BioGas✓CDM

PORTABLE GAS ANALYZER

OPERATION MANUAL

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BioGas✓CDM Operation Manual

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1 Introduction

LANDTEC is the premier manufacturer of products, instruments and software for landfill gas extraction and for regulatory monitoring compliance. LANDTEC has provided the landfill industry with a technologically innovative family of products for more than a decade. These products are the result of field-proven experience in design, operation and maintenance of landfills for environmental compliance.

The BioGas✓CDM, designed by LANDTEC, is specifically designed for use on Clean Development Mechanism Digesters to monitor Bio Gas. The instrument samples and analyzes the Methane, Carbon Dioxide and Oxygen content of Bio Gas. The BioGas✓CDM also has the ability to analyze Bio Gas for Hydrogen Sulfide (H_2S) when used with an optional gas pod. The readings are displayed and can be stored in the instrument and downloaded to a personal computer for reporting, analyzing and archiving.

The BioGas✓CDM instrument is shipped in a protective hard case with a foam interior that offers additional protection, transportation convenience and component hardware storage. When properly sealed, the hard case is watertight. The hard case is equipped with a pressure relief valve (located under the handle on the case) that is normally kept closed. If there is a change in elevation, the hard case may not open until the pressure relief valve is opened to equalize internal pressure. When shipping a BioGas✓CDM back to LANDTEC for calibration or service, always ship it in the original packaging to protect unit from damage.

Carefully unpack the contents of the BioGas✓CDM, inspect and inventory them. The following items should be contained in your package:

- The BioGas✓CDM instrument
- BioGas✓CDM Operation Manual
- Registration/Warranty Card
- Soft carrying case with replaceable protective window and carrying strap
- Clear ¼" vinyl sampling hose assembly (5 ft.) with external water trap filter assembly
- Blue ¼" vinyl pressure sampling hose (5 ft.)
- Spare internal particulate filter element
- Polypropylene male connector (hose barb) connects to blue vinyl tubing
- Spare external water trap filter element
- 100-240 volt battery charger
- Software on CD-ROM
- RS-232 serial cable for computer/instrument communications
- Temperature probe (optional)
- Hard carrying case

Complete the Registration/Warranty Card and return it to LANDTEC. The model and serial numbers are located on the back of the BioGas✓CDM instrument.

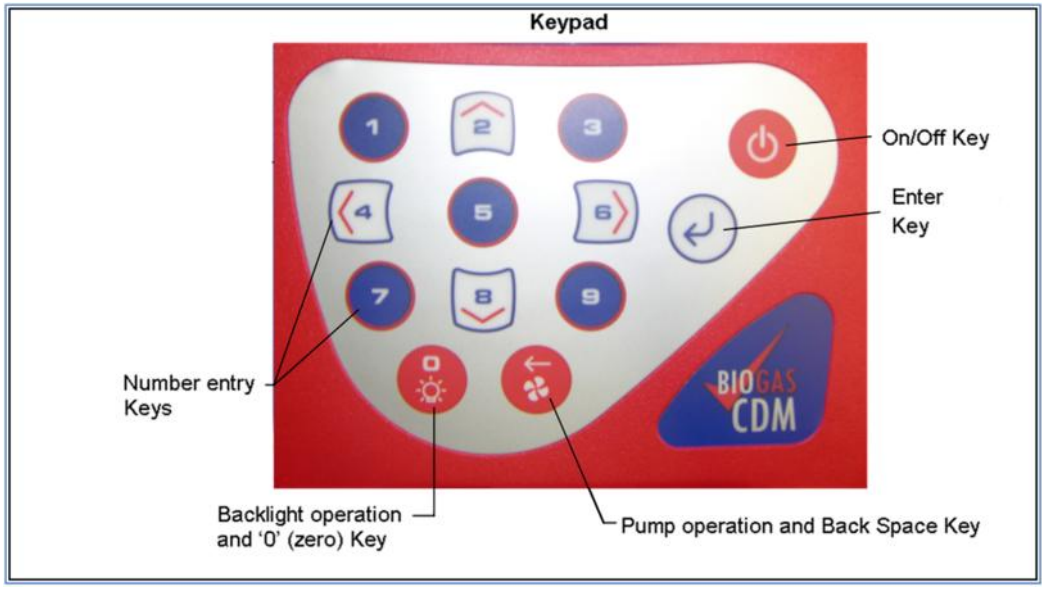
Immediately notify shipping company if the BioGas✓CDM unit or accessories are damaged due to shipping. Contact LANDTEC immediately if any items are missing.

