Fixed ← Select soft-key 'Next' ← Connect the clear sample tube to the sample point. The yellow exhaust hose should be vented a safe distance from the sample point or re-circulated back into the system. ← Select soft-key 'Next' ← Disconnect all tubing from the sample points and wait for readings to stabilise. Select soft-key 'Next' if readings return to zero, otherwise to remove an offset perform a zero

Pressure Readings Fixed → Select soft-key 'Store' → Readings stored successfully → Select soft-key 'Dismiss' → Take another reading? — NO → If using GAM Download readings to GAM → END

Take another reading? — YES → GO TO select or add borehole ID

KEY:
(i) If GPS configured the first reading will display a warning message. Select soft-key 'Dismiss' to continue.
(ii) Special action – if required change the analyser into GA mode of operation.
(iii) System pressure reading only available if set up on GAM.
NOTE: To restart a reading select soft-key 'Special Action' followed by key 1 'Restart Process'.

9.0 Calibration

9.1 Calibration Introduction

The GEM5000 gas analyzer is 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 outlines the correct procedures to enable the site engineer to field calibrate the gas analyzer.

✎ Note: This does <u>not</u> replace the factory service and calibration. If this calibration is completed incorrectly it may decrease the accuracy of the gas analyzer.

CH_4, CO_2 and O_2 can be measured by GEM5000 gas analyzer as standard; these channels can be user calibrated. The analyzers 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 GEM5000 instrument can have a H_2 compensated CO channel. This option requires that H_2 is used in the calibration process and is also set out within this section.

For the other gas channel options contact QED for advice.

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

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

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

9.2 Frequency of calibration – best practice

The GEM5000 gas analyzers can be checked against a known concentration of gas, to give confidence that the analyzer is operating as expected at the time and conditions in which it is being used.

It is recommended that the instrument is regularly serviced and calibrated by QED in accordance with the due date on the instrument.

When defining the frequency of user calibration, the following are factors to be considered:

- The frequency of use of the analyzer. (daily?/monthly?)
- The level of confidence and accuracy required for readings to be taken.
- Historical user calibration data.
- Site specific requirements or conditions.
- Historical understanding of expected readings on site.

Zeroing of the gas analyzer should be undertaken at the start of each day's monitoring.

Use historical data to drive your frequency of calibration.
If there is no historical data a good starting point for a daily monitoring round is performing a calibration once every week or every other week.

The results of the calibrations will need to be recorded to monitor over time whether the frequency of calibration needs to be increased or decreased relative to the confidence required.

The confidence required will be driven by the site specific / user requirements.

When undertaking the monitoring with an understanding of the history of the gas levels of that site, a calibration check could be triggered if the readings measured are different to what is expected.

? Note: For assistance please contact Technical Support at (800) 968-2026 or email landtec_support@qedenv.com

9.3 Calibration gases

User calibration of a gas analyzer will greatly 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_2 compensated) both CO 100ppm and H_2 1000ppm gases are needed.

The following table indicates the different gas mixture canisters used for calibration:

Calibration gas	CH_4	CO_2	O_2
Mixture 1	5%	5%	6%
Mixture 2	5%	10%	0%
Mixture 3	60%	40%	0%

Calibration targets for gas cells are dependent on the gas/range and type of cell fitted. Contact Technical Support for assistance.

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 QED. For further information please contact Sales at (800) 624-2026 or email info@qedenv.com

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

9.4 Calibration set-up

⚠ **Warning**	Do NOT attach the gas supply to the gas analyzer before putting the analyzer into the 'Gas Check' screen. Select 'Check Spans' from the 'Operation Settings' menu.

The regulator supplied with the calibration kit has been configured to deliver a fixed flow.

As **the regulator's flow is factory set, it only r**equires a few turns to open, no adjustment is necessary.

⚠ **Warning**	**Exhaust port**
	When the gas analyzer is being calibrated, there are two possible exits for the gas, via the usual manner out of the exhaust (yellow) port of the analyzer or in cases of over-pressurisation the 1/16″ port on the red pressure relief valve located on the regulator.
	It is recommended that both ports have exhaust tubing attached.
	The exhaust tubing must emerge in a well-ventilated area. Ensure there are no leaks in the tubing and connections.
	The calibration of the gas analyzer should be carried out in a safe area with all necessary precautions taken when using potentially dangerous, explosive or toxic gases.

✎ Note: There is also potential for gas to expel from the internal flow (blue) port of the gas analyzer (applies to the GA5000 only).

9.5 Calibration equipment
The diagram below displays the regulator and tubing equipment for user calibration:

- Certified calibration gas, available in either 29 liter, 34 liter or 58 liter gas canisters are supplied with the Landtec calibration kit. Please refer to the Landtec website www.landtecna.com for further information.

- The regulator supplied with the calibration kit is pre-set for flow and pressure rates that are factory set.

- If you are using a non Landtec supplied regulator, please ensure that it does not supply any greater than 200 mbar pressure.

9.6 Gas analyzer

For the GEM5000 gas analyzer the calibration options can be found by selecting the 'Menu' key followed by soft-key 'Operation Settings'. Select 'Key 2 – Gas Check' then follow the instructions on the analyzer screen by selecting 'Key 2 – Gas Check'.

9.7 Calibration processes – best practice

The following process diagrams outline the calibration steps.

- Ensure that you are regulating calibration gas down to below 200 mbar pressure, if you're not using a Landtec regulator. The use of a pressure relief valve is also highly recommended.

- When calibrating, it is recommended to use a calibration mixture close to the levels you are trying to measure, i.e. if you are trying to measure gas migration on a closed landfill, we'd recommend calibrating with CH4 5%/CO2 5%.

- In regards to frequency, we would recommend that you perform a fresh air calibration before each monitoring session, and a span calibration typical every 4 – 6 weeks.

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9.7.1   Gas Check in fresh air

START → Switch on the instrument and complete the instrument warm up. → Main Gas Read Screen select the 'Menu' key → Select key 2 'Gas Check' → Select key 1 'Gas check'

Let the pump run for 90 seconds and select soft key 'check' ← Select 'Fresh Air' by using the enter key ← Disconnect all tubing

Message will display 'Please wait for timer to reach zero' → When complete a message will display 'Check complete'

Read status field on the right hand side of the screen

Retry / Calibrate / Record

Calibrate → Was the calibration successful?

Record → This feature records that a gas check has been completed but does not calibrate the analyser

Was the calibration successful? — Successful → Result saved

Was the calibration successful? — Unsuccessful → Please see the section 9.11 – Calibration troubleshooting

Result saved → Select soft-key 'Exit' → END

This feature records... → Select soft-key 'Exit' → END

GEM5000 Gas Analyzer

9.7.2   Calibration – mixtures 1, 2, & 3

START → Switch on the instrument and complete the instrument warm up. → Main Gas Read Screen select the 'Menu' key → Select key 2 'Gas check '

Connect the flow regulator to the white port on the analyser ← Press 'Enter' to confirm Gas mixture ← Select correct gas mixture: 1, 2, or 3, or add User-selectable gas mixture ← Select key 1 "Gas check"

Flow certified gas mixture using the gas regulator supplied → Wait for the readings to stabilise. Wait for the analyser to check spans for approx. 1 minute. → Select soft-key 'Check' → Message will display 'Please wait for timer to reach zero' → When complete a message will display 'Check complete'

Read status field in the right hand corner of the screen

Retry Calibrate Record (decision)

Calibrate → / Record → This feature records that a gas check has been completed but does not calibrate the analyser

Was the calibration successful? (decision)

Successful → Read status field in the right hand corner of the screen → Select soft-key 'Exit'

Unsuccessful → Please see section 9.11 – Calibration troubleshooting

Select soft-key 'Exit'

END

GEM5000 Gas Analyzer

9.8 Restore to factory settings

This option will reset the gas analyzer to all of its factory programmed calibration settings and will clear ALL the user defined calibration points. **It will not affect or remove ID's or readings from the analyzer.**

1) Select 'Key 2 - Restore to factory' followed by the soft-key 'Confirm' or 'Cancel'.

2) **A validation message is displayed 'Reset user calibration?' Press the soft-key 'Confirm'** to continue with the factory settings or soft-key 'Cancel' to cancel the operation and return to the Gas Check menu.

9.9   Calibration history

The GEM5000 gas analyzer logs user calibrations in **'History' application**. This can be used as an aid to ensuring that gas measurements are valid and accurate. Both good and failed calibration results are recorded for each channel calibrated.

1) Select 'Key 3 – History'.

2) The operator may view the calibration data stored. Use the soft-key 'Filter' to add a sort filter to the history enquiry.

9.10   Calibration summary

The GEM5000 gas analyzer has the facility to log the history of user calibrations.

1) Select 'Key 4 – Summary'.

2) The operator may view the calibration data history stored by ID, technician, timestamp, type and calibration result. Use the soft-key 'Exit' to exit and return to the 'Gas Check' menu.

10.0 The LANDTEC System Gas Analyzer Manager (LSGAM) Software

LSGAM software is used to communicate with the GEM5000 and GEM2xxx family of instruments. This allows a simple upgrade of information from older GEM2xxx instruments to the GEM5000 instruments.

Configuration Options
The GEM5000 instruments and LANDTEC System Gas Analyzer Manager (LSGAM) software can be utilized in a number of ways:
- Configured for operation with the LANDTEC System online service
- Used offline as a local application storing information on the desktop/laptop computer
- Use of the GEM5000 out of the box without software; (this does not allow the user to generate flow rate values, select comments or select IDs with the instrument. This also prevents downloading of readings to the computer.)

Note: Certain functions that are new to the GEM5000 and are controlled by LSGAM may not be compatible with the GEM2xxx instruments. In such cases, the most compatible configuration will be used. For example: the GEM5000 supports switching of modes based upon ID setup but the GEM2xxx does not. As such, ID's with "NO Flow (GA Mode)" are sent to the instrument as "User Input". Likewise, the ACCU-FLO 1.0V wellhead was introduced after the GEM2xxx was released and the GEM2xxx does not have support for this particular flow device but the GEM5000 does. ID's containing an ACCU-FLO 1.0V flow device will be sent to the GEM2xxx instrument as "User Input".
If using a mix of GEM2xxx and GEM5000 instruments, it is recommended to do all LSGAM related setup work with the GEM5000 instrument in order to take advantage of the new features.

10.1 LANDTEC System Online Users

The procedures included in this section are intended for those who connect to the LANDTEC System online service. The LANDTEC System is an online collaboration tool to Collect, Validate, Analyze, and Communicate information based on field data obtained using LANDTEC instrumentation. LANDTEC offers a variety of On-Line service subscription levels for LANDTEC System software.

If you are a currently registered user on the LANDTEC System, please log in at http://www.landtecsystem.com/. If you are not currently using the LANDTEC System, you may register by contacting LANDTEC in the US: (800) 968-2026.

Online reference for using LANDTEC System Gas Analyzer Manager (LSGAM) with the LANDTEC System can be found under the About → Help & Support menu within the LANDTEC System.

If you do not have login information please contact LANDTEC System Technical Support at (800)968-2026. Alternatively, you may contact your local LANDTEC office for information on connecting to the LANDTEC System online service.

10.2 Offline Users

The procedures included in the section describe use of the LANDTEC System Gas Analyzer Manager (LSGAM) Software while **NOT** connected to the LANDTEC System online service.

GEM5000 Gas Analyzer

10.3 Installation with CD or Memory Stick

System Requirements
- Windows XP, Vista, 7, 8
- Pentium 750MHz or faster
- 128MB RAM
- 200MB Hard Drive Space Available
- CD-ROM Drive
- Available USB port or bluetooth connection

NOTE: The computer may need administrative privileges to install the program. Program may run on other versions of Windows but LANDTEC has not tested the program on older versions of windows or with lesser processor and memory requirements.

As part of LANDTEC's continual improvement process, LANDTEC has consolidated its product information and instrument communications software into one menu structure. On your memory stick or CD you will find technical information, instrument communication software, USB cable drivers, videos and instrument manuals.

To install the USB Cable Drivers and LSGAM (instrument communication software) from this media format, you will need to place your CD or memory stick into your computer. If you have a CD it should automatically start. If you have a memory stick, you may have to browse to it in your computer and then click on the ***ClickHereToStart.htm*** icon. If you **don't have a CD or memory stick, simply call LANDTEC's technical support for internet links** required to install the software.

Once the media opens, you should see the GEM5000 and GEM2000 instruments on the homepage.

Click on the GEM5000 instrument to open the LSGAM Software Setup.

From the setup screen you will see four buttons directly related to the GEM5000:
- Step1 Communications Driver
- Step2 Install LSGAM Software
- 5000 Manual
- Instructional Videos
Note: Technically the communications drivers differ between the GEM2000 and GEM5000

instruments, however, the driver package included with the 5000 instruments shipping after Nov 1, 2012 include drivers for both the GEM5000 and GEM-2000 instruments. The LSGAM software for the GEM5000 is backwards compatible for the GEM2000 instruments.

The LSGAM software will automatically update if an internet connection is available when the software starts. This software has been tested with Windows XP and Windows 7.

Should you have any difficulties, please don't hesitate to contact us. Our Software support group can be reached at (800) 968-2026 or landtec_support@qedenv.com
The instrument communicates to the computer by means of a USB cable or by bluetooth. The USB cable requires drivers to be installed prior to use on the computer. From the CD (or USB memory stick) choose the first option titled "Step 1". A Bluetooth connection requires the instrument to be paired to the computer. Refer to the section "Configuring Communications" for more details.

The Java programming is an import part of this software and will be loaded with the installation. If you have internet access, it is recommended to update your java to the latest version by going to http://www.java.com/en then clicking the button for the Free Java download. Once at the Java downloads you'll see links to download the latest version of Java for your computer.

The Java icon, shown below, will be in the task tray at the bottom of your computer screen where your time is shown. There will also be a GAM log icon, shown below, that will be created on your desk top during installation.

10.4 Start Up

Once the USB cable drivers are installed and you've checked for the latest Java Runtime from the www.java.com/en website, click on "Step 2 — Install LSGAM". LSGAM will install placing an Icon on your desktop and a new Start Menu Group named LANDTEC.

Starting LSGAM can be easily done by doing one of the following:

Double-Click on the Desktop icon. OR - go to;

Start → All Programs → LANDTEC → LANDTEC System Gas Analyzer Manager
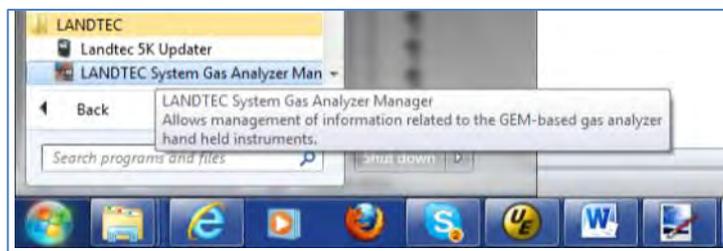
The software will start.