For questions regarding instrument operation and procedures, please contact LANDTEC at:

Customer Service or Technical Support	(800) 821-0496 Extension 6131
Factory Service	(800) 821-0496 Extension 6141
Sales USA/International	(800) LANDTEC (526-3832)/(800)821-0496

2 General Operational Features

2.1 Physical Characteristics of BioGas✓CDM



2.2 Storage

Do not keep the instrument in the trunk of a car or shed because it may be exposed to temperature extremes.

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

The instrument batteries should be discharged and fully charged at least once every four weeks regardless of indicated charge state. The discharge function may be carried out by turning on the unit and selecting **'⑥ Reset functions'** from the main menu and leaving the unit powered on at the Pass-code screen over night. Typically the instrument will automatically turn off after approximately 15 minutes of non use to save batteries but the power save function is disabled in the Pass-code screen.

2.3 Battery/Charging

The Battery Charger IS NOT covered by the unit UL certification. Therefore, when connected to the Battery Charger, the instrument IS NOT intrinsically safe and should not be used in confined spaces.

The battery used in the BioGas✓CDM is a Nickel Metal Hydride manufactured as an encapsulated pack from six individual cells. This type of battery is not so susceptible to "memory effects" as Nickel Cadmium batteries, although it is not recommended that the unit be given short-term charges. When the flashing LED indicates "Trickle Charge" the charging is completed and the unit can be disconnected from the charger.

The battery charger indicates when the unit is charging, charged or if there is a fault. A full charge should take approximately 2 hours.

2.4 Instrument Certification

The BioGas✓CDM is UL/Sira certified for use in hazardous locations. Specifically certification as to intrinsic safety for use in hazardous locations Class I, Zone 1, AEx ib d IIA T1 (Ta=32°F to +104°F).

For the certification to remain in tact it is vital the instructions in this manual are followed closely and repairs of this equipment be carried out in accordance with the applicable code of practice by an approved repair facility.

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

2.5 Safety Information

The BioGas✓CDM is normally used for measuring gases from digester sites inhaling these gases, or gases from other sites 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.

2.6 Turning the Instrument On/Off

When switching the instrument on, a long beep will sound, followed by the LANDTEC logo being displayed and the self-test will commence. Whenever a key is pressed the unit will emit a short 'beep' as an acknowledgement. This function cannot be turned off.

When switching the instrument off, the On/Off button must be held down for approximately 2-3 seconds, at which point a clean air purge will be carried out. If for any reason the instrument 'locks-up' and will not switch off, press and hold the On/Off button for 15 seconds. This will force the instrument to switch off.

2.7 Warm-up Self Test

When switched on, the instrument will perform a predetermined self-test sequence taking approximately 30 seconds, during this time many of the instrument's functions are tested, including:

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

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

- Software version
- Serial Number. Calibration due date.
- Date format.
- Operating language.
- Communication Baud rate.

2.8 Warning and Error Display

During the self-test, if any operational parameters are out of specification or the pre-programmed recommended calibration/service date has passed errors or warnings may be displayed. Only three errors/warnings can be displayed at any time. To ascertain if more errors occurred, use the 'ė' and 'Ę' key to scroll up/down the list, to exit from this screen press the "Enter/Store" key 'ý'.

2.8.1 WARNING Displayed

All warnings displayed will be prefixed by the word '**WARNING**' followed by a relevant description. Two types of warnings may be displayed.

1. General warnings that may not have an effect on 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, etc.).
2. Specific warnings of operational parameters that can affect the performance of the instrument (e.g. O_2 Cell out of calibration, CH_4 out of calibration, CO_2 out of calibration, etc.).

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.

2.8.2 ERROR Displayed

All errors displayed will be prefixed by the word '**ERROR**' followed by a number and description. The errors detected by the self-test are usually caused by a user calibration being out of specification or possibly memory corruption. This will have an effect on the functionality of the instrument and should be corrected before use (e.g. 01 - User cal data, CH_4 reading or channel out of specification, 02 - User cal data, CO_2 reading out of specification).

If any other Warnings or Errors are displayed, contact LANDTEC for further information.
LANDTEC is the ONLY authorized service center for the BioGas✓CDM instrument in the Americas.

2.9 Main Menu Screen

Upon self-test completion, the BioGas✓CDM will display the main menu screen. All operations are carried out from this starting point. The following information is displayed at this time:

- ① -Field Calibration
- ② -Instrument Information
- ③ -Adjust screen contrast
- ④ -Take Reading
- ⑤ -View Data
- ⑥ -Reset Functions
- Battery Charge graph (5 segment, flashes at 20% remaining)
- Memory Usage graph (5 segment, flashes at 5% remaining)

2.10 Optional Gas Pods

Optional Hydrogen Sulfide gas pods are available for use with the BioGas✓CDM. These pods are available in three different PPM ranges. Connection to the instrument is made via the data port and exhaust port. The Gas Pods are not classified as intrinsically safe they should not be attached or detached from the instrument in hazardous areas.

Gas Type	Range (PPM)	Resolution (PPM)
H_2S	0-50	0.1
	0-200	1.0
	0-5000	35

Gas pods are intended for use as an inexpensive detection means and not for regulatory reporting purposes. If the BioGas✓CDM, fitted with a Gas Pod, indicates the presence of the selected gas, further testing should be performed with regulatory approved instrumentation. LANDTEC recommends that field calibration be performed using the relevant gas and concentration, prior to sampling with a gas pod. If calibrated properly the accuracy of these gas pods are typically 5-10%FS.

2.11 Memory

The instrument's memory is volatile. It is maintained by a battery back-up system, which will maintain the memory while the battery is being changed.

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

Although unlikely, sudden shocks, high levels of electromagnetic interference or static discharge may cause memory corruption or loss. If this occurs, the instrument should be Cold Started and the calibration reset to factory settings before further use. **Cold starting will erase all data in the instrument including resetting the time and date to the default value**.

2.11.1 Cold Start

THIS FUNCTION SHOULD BE USED ONLY AS A LAST RESORT.
(For Gas Calibration Error Messages, confirm that Factory Settings and User Calibration are done).

A Cold Start should only be carried out to correct an instrument if no other course of action has proved successful. This function **WILL ERASE** the instrument memory entirely. After a cold start is performed the

user will need to reset the instrument to factory settings, perform a field calibration and reset the internal time/date to the default settings. Please note that the time/date may only be updated through the communication software. It cannot be updated manually.

To carry out a cold start, turn the instrument on and allow it to go through the self test. From the main menu select **'⑥ Reset functions'** this will bring up the Pass-code screen. Enter the pass code **54321** and press 'ý' to confirm.

After the pass-code entry has been accepted, the instrument will display the Rest menu. There are four options from this screen;

1 - Return to factory settings
2 - Cold Start
3 - Operating Language
0 - Main Menu

Select option '①' if it is desired to clear the field calibration and reset the factory calibration settings. Press key '①' to confirm this operation or press key '③' to exit to the Reset Menu. If you select **'①'** to confirm returning to factory settings a message will be displayed confirming the operation. Pressing **'①'** Yes will clear the field calibration information and reset factory calibration values. Pressing '⓪' No will return to the Reset Menu.

ONLY select option '②' if a Cold Start is to be carried out. Press key '①' to confirm this operation or press key '③' to exit to the Reset Menu. If you select **'①'** to confirm cold start a message will be displayed confirming the operation. Pressing **'①'** Yes will clear all memory in the instrument. Pressing '⓪' No will return to the Reset Menu.

2.11.2 Operating Language

This function allows the user to select from the available languages loaded in the instrument.

2.12 RF Interference

The gas sensors, especially the Methane sensor, are sensitive to RF interference.

Any device that transmits radio waves can cause your gas readings to fluctuate. Cell phones are the most common cause of the problem. You should never use your cell phone while you are taking gas readings.

3 LANDTEC System Gas Analyzer Manager (LSGAM)

3.1 Getting Started

The following instruments are supported the LANDTEC Gas Analyzer Manager

Gem 2000

Gem 2000 Plus

BioGas✓CDM

System Requirements:
Windows 98/NT/2000/XP/Vista
Pentium III 500 MH or equal
64 (MB) RAM
120 (MB) Hard Drive Space Available
CDROM Drive

LANDTEC System Gas Analyzer Manager CD

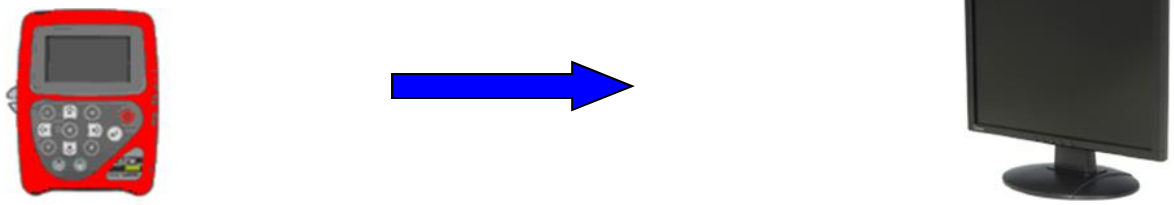
The computer may need some administrative privileges to install the program.
Once the software is installed on your computer with an internet connection this instrument communications program has Auto application updates. This enables you to always have the most current version of the instrument communications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

3.1.1 Installation with the CD

Insert the CD into your CD ROM drive and wait for the setup to auto start.
Click on the Launch Setup button and follow the onscreen instructions

Once the software is installed you will have a shortcut icon on your desktop  which you will use to start the LSGAM instrument program.