GEM5000 Gas Analyzer
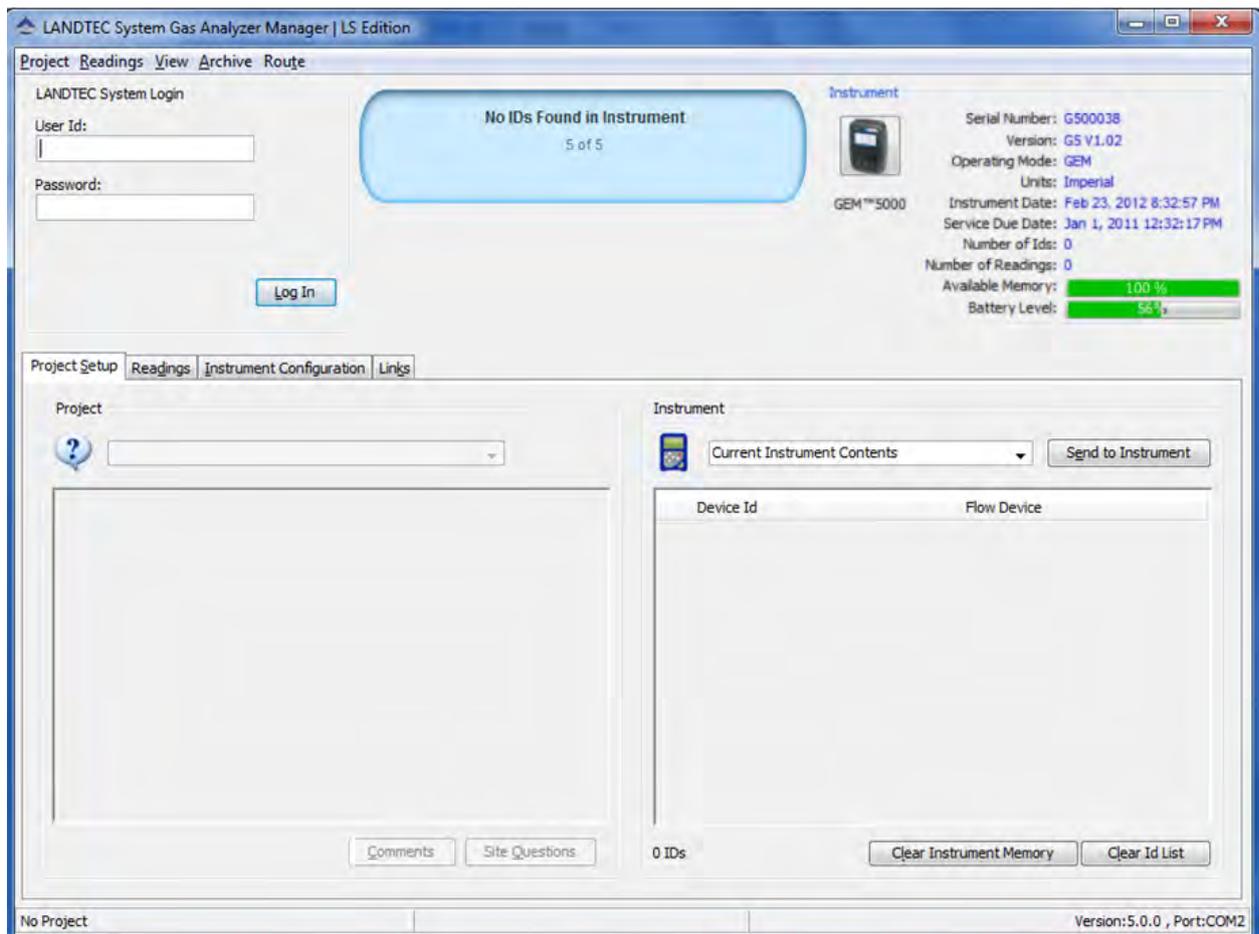
10.5 Navigation

The LANDTEC System Gas Analyzer Manager User Interface allows for easy access and navigation to various utilities to use the LANDTEC portable instrument on a day to day basis. The following is a general description of the user interface.

LANDTEC System Login
When LSGAM is used with the LANDTEC System online service, the username and password will be entered in the screen below, if you are using LSGAM as a desktop application the User Id and Password fields do not need to be filled in.
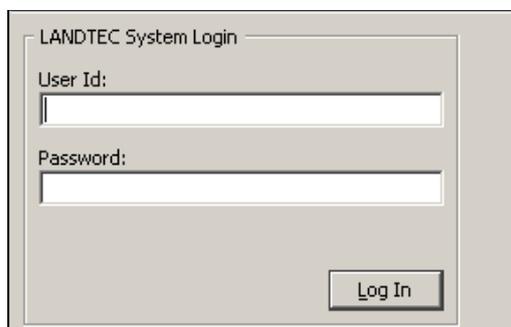
The Progress section indicates the status of the current process. For example, when starting up LSGAM, this will show you the activity of the software.

The Instrument section displays whether or not an instrument is connected. This also downloads the IDs, readings, and comments. If an instrument is found the following details are shown about the instrument:

10.6 Connecting to the Instrument
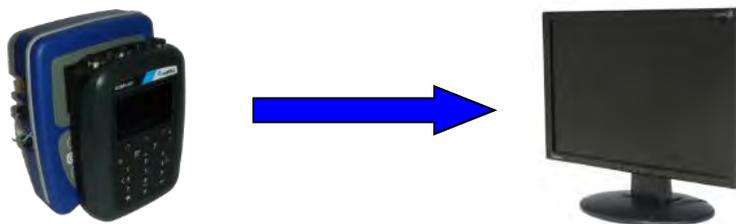
- Connect the GEM5000 to your computer with either the USB cable or a Bluetooth connection.   In the event you instrument has difficulty connecting, refer to Appendix—Configuring Communication Connections for more information setting up and testing USB Serial communications and Bluetooth Serial communications.
- The Instrument must be powered ON and in the Gas Reading screen
- Launch the LSGAM software by clicking on the icon on your desktop

This is the first screen you will see when starting the program.

 or

Once the software is installed on your computer with an internet connection this instrument communications program has Auto application updates. This enables you to always have the most current version of the instrument communications LSGAM.

If an update to LSGAM is available, <u>you will be prompted to install the update.</u>

GEM5000 Gas Analyzer
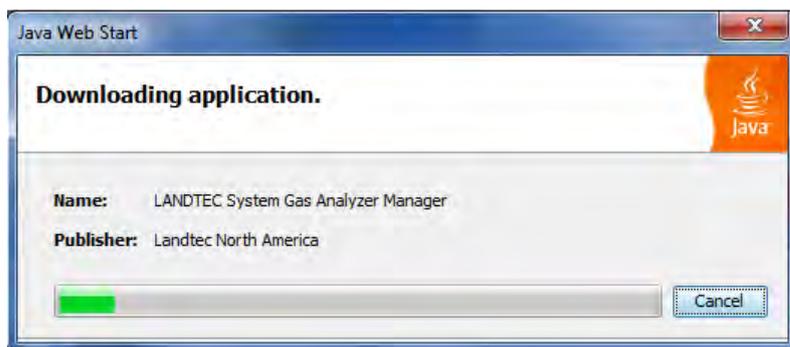
Click on OK this will return you to the desktop and you will then need to click on the LSGAM shortcut again.

The GEM5000 must be connected to computer and turned ON. It must also be in the Gas Reading screen. The LSGAM software will automatically download any information in the instrument including readings, comments and IDs.

Note: Connection of instrument to computer should not be performed in a hazardous area.

A new instrument containing no information will display only the instrument information: Serial Number, Version, Operating Mode, Instrument Date, Service Due Date, Number of IDs, Number of Readings, Available Memory, and Battery Level.
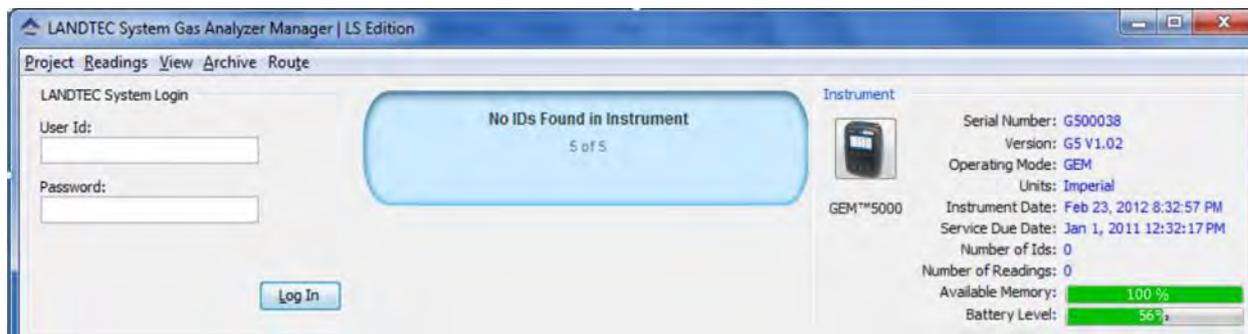
10.7 Create a Project/Select a Project

Projects are a collection of Device IDs and their associated reading history. A project can be created using LSGAM to contain a group of sequenced IDs and chronological history of instrument readings.

To create a Project, click on the Project menu and select New Project.
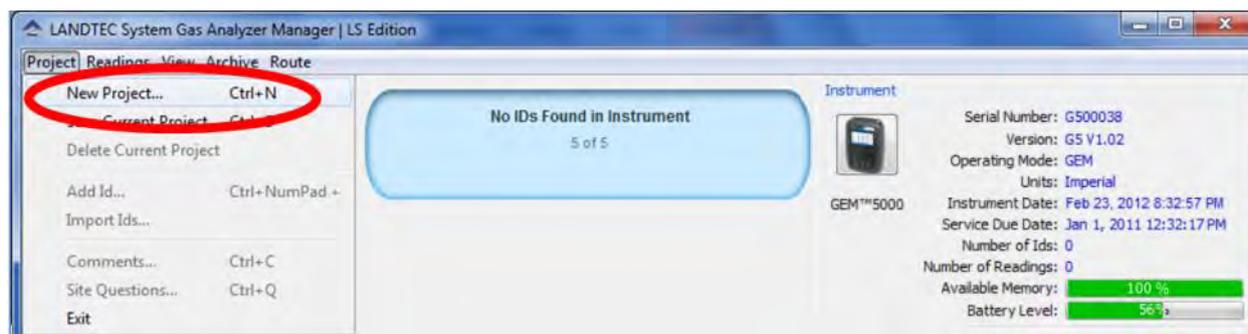
Upon selecting **New Project...** you will be prompted to enter a Project Name and select from one of three options.
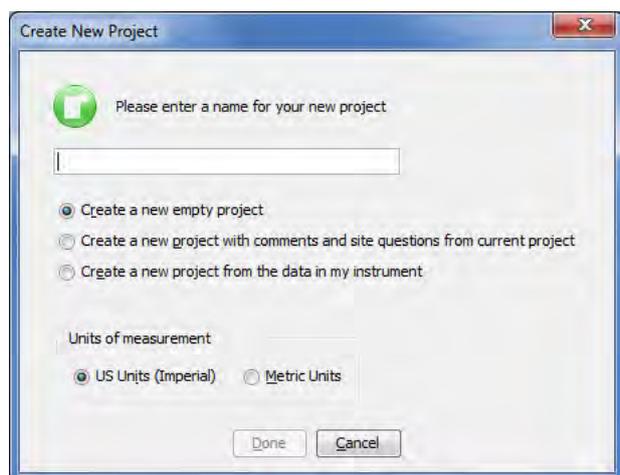
Create a New Empty Project
This option creates a blank project where you configure all IDs and Comments. Alternately ID's can be loaded from a file using the DataField CS version 3.4 ID file format.

Create a New Project with comments and site questions from a Current Project
Selecting this option allows the user to create a new project that will have the same Comments and Site Questions as an existing project.

Create a New Project from the data in a GEM instrument
This option will create a New Project and automatically associate the IDs, Comments, and Site Questions that exist in the connected portable instrument.

10.7.1 ID Set Up

An ID represents a physical sampling point in the field. An ID can be allocated to field components such as extraction wellheads, gas transmission lines, or passive monitoring probes. LSGAM allows users to configure an ID for each sampling point in order to obtain accurate readings with LANDTEC portable instrumentation

IDs are created, modified, and removed from the Project Setup tab in the software.

10.7.2 Creating Comments

Comments should be setup prior to creating new IDs. The user can define Comments that can be associated with a reading in the portable instrument.

If you selected Create a New Project, when creating your project, you will need to click on the Create Comments button. Comments can be entered in this setup screen or loaded from a text file and will be displayed in the user interface. Comments can be 64 characters in length. "Notepad" or another text editor can be used to create a file containing one comment per line up to 64 comments in total.

Note: It is extremely important to NOT include any punctuation other than dashes or underscores when setting up a comments file in notepad. Commas and Quotation marks are used by programs for determining where data begins and ends. Using characters other than underscores and dashes and cause unpredictable results within the data when downloaded
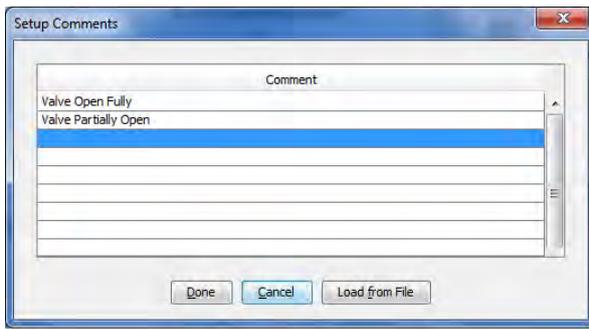
Typical Comments Might Include
Valve Fully Open
Valve Partially Open
Valve Closed
Air Leak in Wellhead
Water Blockage in Header
Surging at well
Sample Port Needs Replacement
More Vacuum Needed
5 Day Recheck

10.7.3 Creating ID's

There are several ways to input IDs to the Project. The following describes each process:

Creating new IDs with LSGAM

To create a new ID using the LANDTEC System Gas Analyzer Manager, Right Click on the left ID pane beneath your active project and select the Add New ID option.

The Add New ID form will be displayed. From the ID Information tab of this form, entry of the following is available:

Note: LAT & LONG will only be available on **GEMs with the NAV option**

GEM5000 Gas Analyzer

ID INFORMATION

Device ID: Must be eight (8) alphanumeric character spaces. (For example, ALFGW001)

Device Type:

- Well: An active gas extraction well connected to a piping network which may require a flow rate reading.
- Sample Port: A sample point along a gas transmission line that may require a flow rate.
- Probe: A passive gas migration monitoring probe that does not require a flow rate.

The GEM5000 calculates flow rate values specific to each device type (listed above). The available flow devices programmed in GEM mode are listed below.

Flow Devices:
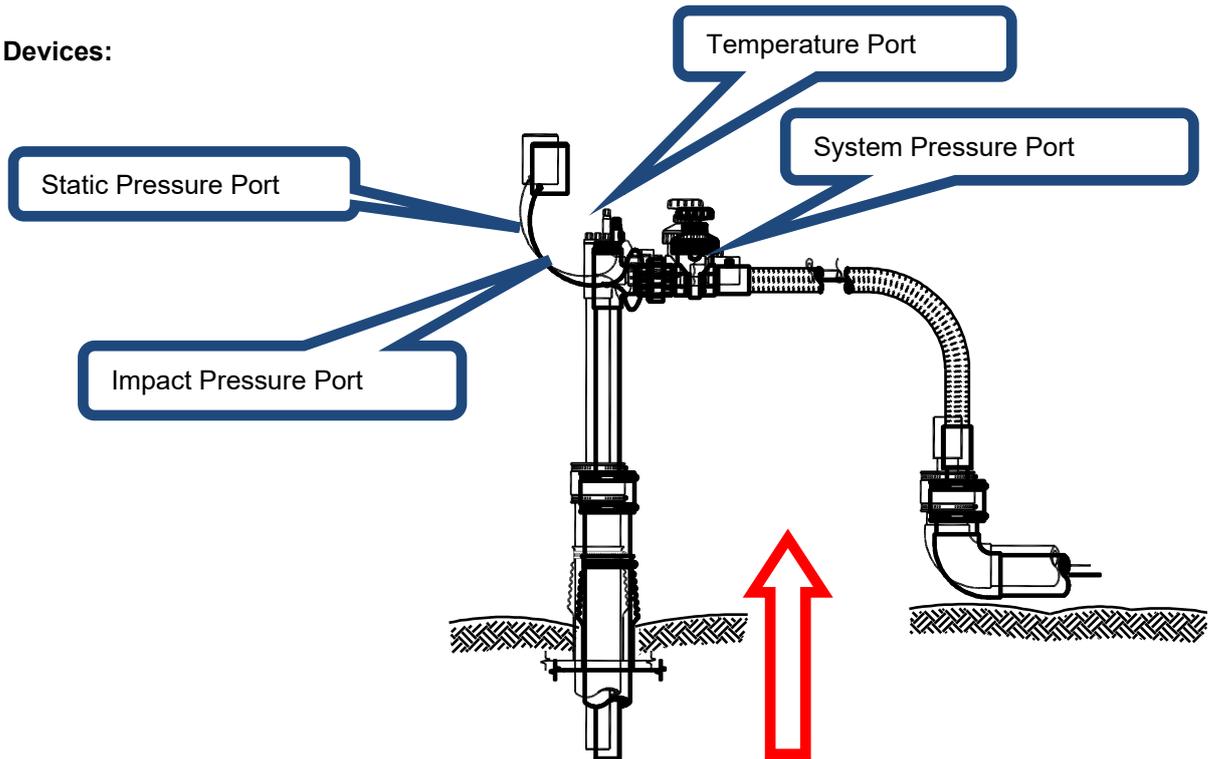
Figure 1 - ACCU-FLO Vertical Wellhead
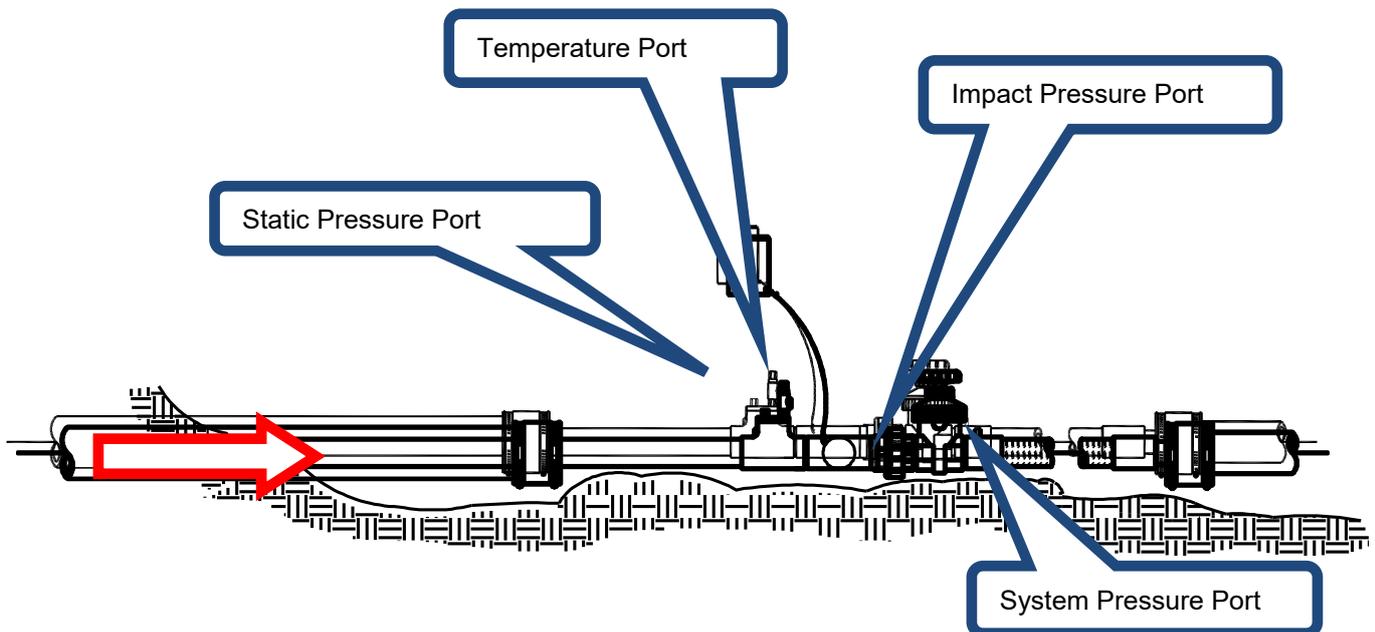
Figure 2 - ACCU-FLO Horizontal Wellhead