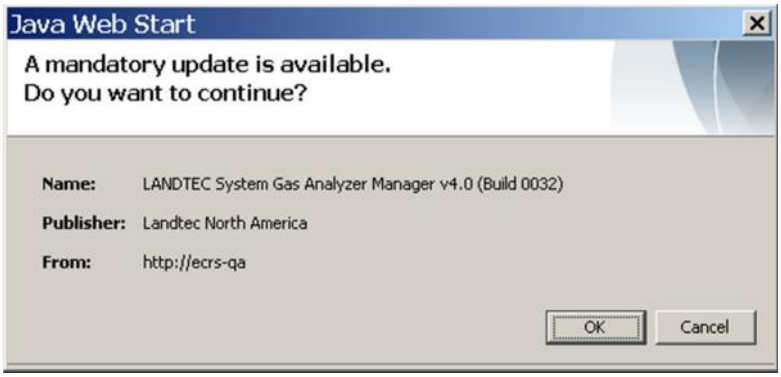
3.1.2 Connecting your Instrument



1. Connect the INSTRUMENT with the RS232 download Cable to your Computer
2. Instrument must be powered on and in the Main Menu screen before starting the software.
3. Launch the LSGAM software by clicking on the  Icon on your desktop
4.

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

If an update has been completed by our IT group when connected to the internet you will receive the notice below.



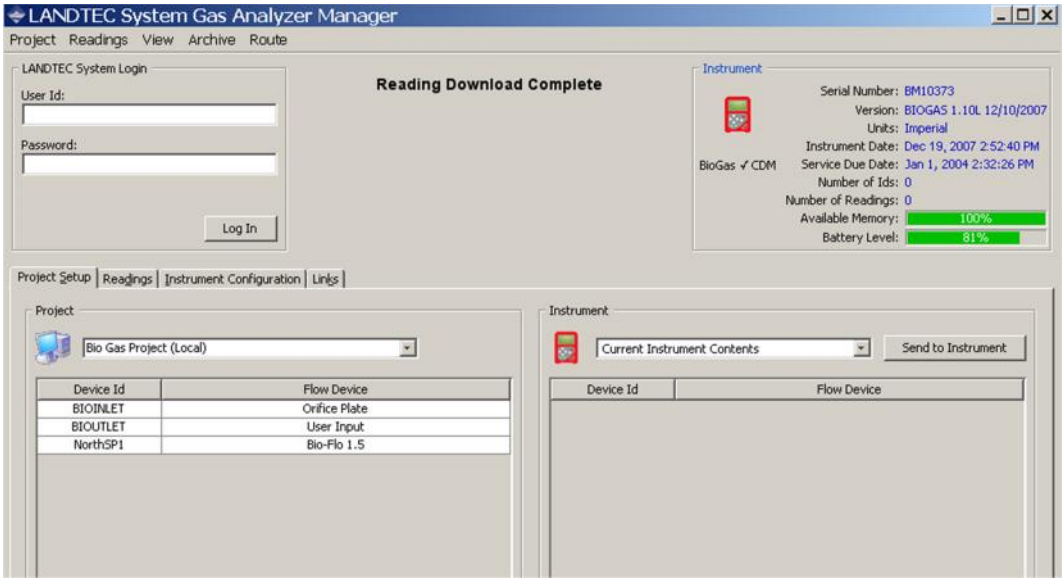
You may choose either OK or Cancel if this returns you to the desktop you will then need to click on the LSGAM shortcut again.

3.2 LSGAM software

The LSGAM software will automatically search for the instrument.