GEM5000 Gas Analyzer

Impact/Total Pressure Port

IMPACT PRESSURE

PITO TUBE
(SECTION ENLARGED TO SHOW DETAIL)

Static Pressure Port

STATIC PRESSURE

Figure 3 - Pitot Tube

FLOW

PT   STATIC

Impact Pressure/ "L_{ow Pressure}"

Static Pressure / "L_{ow Pressure}"

Static Pressure / "H_{igh Pressure}"
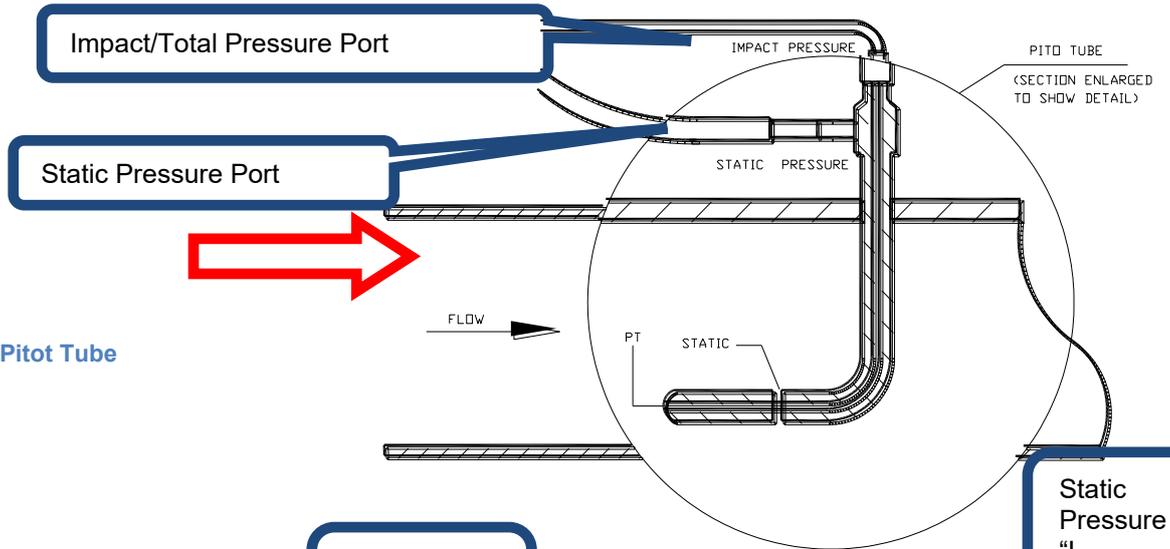
Impact Pressure/ "H_{igh Pressure}"
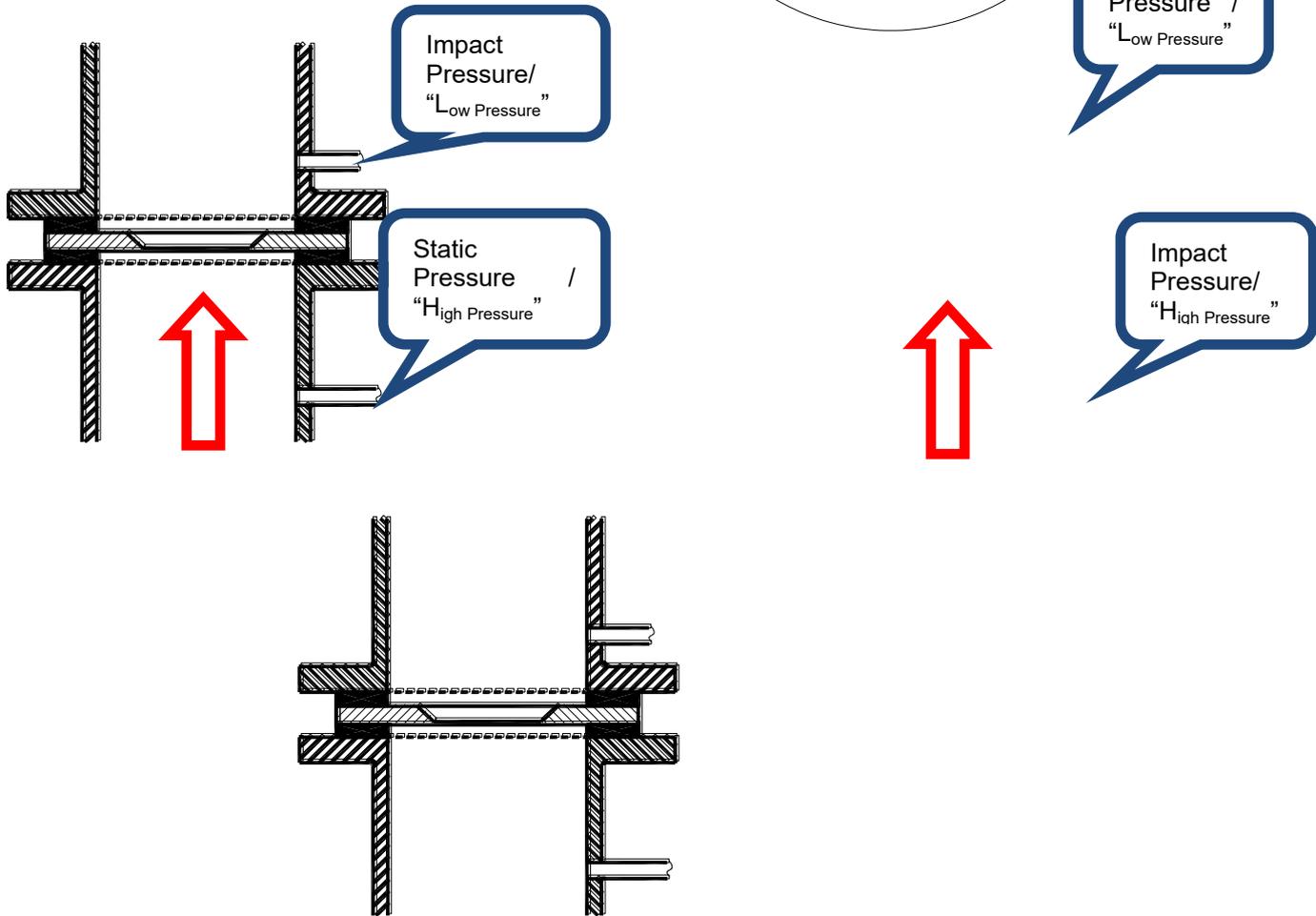
Figure 4 - Orifice Plate (WellSide)

Orifice Plate

Flow Device Name Programmed in GEM	Orientation	Size (Inches)	Flow Range (SCFM)	System Pressure
No Flow (GA Mode) *				
ACCU-FLO 1.0V	Vertical	1.0	1-25+	
ACCU-FLO 1.5V	Vertical	1.5	1-50+	
ACCU-FLO 1.5H	Horizontal	1.5	1-50+	
ACCU-FLO 2V	Vertical	2.0	5-125+	
ACCU-FLO 2H	Horizontal	2.0	5-125+	
ACCU-FLO 3V	Vertical	3.0	35-300+	
ACCU-FLO 3H	Horizontal	3.0	35-300+	
Orifice Plate				
Pitot Tube				
User Input				
Orifice Plate WellSide				
ACCU-FLO 1.0V	Vertical	1.0	1-25+	✓
ACCU-FLO-1.5V (System Pressure)	Vertical	1.5	1-50+	✓
ACCU-FLO-1.5H (System Pressure)	Horizontal	1.5	1-50+	✓
ACCU-FLO-2V (System Pressure)	Vertical	2.0	5-125+	✓
ACCU-FLO-2H (System Pressure)	Horizontal	2.0	5-125+	✓
ACCU-FLO-3V (System Pressure)	Vertical	3.0	35-300+	✓
ACCU-FLO-3H (System Pressure)	Horizontal	3.0	35-300+	✓
Orifice Plate-System Side (System Pressure)				✓
Pitot Tube (System Pressure)				✓
User Input (System Pressure)				✓
Orifice Plate WellSide (System Pressure)				✓

- *Note: Use of the No Flow type of device on a Probe will allow the GEM5000 instrument to automatically switch to the GA workflow when the ID is selected. The user can always use special actions from the menu to switch workflows between GEM and GA.*

Pipe Diameter: The pipe inside diameter (ID) is required for Orifice Plate and Pitot Tube type flow devices.

Orifice Diameter: The field for orifice bore diameter is available for all Orifice Plate flow devices.
Note: For the instrument to calculate a flow the ratio of orifice size to pipe diameter must be between 0.25 and 0.75.

Pump Run Time: Indicates the duration the instrument's pump will run while sampling for the selected ID.

Device Information: Allows the user to enter general information for the device. This will display on the screen of the instrument if the user chooses the ③ View ID Details option from the ID selection screen on the instrument.

ID QUESTIONS

There are 5 Question Types that can be selected:
- **None -** No question will be prompted to the user
- **Alphanumeric -** An alphanumeric answer can be entered when taking a reading
- **Numeric** - A numeric only answer can be entered when taking a reading
- **Multiple Comment selection -** Up to 8 comments that may be appropriate for this device ID can be selected in the ID setup. Then one or all of the comments can be selected when taking a reading.
- **Single comment selection -** Up to 8 comments that may be appropriate for this device ID can be selected in the ID Setup but only one comment can be selected when taking a reading. Comments related to valve position are often used with a Single Comment Selection because the valve can only be in one position.
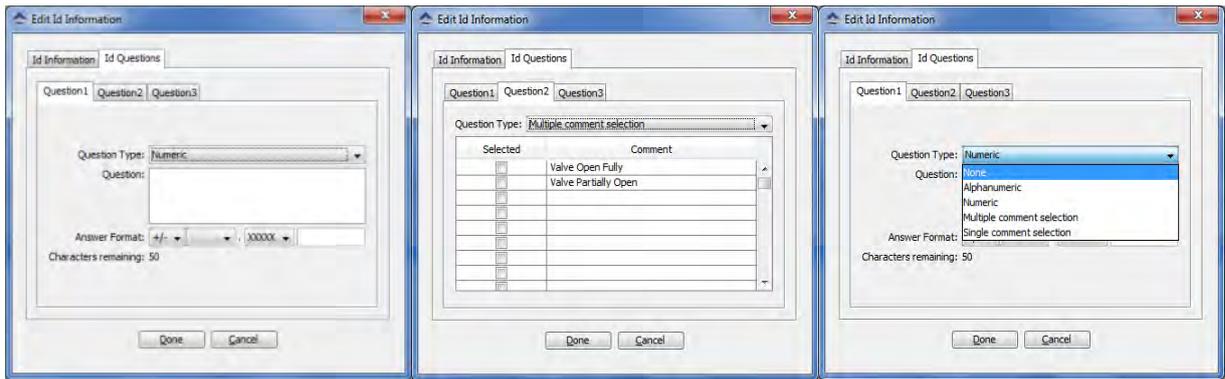
10.7.4 Importing Data Field CS ID's

If you have existing ID files from DataField CS v3.4.x, these files can be imported by LSGAM. To begin this operation select the **Import IDs...** option from the **Project** menu.
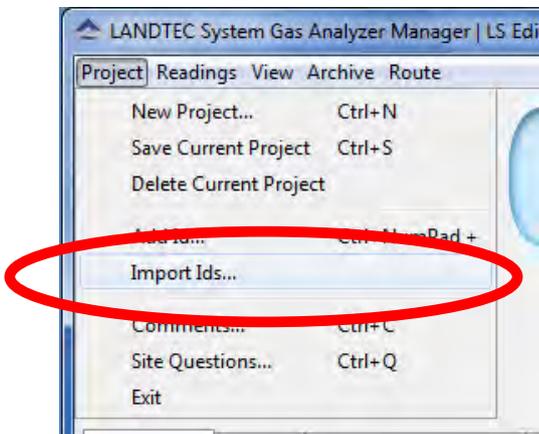
Select an ID file generated by DataField CS v3.4.x.