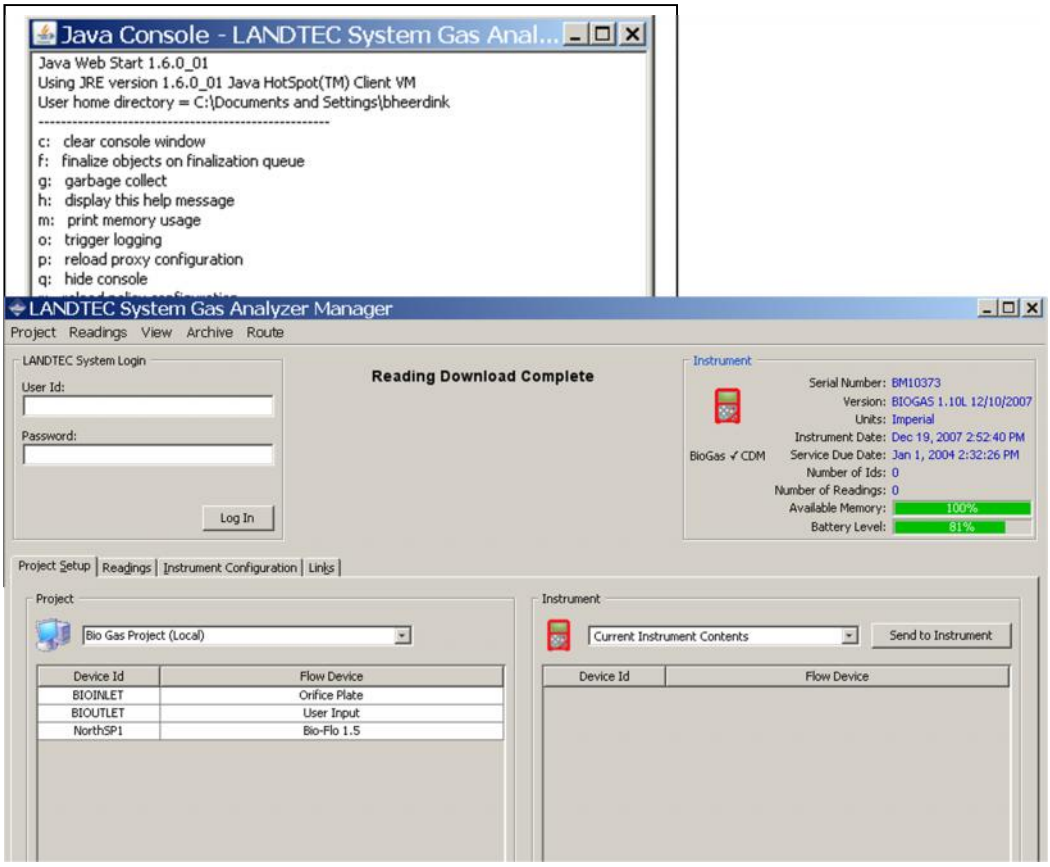
Note: If the auto detection is unsuccessful please ensure the instrument is in the MAIN MENU screen.

Click on the  this will start the instrument search again.



3.2.1 Java

The Java programming is an import part of this software and will be loaded with the CD install.

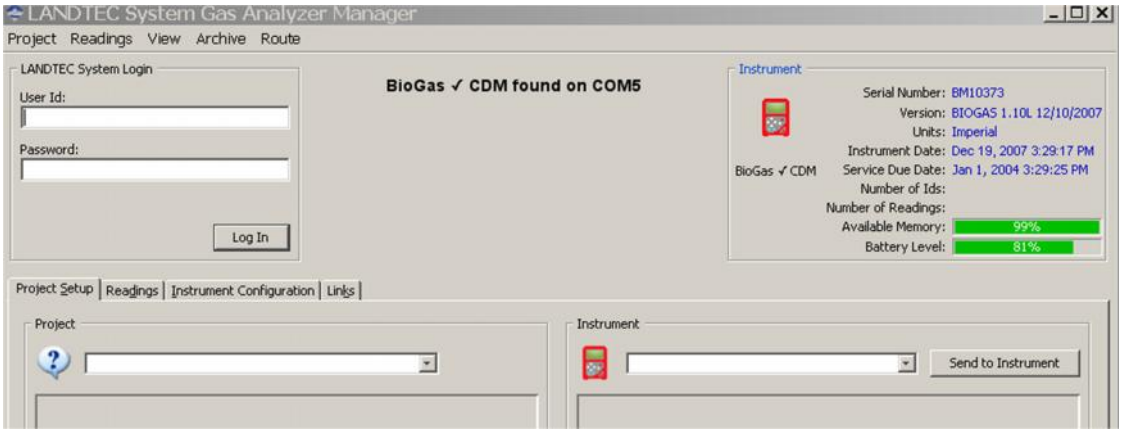


The java icon will be in the task tray at the bottom of your computer screen where your time is

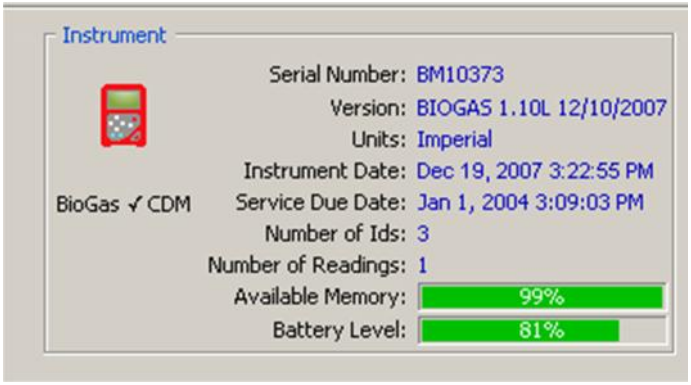
shown. When starting the program the consol may appear in the back ground of the LSGAM window. You can also open it from the icon with a right click and open consol from the menu that appears. The java console will document what the software is creating. You may be asked to copy and send the java consol to our Support group if you are having a problem with the upload or download application.