10.7.5 Creating a New Project (ID's already in instrument)

To create a Project based on the information in the instrument, select **Create a new project from the data in my instrument**.
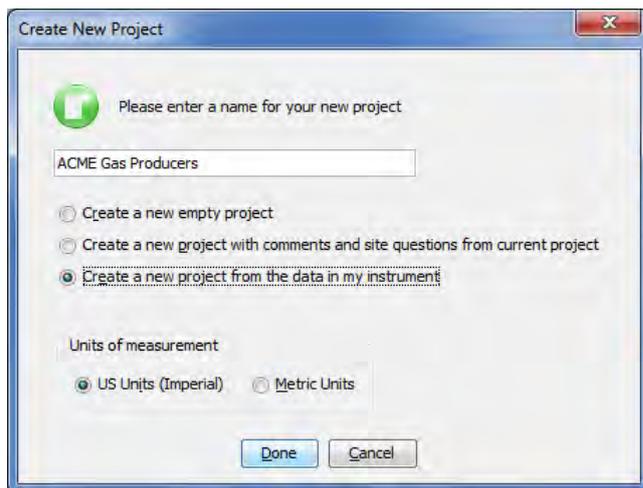
*Note: When using the **Creating a new project from the data in the instrument option**, only IDs NOT associated with other projects will be created into the new project.*
Creating a Device ID that does not measure flow Example- Probe or Sample Port

If there is no flow device you can choose the "No Flow (GA Mode)" option. Alternatively, you can also choose User Input. When choosing the User Input option you will need to enter the appropriate pipe inside diameter. A pump run-time must be specified in with either type of flow device.
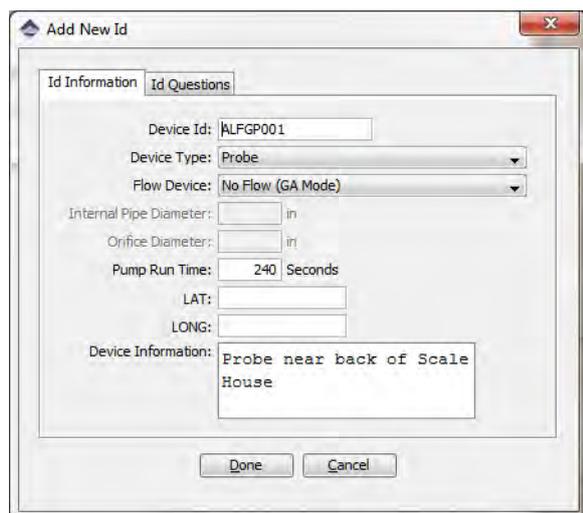
Figure 5—Probe Definition using "No Flow" option
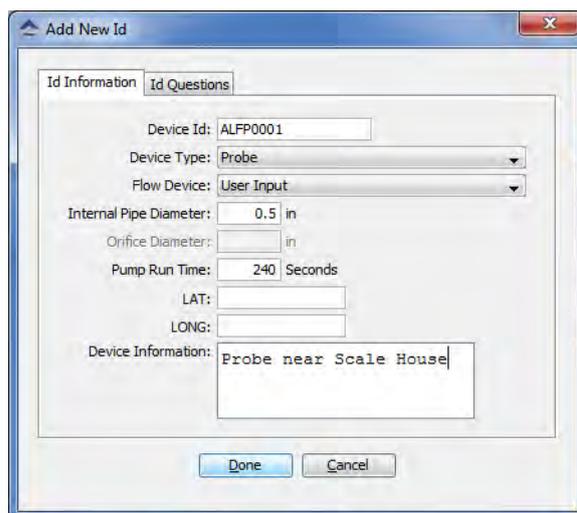
Figure 6—Probe Definition using "User Input"

10.7.6 Creating Site Questions

Site questions are setup in the same manner as ID questions however unlike ID questions, the answers for Site questions will apply to all subsequent readings until the site question is updated. A total of 5 site questions can be sent to your instrument. These must be updated each time you use the GEM. This is done by going to the ① Menu selection on the instrument and choosing [Update Site Data]

The options for questions are Alphanumeric – Numeric – Multiple or Single comment selection.
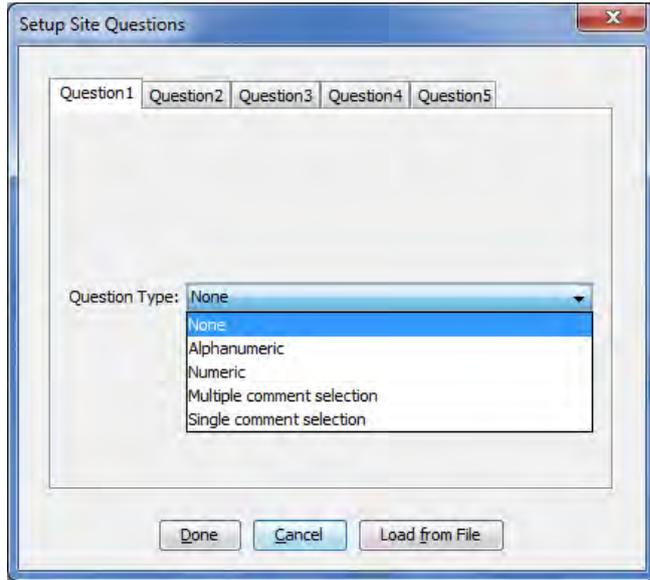
These Site Questions may be used again with another project by selecting the Create New Project and create new project with comments and **site questions** from current project.
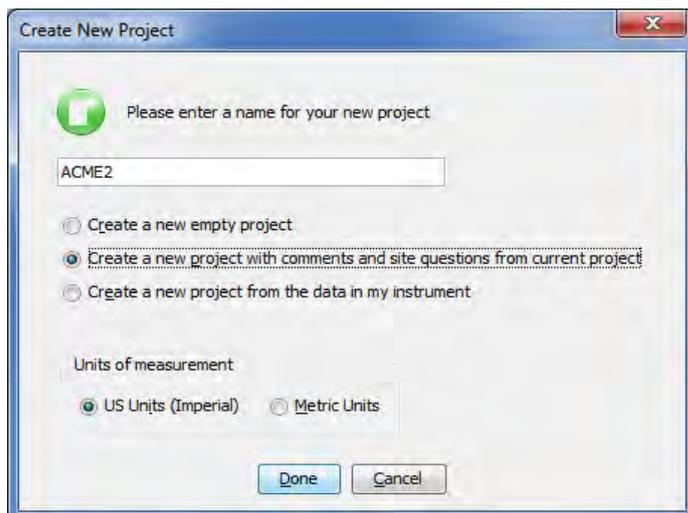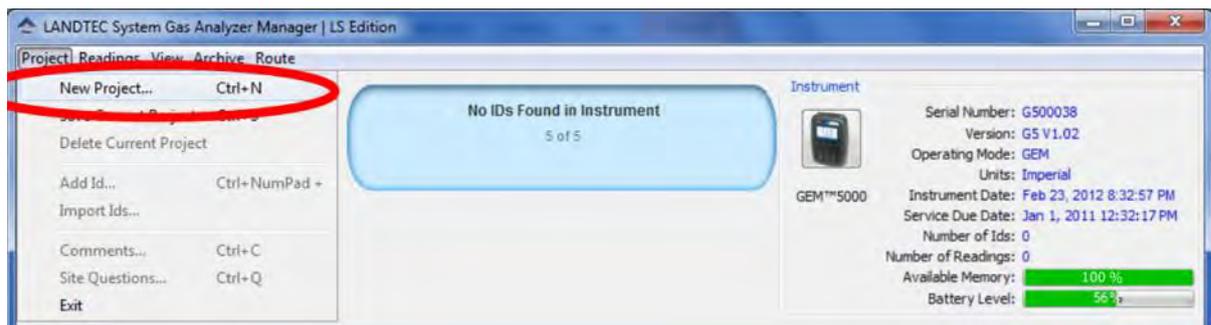
The project will be created and the IDs, Comments, and Site Questions that exist in the instrument will be applied to the new project.

10.7.7 Working with Device ID's

Once some IDs are added to your project you may need to occasionally edit them or reference them. First select the project which you want to work with from the project drop down list.
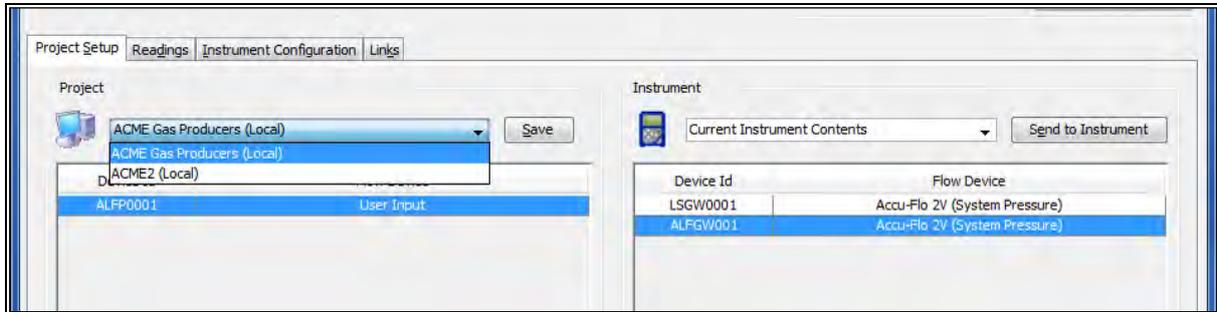
Placing the mouse cursor over a specific device ID will show detailed information about that ID.
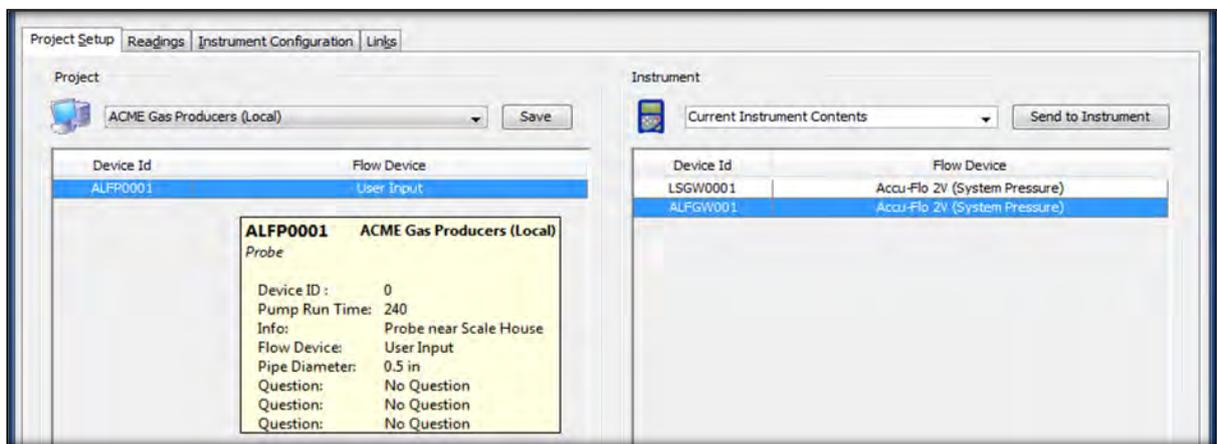
To edit a Device ID, right click on the desired device and select **Edit Device ID**.
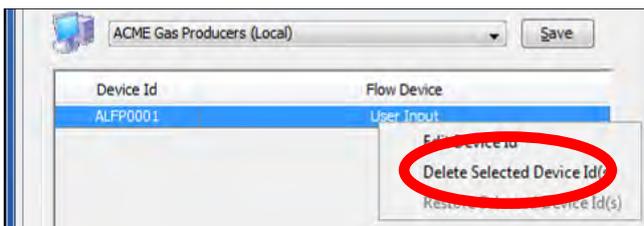
To delete an existing ID, right click on the desired device and select **Delete Selected Device ID(s)**.
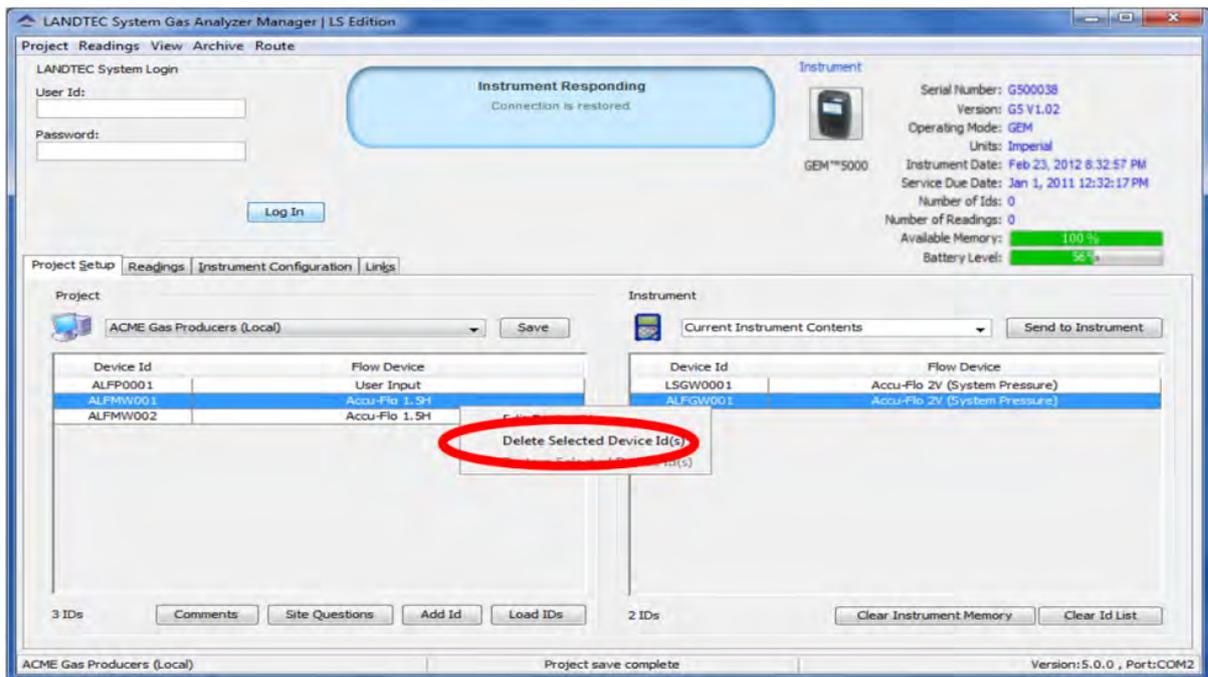
Upon clicking on Delete Selected Device Id(s) you will see the line ~~strikeout~~.
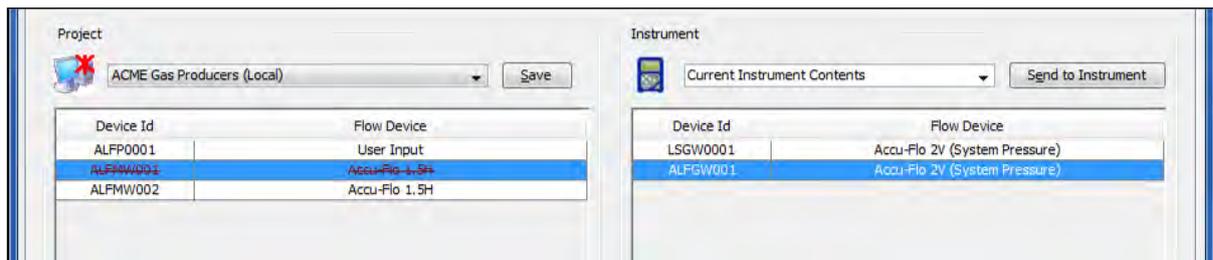
The computer Icon will now display a red asterisk* over the image . This indicates that the IDs are NOT saved. Deleted IDs are displayed with a line through the information on the screen. To restore a deleted ID, right click on the ID and click **Restore Selected Device ID(s).**

Note: Deleted ID's can only be restored while the project state is unsaved. Once saved, the ID changes are saved and restoration cannot be completed.

Once all work with the device ID's is complete, click on the Save button.
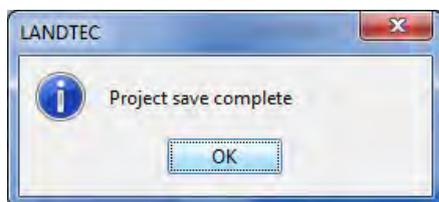
After clicking on OK, the device is removed and the computer icon returns to the unaltered state .

10.7.8 Sending ID's to the Instrument

Once IDs have been created in the project, they must be uploaded to the instrument. To perform this operation, select the desired IDs from the left hand table under the Project name (computer side), left click and hold while dragging the IDs to the right hand table and **release the mouse button. This is action is known as a "Drag & Drop".**

Three basic methods of selecting IDs exist.
- Select Specific ID(s)
- Select a Range of IDs
- Select All IDs

Specific IDs

To Select Specific IDs from the List, place the mouse arrow   at the edge of the first cell and hold down the left Ctrl key. Now click the next ID cell that you wish to select. Repeat this as many times as necessary.
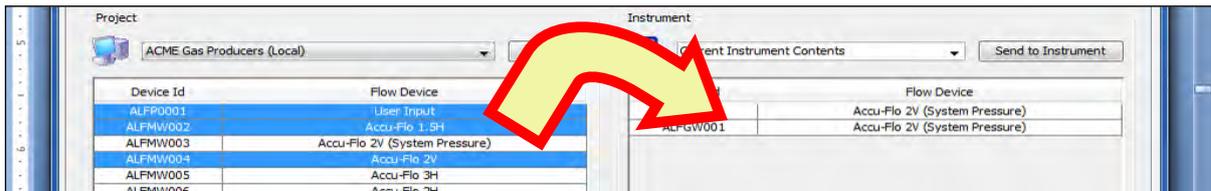
Selected IDs (shown as Highlighted). Arrow depicts "Drag & Drop" action after selection.

Now "Drag & Drop" the IDs from the left (computer window) to the right (instrument window). During the "Drag &Drop" process, the arrow   will change to ⊘.
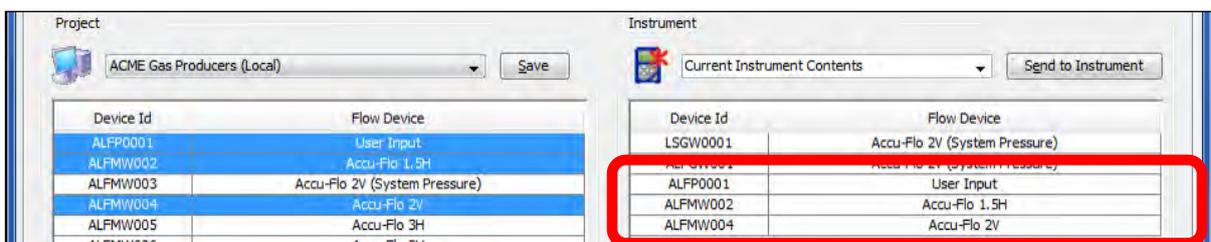
The selected IDs ALFP001, ALFMW002, and ALFMW004 now appear on the Right (Instrument) side. At this point the IDs are on the Instrument side but have NOT been sent to the instrument. The instrument with the red asterisk ✳ 🖳 indicates this unsent ID state. Click on the Send to Instrument button [Send to Instrument] to send these IDs to the instrument.
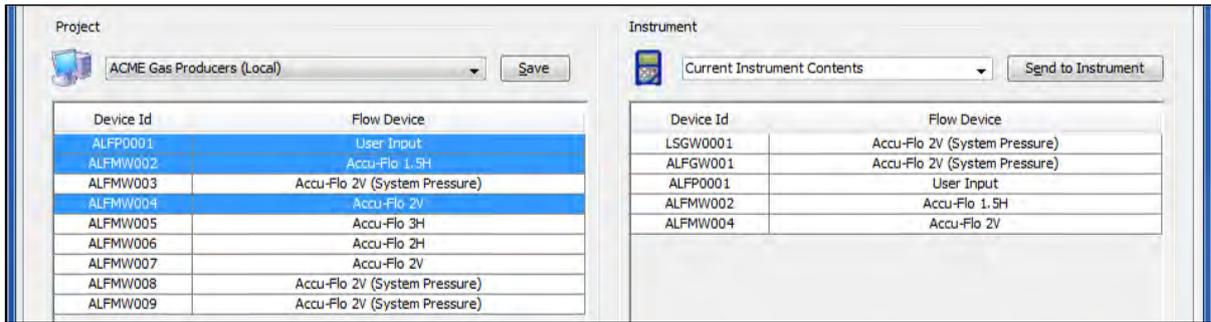
After the IDs are sent to the instrument, the instrument will appear without the red asterisk*

Range of IDs

To Select A Range of IDs, place the mouse arrow at the edge of the first cell and hold down the left shift key. Now click the last cell in the range. The entire selected range will now be selected.
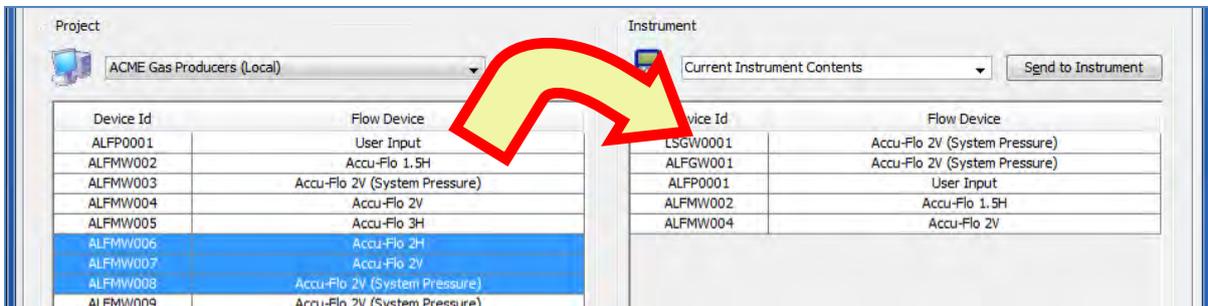
As with selecting specific IDs once the IDs are selected, they are moved to the Instrument **side by "Drag & Drop". The Instrument icon will appear with a red * and the ID's will need to** be sent to the instrument.
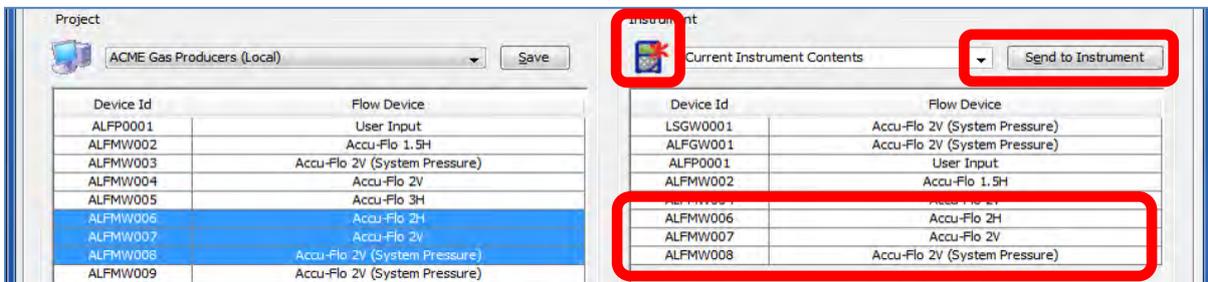
Click on the Send to Instrument button to send these IDs to the instrument.

Selecting All IDs

All IDs can be selected by selecting one ID in the Project window and then pressing Ctrl-A.
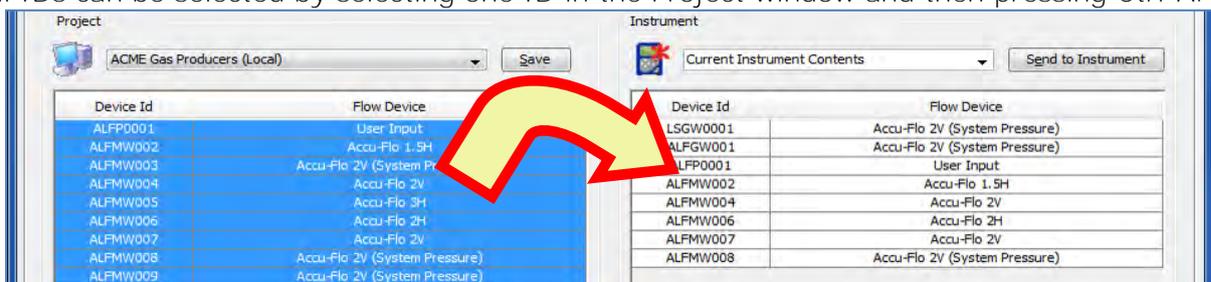
Now move IDs from the Project Side to the Instrument Side by dragging and dropping them.
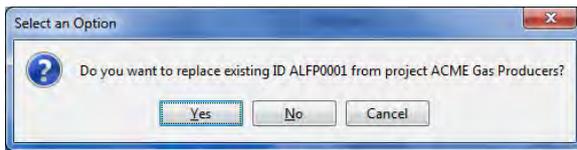
If you are dragging and dropping an ID that is already on the instrument side, you will be prompted with the above message. Answer Yes to update the IDs on the instrument side from those on the computer side. Answer No to ignore IDs that are already in the instrument. Answer Cancel to cancel the action without sending ID's to the instrument side.
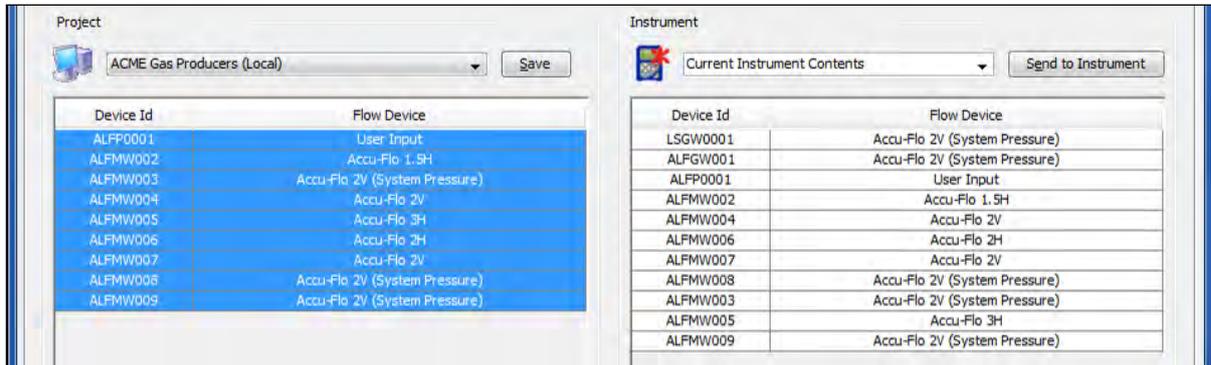
Click on the Send to Instrument button to send these IDs to the instrument.

10.7.9 Clearing ID's or Deleting a Project
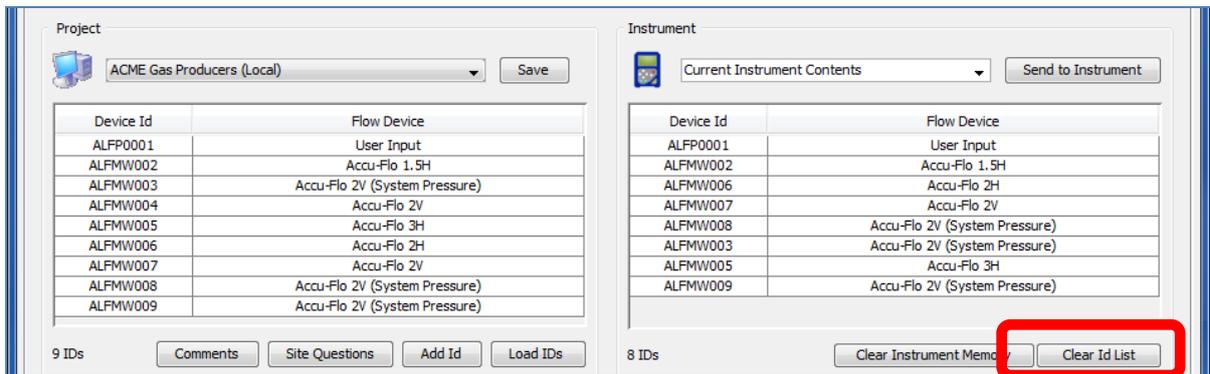
In current instrument contents when selecting the **Clear ID List** option, lines will be drawn through the IDs.
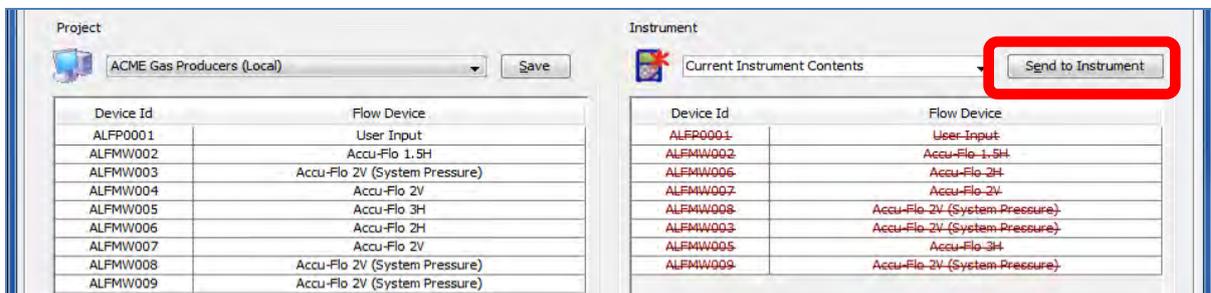
You then need to select **Send to Instrument**. This will clear all IDs from the instrument.
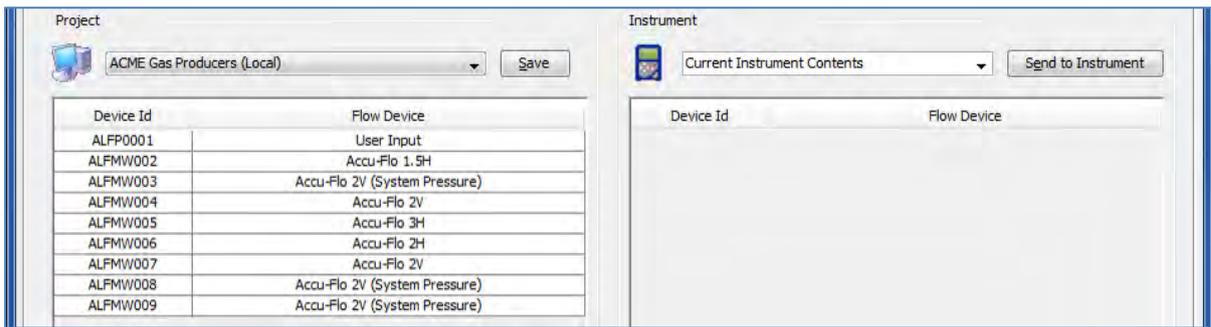
You may also delete one ID from a list by highlighting the ID RIGHT CLICK with your mouse and select the **Delete Selected Device** option. If you have selected the wrong ID and deleted then you may select the Restore option to return the ID to the list.
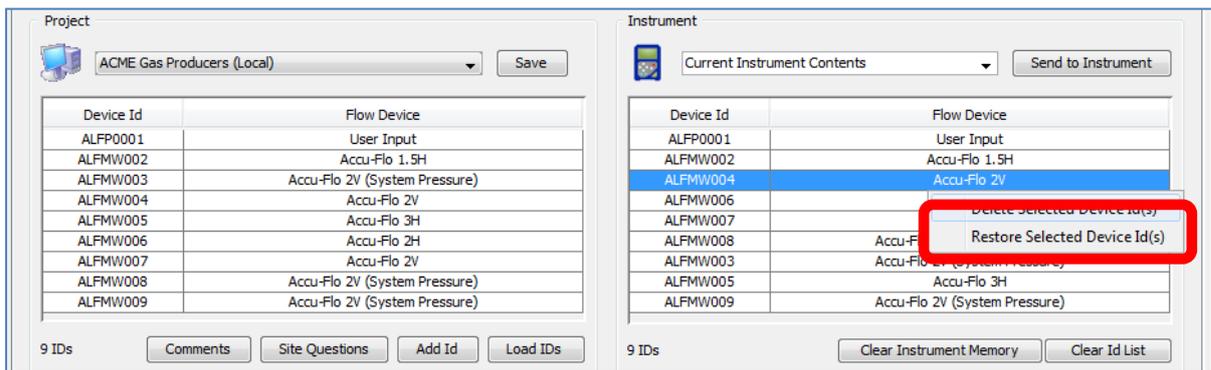
Upon selecting Delete Selected Device Id(s) you will see a ~~strikeout~~ line appear through the ID
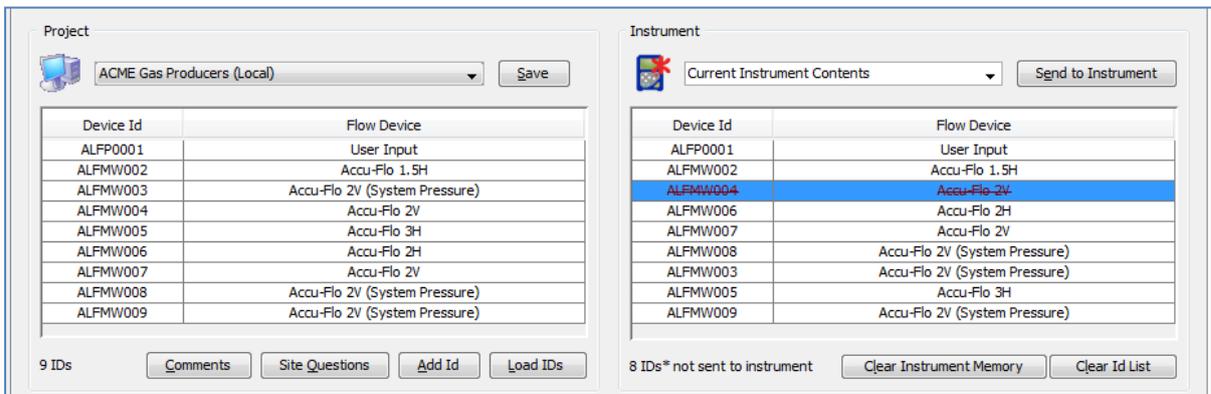
Click on the Send to Instrument button [Send to Instrument] to send the ID corrections to the instrument.
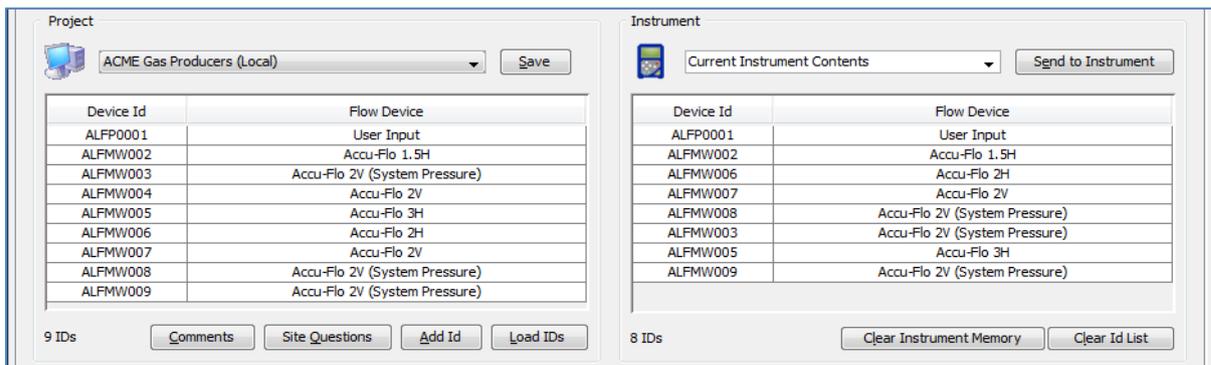
The instrument contents will now be updated and the ALFMW004 ID no longer shows in the instrument side of the list.