There should also be an icon on your desk top like this  called GAM log this also can help our IT department analyze any problem you might have when this log is sent to them.

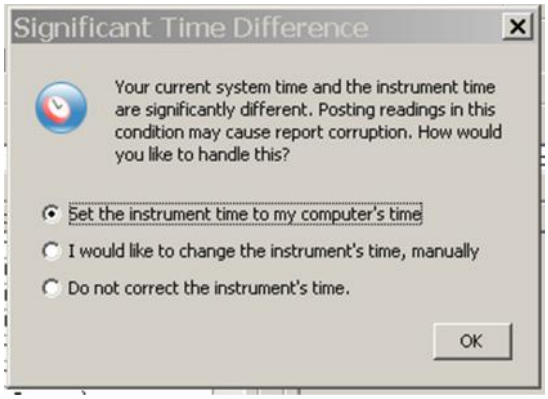
The first screen you will see while the Gem is downloading will tell you when the instrument is found.



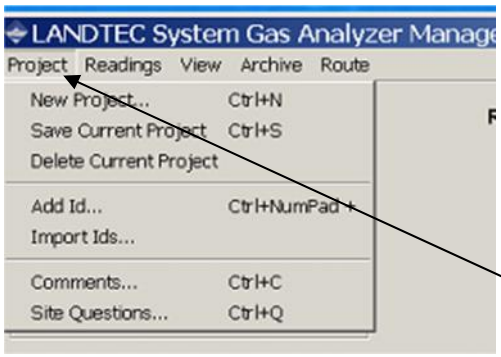
Once the download is complete the information about your Gem will be displayed in the top right hand corner.



If time and in the instrument and your PC are different you will receive the message below.

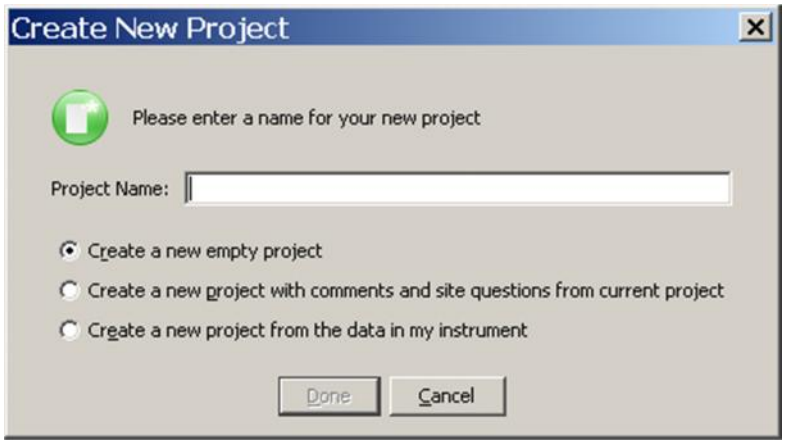


3.2.2 Creating your Project



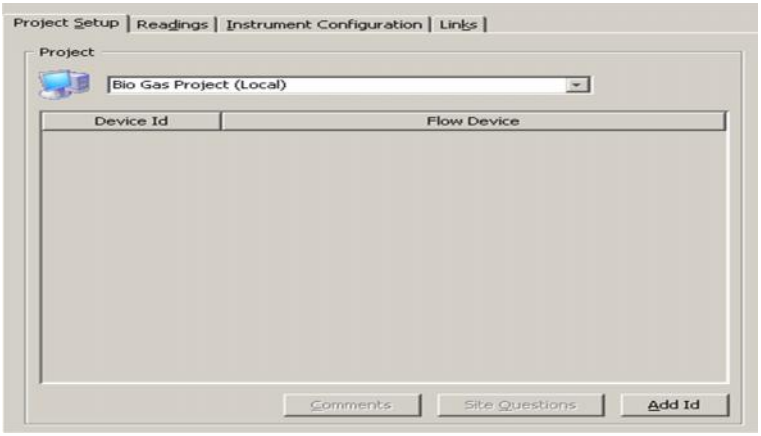
Now you can create your local project. Select the Project button from the list select the New Project option.

Choose the option Create an empty project.



You now need to give the project a name in this screen. Once you have entered the name the done button will be come available and clicking on done will put your project in the project list below

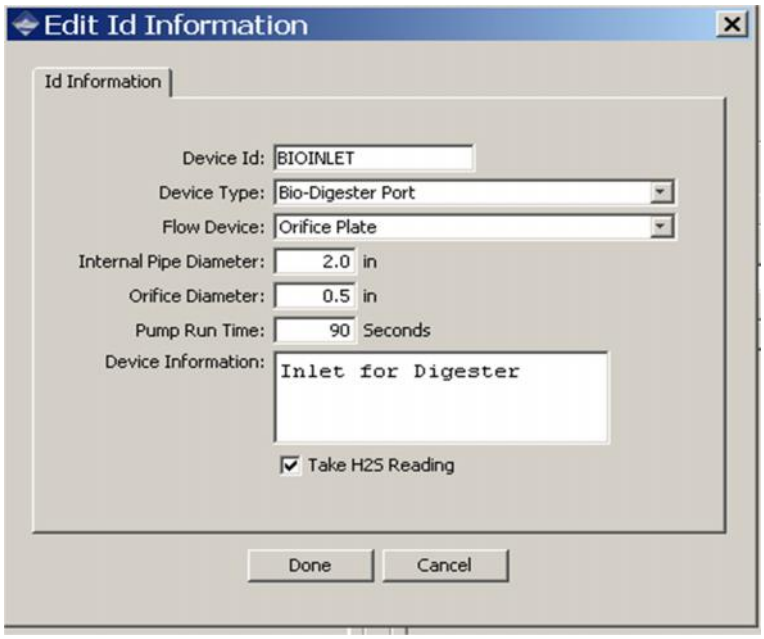
Note: An empty project means it has no IDs,and you will be creating a complete new project.

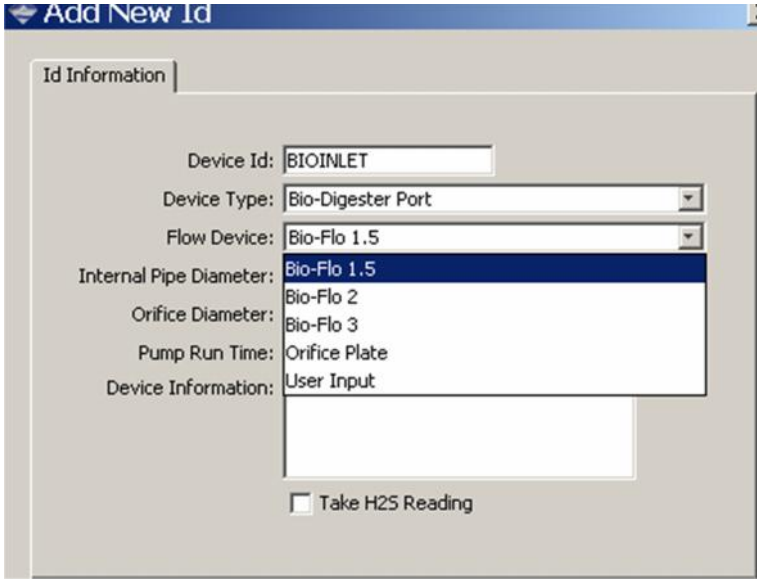


3.2.3 Add New ID

When selecting [Add New ID] the screen below will appear for entering the Device ID. This ID will need to be 8 characters. It is also necessary to choose a flow device the pump run time is the count downtime for collecting

your gas sample. The instrument shuts off at the end of the second's entered. You can extend the pump time or shut the pump off with instrument pump key or with pressing 1 to store reading. The ID screen below uses 90 seconds as a general entry.





You will have this list of flow devices to choose from.

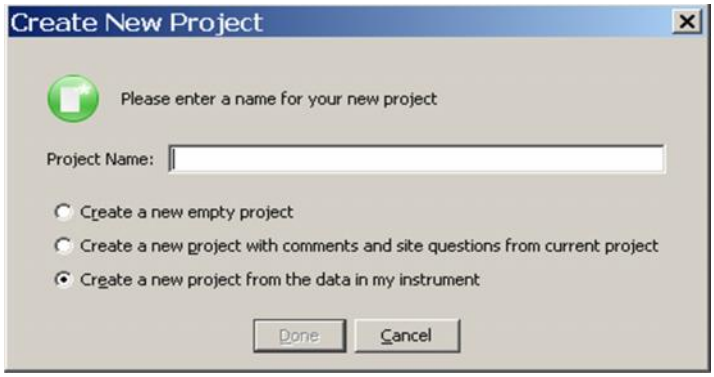
Bio-Flo 1.5 - Bio-Flo -2 - Bio-Flo -3 – Orifice Plate - User Input

(If there is no flow device you will choose User Input.)

A completed ID will look similar to the above. It will include the following things;
Device ID must be 8 charters
Device type will be Bio-Digester port
Flow device is described on the pervious ID entry page
Be sure you enter a pump run time
Device information can be entered but is not necessary
If you want to take a H2S Reading you need to put a check mark in the box as shown below.