10.7.10 Clearing the Instrument Memory

The Clear Instrument Memory function [Clear Instrument Memory] allows various parts of the instrument's memory to be cleared. Upon clicking on the **Clear Instrument Memory** button the following options are available.
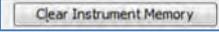
Answer **Yes** to perform the action.
Answer **No** or Cancel to return to the clear memory dialog.

10.7.10.1 "Cold Start"

A "Cold Start" of the 5000 instrument is a way to reset the instrument and purge all non-factory information from the instrument. A cold start will <u>PERMANENTLY DELETE</u> readings, calibration events, IDs, and technician information from your instrument. Under normal operating conditions, instruments should NOT need to be Cold Started. Due to technical reasons, Cold Starting a GEM5000 is the only means of clearing technician information from the instrument.
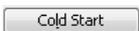
Upon clicking the [Cold Start] button a confirmation screen will appear. Click NO to abort the Cold Start operation, Click Yes to perform the cold start.
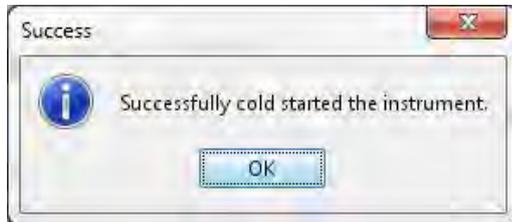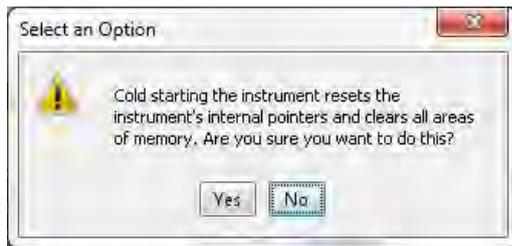
10.7.11 Instrument Settings

The LANDTEC System Gas Analyzer Manager software allows users to change many of the operational settings of the instrument. To view and change the available settings click on the **Instrument Configuration** tab.
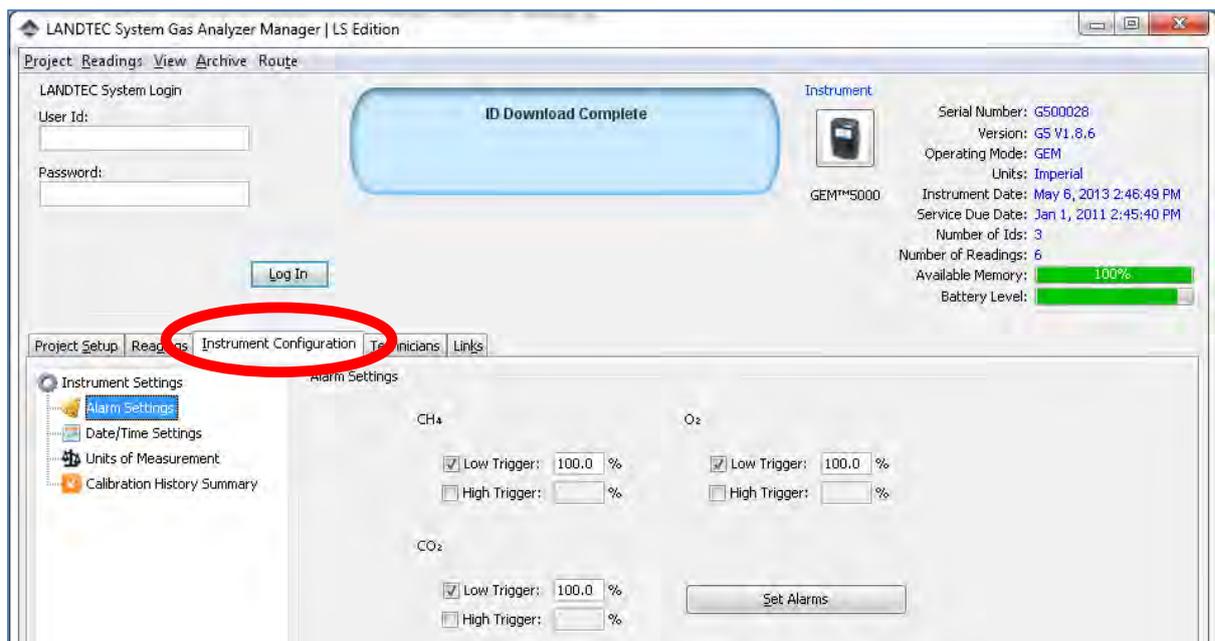
In the Instrument Configuration user interface, there is an Instrument Settings option tree. The Instrument Settings tree allows for easy navigation to the following categories:

- **Alarm Settings**
- **Date/Time Settings**
- **Misc Options (GEM-2000 only)**
- **Units of Measurement**
- **Calibration History Summary (GEM5000 only)**

The following sections describe each option category.

10.7.12 Alarm Settings
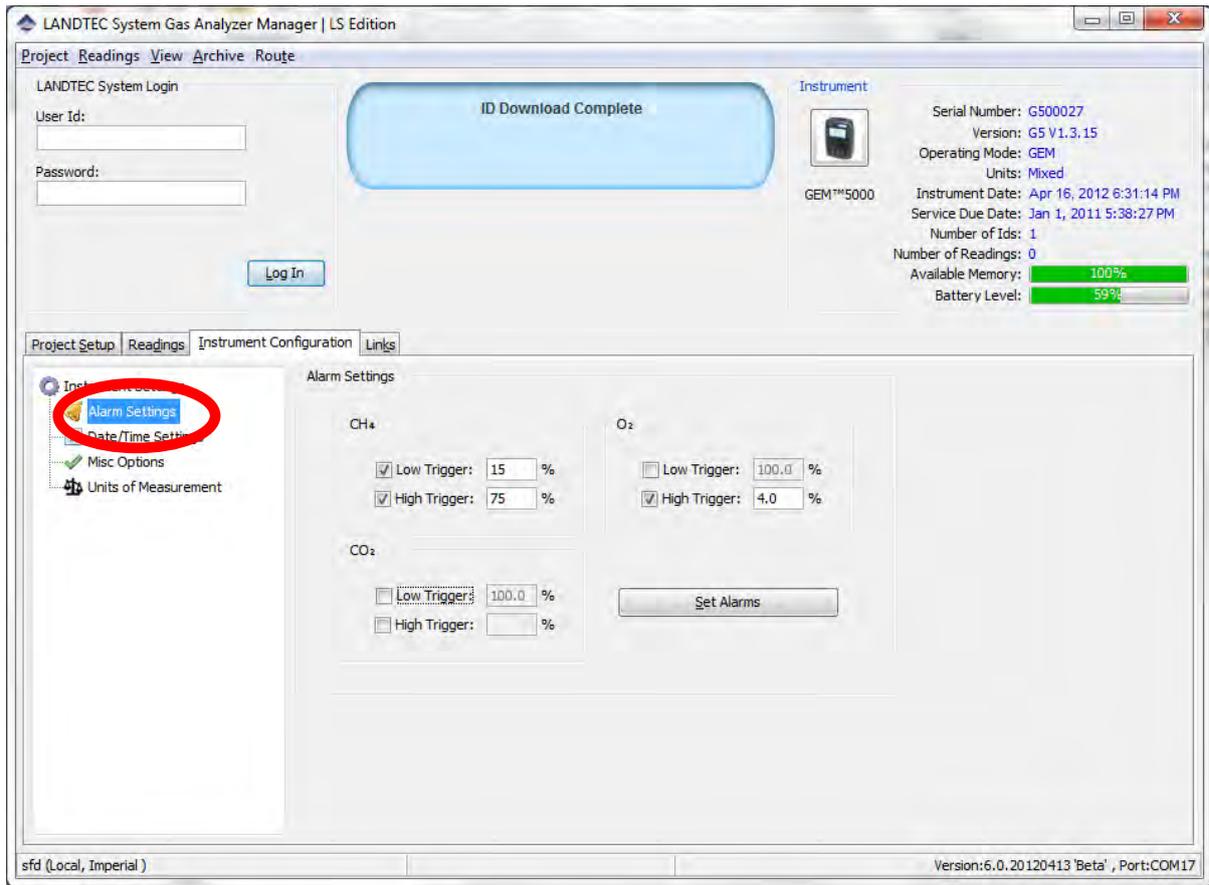
The Alarm Settings options control the activation and deactivation of the audible alarms in the instrument. Audible alarms can be configured for CH_4, CO_2, and O_2 parameters (additional gases present on plus model instrument). Each parameter can be configured with a Low Trigger and/or High Trigger for the alarm. To activate any specific alarm, click and place a checkmark in the desired box. This will activate the entry field to place the value. The values must be 0 – 100 percent. When alarms are set, the instrument will highlight the composition component in orange on the 5000 instrument on the 2000 instrument it will beep and flash the parameter on the screen if an alarm threshold is surpassed when taking a gas **reading. Refer to the section titled "Set Alarms" for additional options that are available for setting alarms directly on the 5000's instrument.**

Figure 7—Alarm Highlighting Example

Date/Time Settings
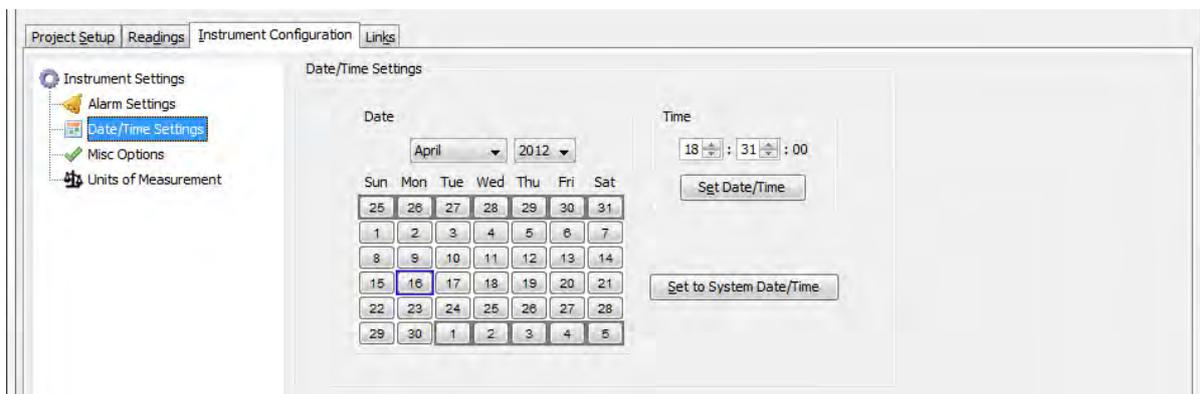
The **Date/Time Settings** screen allows the user to set the date and time of the instrument.

Setting the Computer's Date and Time
To set the instrument's date and time to that of the computer, click on the **Set** to System Date/Time button.
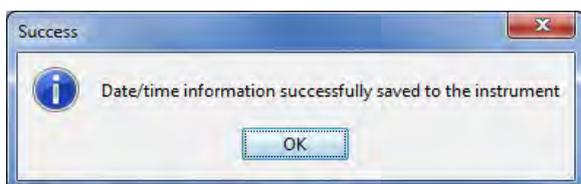
Answer OK and the instrument's date/time will be set to that of the computer.

Date
Use the calendar options to select the desired date.

Time
Use the up and down controls to select the desired hour and minutes.

Set Date/Time in the instrument
Click the Set Date/Time button to apply the settings to the instrument

10.7.13 Misc Options

Under the miscellaneous options interface the user can change the following instrument settings:
Automatically purge instrument
Activates and deactivates the automatic purge feature in the instrument

Automatically zero instrument
Activates and deactivates the automatic zero feature in the instrument

---

Low Flow Warning
Specifies the point at which the instrument will "Flow Fail". If the instrument detects that it is not able to extract the appropriate gas flow for analysis the word "Flow" will flash in the upper left part of the screen where the pump timer is normally shown. If flow does not increase the pump will automatically be stopped. Adjusting the setting to "Low" will allow the pump to run with less flow going through the instrument. This may help avoid flow fail conditions when sampling from high vacuum systems.

Purge Time
Specifies the duration the pump will run when activated by the purge feature of the instrument.

10.7.14 Units of Measurement
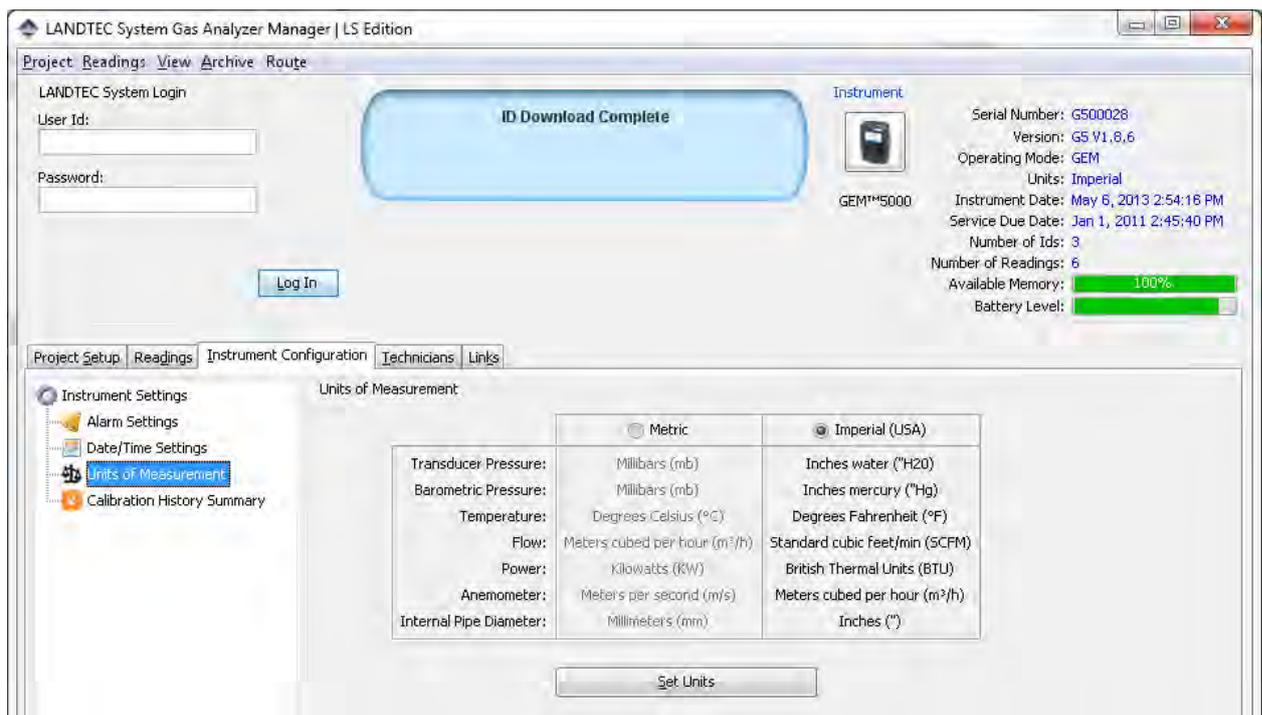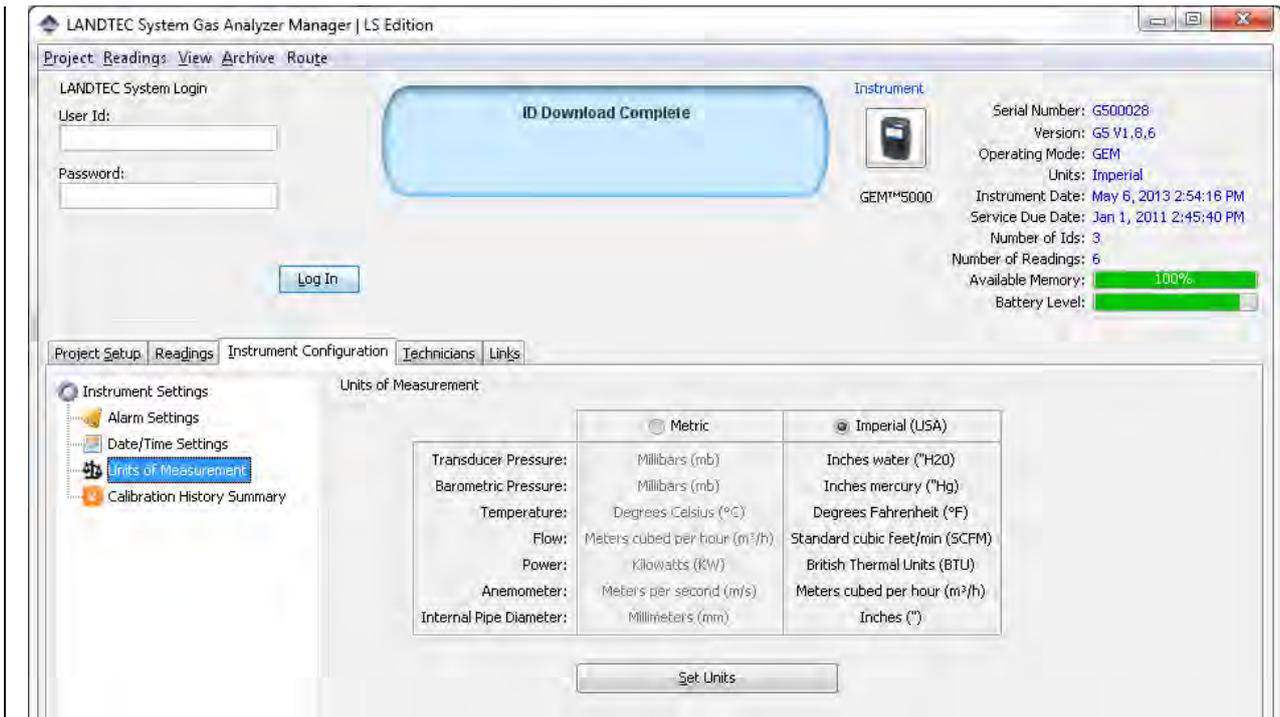
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The Units of Measurement interface allows users to select whether to operate the instrument in metric or imperial units. The units for each parameter are displayed on the screen.

WARNING: *Units of Measure are as critical as the values of the readings stored. Be certain to verify the appropriate Units of Measure for your project prior to making a change to this option. Changing the Units of Measure will **NOT** convert any existing values stored in the instrument. To avoid confusion, download any stored readings prior to changing the Units of Measurement.*

Clicking on the Set Units button will bring up the Change Units Password box. If you must change the units of measure please call LANDTEC's Software Support for a password.
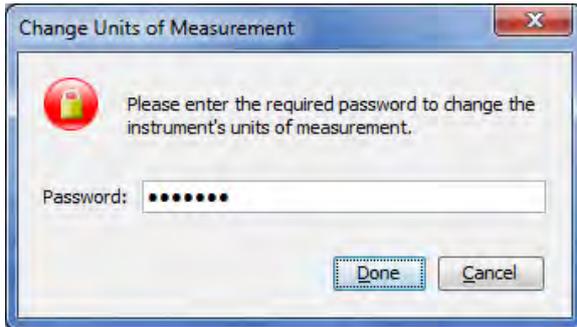
Upon entering the password you'll be prompted one last time to download your data from the instrument. If you have not downloaded your instrument press the **No** or **Cancel** buttons. Click Yes only if you have all data from your instrument as changing the units of measure must erase data that is in the instrument to ensure data integrity.
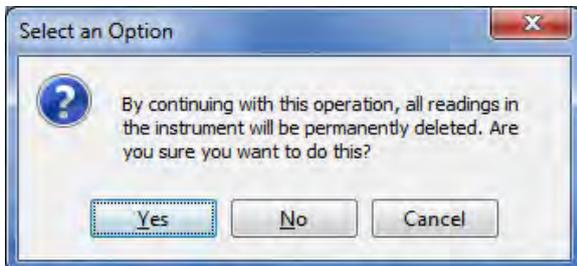
Calibration History Summary
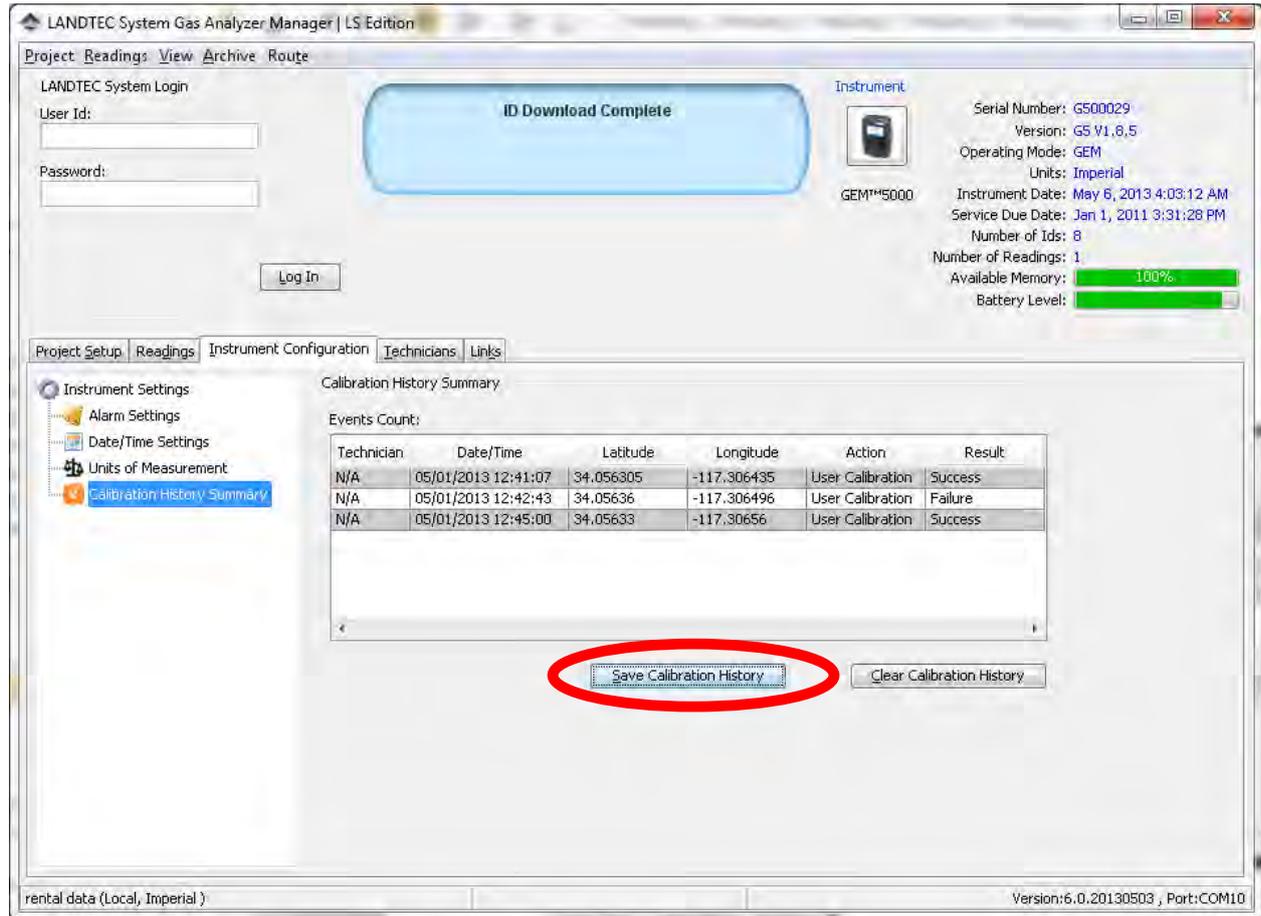
The Calibration History Summary allows you to view the calibrations, Save the Calibration History and Clear the Calibration History.

Viewing the calibration history can be done simply by clicking on "Calibration History Summary" option within the Instrument Configuration tab

Saving the calibration history to file can be accomplished by clicking on the [Save Calibration History] button. Upon clicking the Save button. You will be prompted for a directory location and file name for storing file.

The directory location varies depending upon your operating system. In Windows 7 & 8 it is in

   C:\ProgramData\LANDTEC\LSGAM\EventLogs

On Windows XP the directory defaults to

C:\Documents and settings\All Users\Application Data\LANDTEC\EventLogs

These directories may be hidden on your computer. If so, please type the directory name into the Run or Search Box.

Upon opening the .CSV file you'll notice the following fields:
- Technician
- Date Time
- Lat
- Long
- Action
- Result

The following fields are repeated for each gas composition component (CH_4, CO_2, O_2, H_2S, CO, Etc…)
- Channel
- Before
- After
- Span Target
- Status

For illistrative purposes only these have been colored in the following example.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
1	Technician	Date Time	LAT	LONG	Action	Result	Channel	Before	After	Span Target	Status	Channel	Before	After	Span Target	Status	Channel	Befor
2	N/A	5/1/2013 12:41	34.056305	-117.306435	User Calibration	Success	CH4	-0.072369404	-0.003705339	0	Passed	O2	20.160007	20.9	20.9	Passed	CO	0.201
3	N/A	5/1/2013 12:42	34.05636	-117.306496	User Calibration	Failure	CH4	-0.008667287	-0.008667287	50	Failed	CO2	0.14623539	0.14623539	35	Failed	O2	20.8
4	N/A	5/1/2013 12:45	34.05633	-117.30656	User Calibration	Success	O2	20.855478	20.9	20.9	Passed	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Figure 8—Calibration Information spread sheet Example

Each row of the spread sheet represents one calibration or gas check event on the instrument. A total of 7 sets of Channel, Before, After, Span Target and Status Columns are included on the spread sheet. Unused channel data will contain N/A

AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO
Channel	Before	After	Span Target	Status	Channel	Before	After	Span Target	Status
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Figure 9—Unused Gas Components in Calibration Record

10.7.15 Downloading Readings

After successfully creating projects, IDs, and setting appropriate instrument settings, the instrument is ready for field use. When used in the field, *readings* are collected and stored within the instrument's memory. The readings consist of the measured, input, and calculated parameters such as CH_4, CO_2, O_2, Gas Temperature, Flow Rate, etc. These readings must be downloaded from the instrument to be reviewed on the computer and stored for review at a later time. This section of the Operation Manual reviews the process of downloading and storing readings from the instrument.

To view your readings from the instrument, select the Readings tab of the LANDTEC System Gas Analyzer Manager software. Then click on the **Get Readings** button
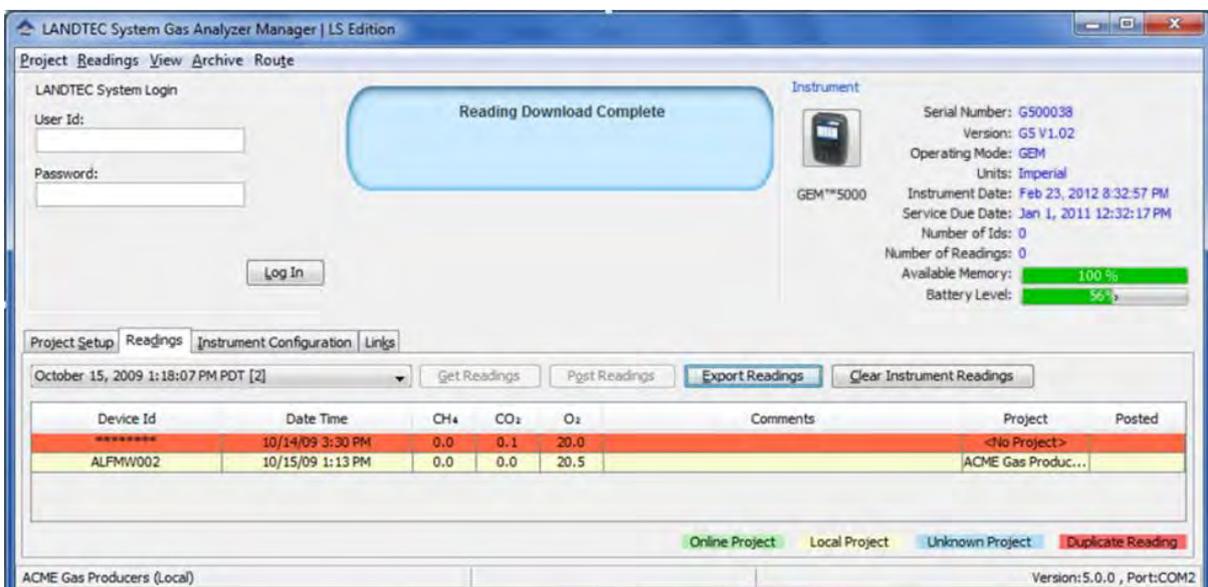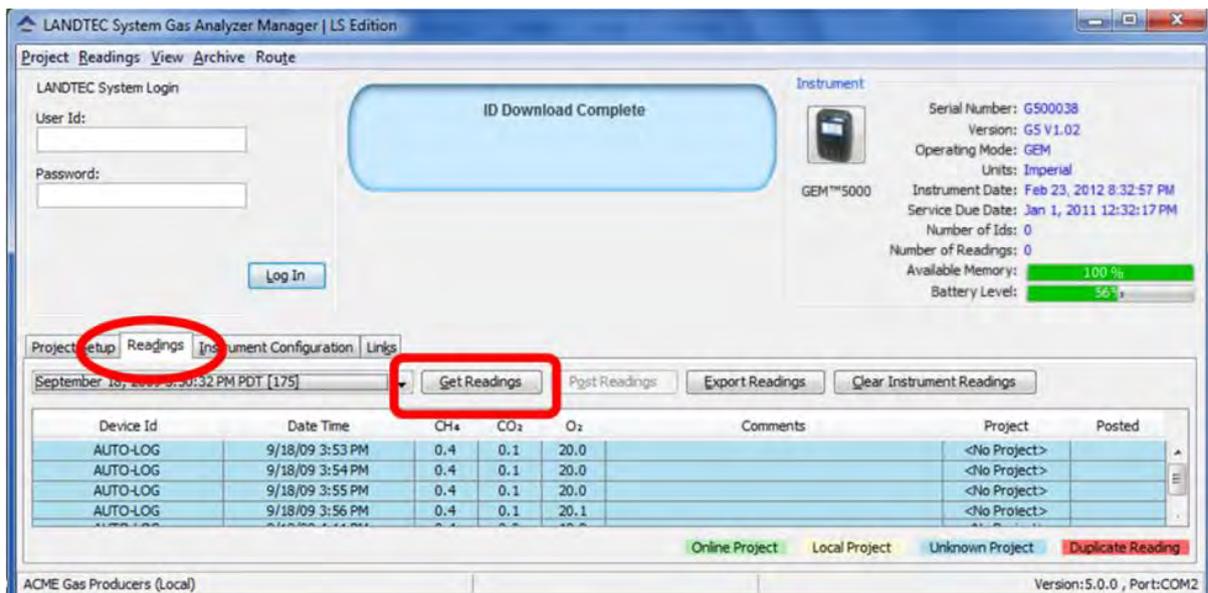
When the instrument is initially detected by the LSGAM software, the Get Readings button will activate if there are readings in the instrument to be downloaded.

Readings will be highlighted based upon the following:

- **Online Project**:   If the readings were taken against an ID belonging to an On-Line Enterprise System which the download computer is configured for as (REMOTE) the readings will highlight in a green color.
- **Local Project**:   If the readings were taken against a project that is setup on the computer as a local project then they will highlight in a beige color.
- **Unknown Project**:   IDs in the instrument that do not match any of the Local or Remote projects on the download computer.   This is the result of uploading an instrument with IDs from one computer but downloading on a different computer without the exact same project configuration(s).
- **Duplicate Reading**: This does not imply that the reading was taken twice. Rather it is an indication that the reading was previously downloaded and exists on the computer in a different readings file.

Placing your mouse over a reading will display additional parameters of the reading. As shown below on the left, clicking on a reading will open a Reading details window and allow you to click through the readings one-by-one in detail by clicking the **Previous** and **Next** buttons.
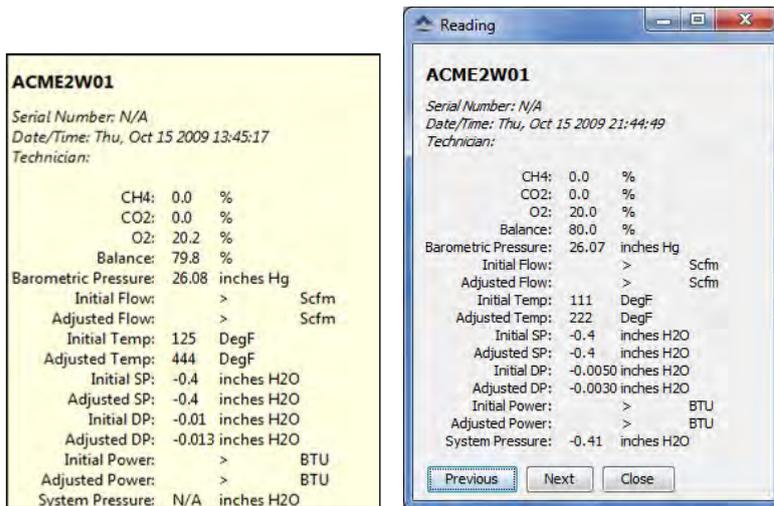
10.7.16 Clear Readings

To clear the readings from your instrument, after the readings are downloaded successfully, click the **Clear Instrument Readings** button [Clear Instrument Readings] . A prompt will verify the permanent deletion of the readings from the instrument.
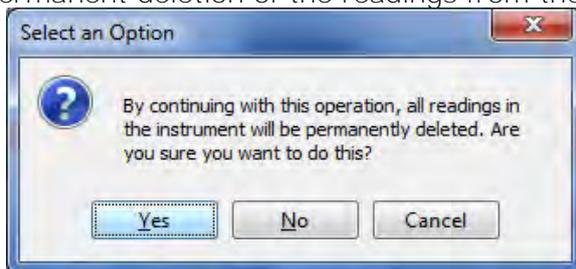
This will clear information within the GEM and GA Mode **simultaneously**.

Note: Clicking yes will NOT check to ensure all data is saved from the instrument. If you plug in an instrument and click the Clear Instrument Readings button without first performing a Get Readings operation, data not previously downloaded will be lost!

10.7.17 Exporting Readings

To export readings to a file, click the **Export Readings** button.
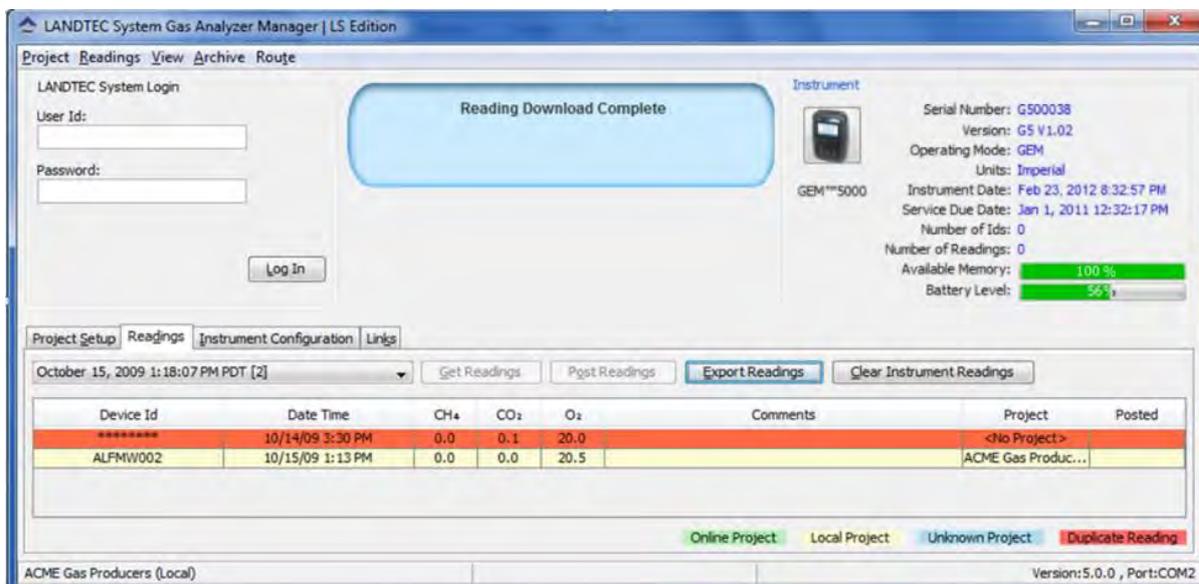
This will open the Stamping Information Screen. Stamping information are details that are most often stored with the historical data but not directly stored by the instrument. Detailed historical Stamping Information can assist when reviewing the data as atmospheric conditions do impact a gas system's production performance.

Clicking on Done will open the **Export Readings to CSV** screen.
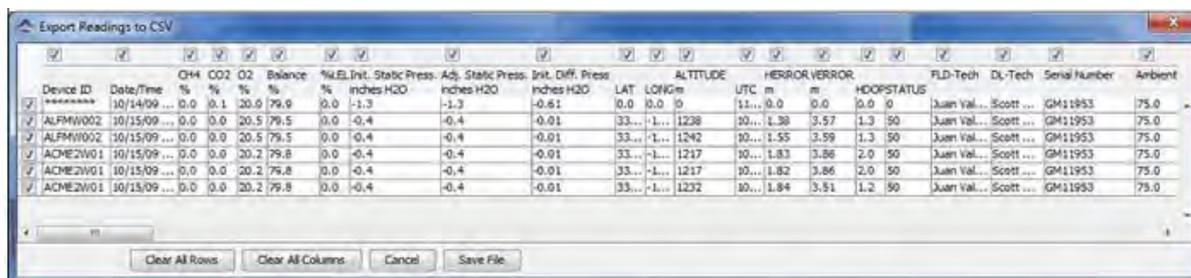
Note: Depending upon your specific Instrument model you will see additional fields specific to the instrument. For example "NAV" option models have the fields of Latitude, Longitude, Altitude, Herror, Verror, and HDOP Status that the others models do not have.

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This interface provides several options described below.

- To add or remove a single reading from export, uncheck the checkbox in the leftmost column.
- To add or remove a specific parameter from export, uncheck the corresponding checkbox across the top.
- To clear all row checkboxes, click the **Clear All Rows** button at the bottom of the screen. After Clearing all Rows you can click the button and it will change to **Set all Rows**
- To clear all column selections, click on the **Clear All Columns** button at the bottom of the screen. After Clearing All Columns the button will change and you can then choose **Set All Columns**
- To exit the operation without saving, click the **Cancel** button.
- To specify a filename and save the selection to a file, click the **Save File** button. Clicking this button will open a Save window.
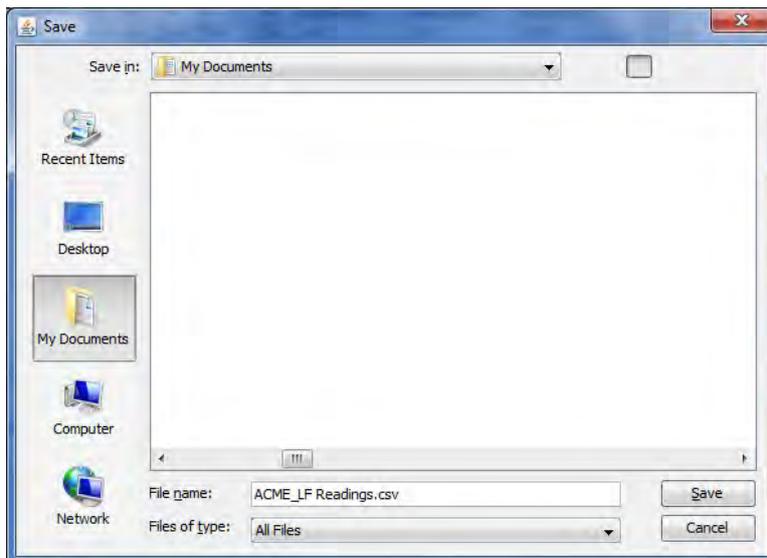
The save file dialog will open and default to the My Documents of the user who is currently logged in on the computer. Specify a filename and location then click the Save button. The selected readings will be saved in comma separated value (.CSV) format. The .CSV file may now be opened in another application such as Microsoft Office Excel or Open Office Calc.

11.0 Problem Solving
This section outlines various warning and error messages which the operator may receive during general operation of the instrument. For further assistance please contact Technical Support at (800) 968-2026 or email landtec_support@qedenv.com

12.0 Warning and Error display
When switched on, the instrument will perform a pre-determined self-test sequence taking **approximately 15 seconds. During this time many of the instrument's working parameters** and settings are checked.

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

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

Only three warnings/errors can be displayed at any time.

To ascertain if more errors have **occurred use 'Key 8' – Scroll down' and 'Key 2'** - Scroll up' through 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:

1. **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.

2. Operational parameters that could affect the performance of the analyzer: Cell out of calibration, CH_4 out of calibration, CO_2 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.

13.0 Service

The GEM5000 gas analyzer should be regularly serviced to ensure correct and accurate operation. QED recommends a service and recalibration every **12 months**.

The GEM5000 range 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.

⚠ **Warning**	If the GEM5000 is serviced by unqualified engineers the ATEX certification may be invalidated and the instrument may be unsafe for use in a potentially explosive atmosphere.

User serviceable parts:

There are no user serviceable parts inside the instrument.

The following parts can be user serviced:

In-line water filter	This should be regularly inspected for obstructions, moisture 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.
Sample tubing	Always ensure that sample tubes are not contaminated or damaged.
Gas port connectors	Periodically check that the O-rings on the gas port 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 gas port connector should be replaced.
H_2S filter material	When the filter material changes color to a *light gray* color the filter should be replaced.

14.0 Warranty policy

This instrument is guaranteed, to the original end user purchaser, against defect in materials and workmanship for a period of **3 years** from the date of the shipment to the user.

During this period QED will repair or replace defective parts on an exchange basis.

The decision to repair or replace will be determined by QED.

To maintain this warranty, the purchaser must perform maintenance and calibration as prescribed in the operating manual.

Normal wear and tear, and parts damaged by abuse, misuse, negligence or accidents are specifically excluded from the warranty.

✍ Note: Please contact Technical Support at (800) 968-2026 or email
            landtec_support@qedenv.com for further information.

15.0 Glossary of terms

5000 series	The 5000 series refers to the GA5000, GEM5000 and the Biogas5000 gas analyzers.
Accu-Flo	A flow device used to aid accurate flow measurement.
Analyzer error messages	Operational errors are prefixed on the analyzer by the word ERROR followed by an error code. Refer to the list of standard error codes for more information.
Analyzer warning	Analyzer warnings are prefixed by the word WARNING followed by a relevant description. There are two types of warning messages displayed; general warnings that may not necessarily affect the instrument's function (for example, battery power low) and operational parameters that could affect the performance of the analyser (for example, CH_4 out of calibration).
Anemometer probe	Device for measuring velocity of gas in the pipe. The GEM5000 analyzer can be set to convert into a flow. See also flow measurement.
ATEX certification	The GEM5000 is ATEX certified to zone 1 & 2 areas above ground not in mines.
Auxiliary channel	This refers to the channels where external devices will be connected or displayed.
Backlight	The analyser has a built-in backlight for low ambient light conditions. This can be toggled on/off using the backlight key.
Barometric pressure	The atmospheric pressure at the given location.
Borehole	Typical location from which a gas sample is obtained.
Calibration	The gas analyzer is carefully calibrated against known standards.
Calibration record	The GEM5000 instrument has the facility to log user calibrations as a validation tool.
CH_4	Methane
Chemical cells	A method of gas detection that works on the basis of a chemical reaction with the target gas.
Clean air purge	Process used to clear out gas from the sample tube and analyser prior to taking a new reading.

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CO	Carbon monoxide
CO_2	Carbon dioxide
Data logging	Data logging enables the operator to leave the analyzer unattended to take samples at predetermined intervals for a set period of time
Download	Terminology used for the movement of data from the analyzer to the LSGAM application on the PC.
Dual beam infrared absorption	Method of gas detection by measuring how much infrared is absorbed by the target gas.
Event log	Used as an aid to monitoring the use of the analyser. It can also be used as a diagnostic tool.

The event log can be viewed via LSGAM. It <u>cannot</u> be viewed on the analyzer screen. |
Exhaust port	The usual manner for the gas to exit the analyzer is via the exhaust port located on the top side of the analyzer. This port should have an exhaust tube attached.
Exhaust tube	Clear plastic tubing used to expel gases from the exhaust port.
Factory settings	Default settings preset at time of manufacture or service.
Firmware	Firmware is the term by which the internal analyzer software is known and is not accessible by the client. This firmware is updated to the latest version when the analyzer is returned for servicing.
Flow measurement	Flow can be measured by either gas velocity m/s or volume flow rate m^3/hr. This measurement of flow relates to the use of the anemometer and not the internal flow measurement technique.
Flow port	For the measurement of gas flow at the sample point.
Landtec Systems Gas Analyzer Manager	Also referred to as LSGAM. PC based software which enables the operator to upload and download information to/from the analyser.

LSGAM enables operators to maximise the operation of their gas analyzer. It features a simple upload and download facility and is fully **compatible with the latest Microsoft™ operating** systems.

This is optional. |

Gas channels	The gases that are analyzed by the instrument.
Gas velocity	The positional rate of change of the gas. Measured using the optional anemometer.
General warnings	Displayed throughout the documentation with a warning symbol. Warning information may affect the safety of operators.
H_2	Hydrogen
H_2S	Hydrogen sulphide
H_2S filter	Filter required for removal of H_2S. When the filter material changes color to a light gray color or if H_2S values are displayed, then the filter should be replaced.
Hydro-carbons	Organic compound consisting of only hydrogen and carbon.
In-line water filter	The component used to help protect the instrument from water ingress.
LCD display	Liquid Crystal Display
LEL	Lower Explosive Limit. Lower explosive limit of methane in air. 5% methane in air is the point at which it becomes explosive. 100% LEL equates to 5% methane.
m/s	Meters per second – measurement of gas velocity.
m^3/hr	Meters cubed per hour – volumetric flow rate measurement.
Main Gas Read Screen	The main analyzer screen for normal operations and all operations are carried out from this screen.
Material data sheet	Document from which information about a certain substance can be obtained.
MCERTS certification	MCERTS is the UK Environment Agency's Monitoring Certification Scheme. The scheme provides a framework within which environmental measurements can be made in accordance with the Agency's quality requirements. The scheme covers a range of monitoring, sampling and inspection activities.
Memory	Location where data and ID information is stored. The analyzer memory should not be used as a permanent storage medium. Stored data should be regularly transferred using the LSGAM download software.

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NO$_2$	Nitrogen dioxide
Operating language	The operator can choose the default operating language for the analyzer. Choices are English, German, Spanish, French and Italian.
PPM	Parts per million
Pump	Used to draw the gas sample from the sample point to the analyzer. Select the pump key on the analyzer to activate.
ID	The user definable identification tag allocated to a sample point.
Relative pressure	**The pressure at the sample point 'relative' to** atmospheric (barometric) pressure.
Relative pressure transducer	The internal component used to measure the relative pressure.
Residual N$_2$	The calculation for the residual N$_2$ used on the latest version of the GEM5000 platform is as follows:

Residual N$_2$ = Balance – (O$_2$% x 3.76)

Where, Balance = 100% - (CH$_4$% + CO$_2$% + O$_2$%) and 3.76 is the ratio of O$_2$ to N$_2$ in ambient air (79/21)

Sample tube	The tube used to obtain a sample of gas from the sample point to the analyzer.
Span	The point at which the gas analyzer is calibrated when a known quantity of the target gas is present.
Span multi gas	Term by which the span calibration of the three main gas channels is known. This option must only be used when the calibration gas being used is a combination of CH$_4$ CO$_2$ O$_2$.
Technician ID	An alpha-numeric code tagged to each gas reading. Facility only available via LSGAM. This is an optional feature.
Temperature probe	External device used to measure the gas temperature at the sample point. This is optional.
Update site data	Enables the operator to answer pre-defined questions relating to the site, environment etc. These questions are defined via LSGAM software.

Upload	Terminology used for the movement of data from the PC via LSGAM software application to the analyzer.
Volume flow rate	The volume of a gas that passes through a given surface per unit of time e.g. m^3/hr
Warm-up self-test	Pre-determined self-test sequence to test the analyser functions which takes place after the analyzer is switched on.
Warranty	The instrument is under guarantee against defect in materials and workmanship for a period of 3 years from the date of shipment to the operator and is subject to the recommended service and recalibration requirements.
Water trap	Device used to protect the instrument from water or moisture ingress.
Zero	The point at which the gas analyzer is calibrated when there is none of the target gas present.
Zero transducers	This option allows the relative pressure transducer to be zeroed.