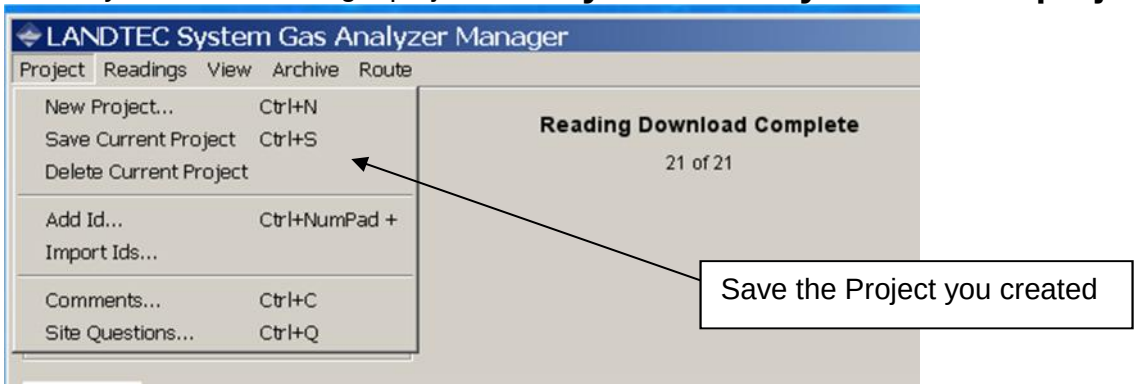
Eight (8) is the limit of IDs you can send to the Instrument.

You can create a project with the information that is in your Gem that was downloaded when the instrument was connected. All you will have to do is give the project a name.

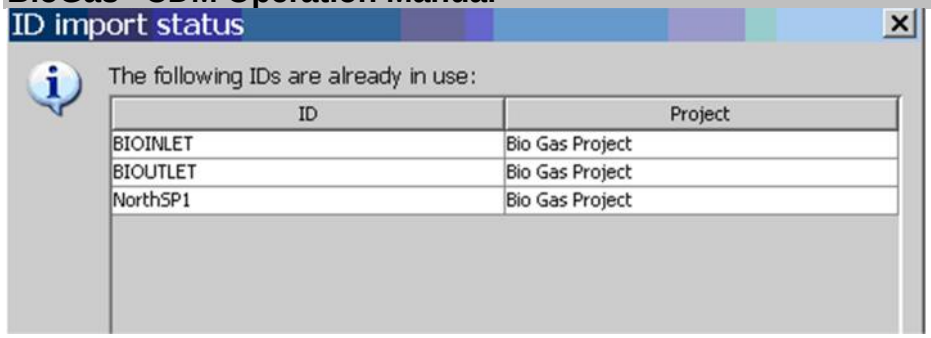


3.2.4 Save the Project

With any choice of creating a project **"always" Be sure you save the project**.

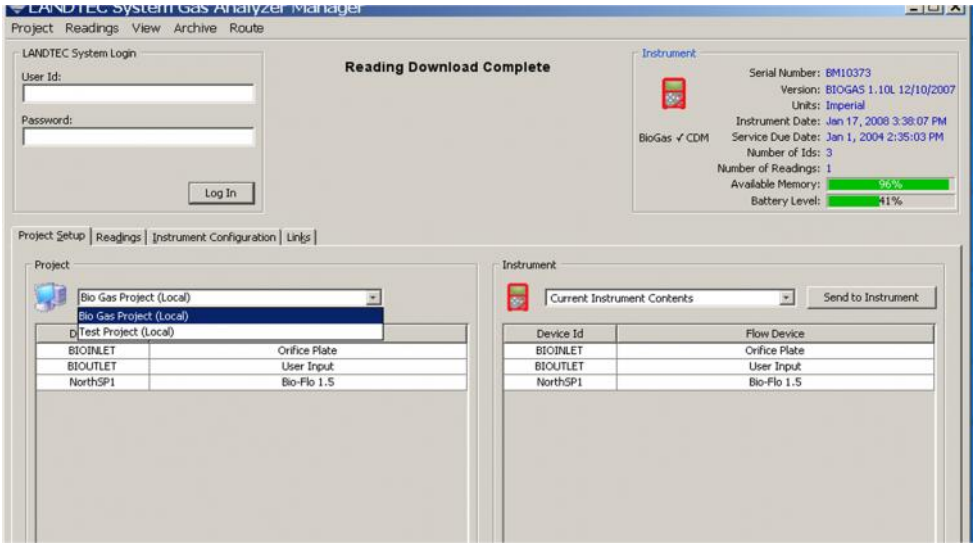


You may create as many projects as you need **BUT** you can only use a set of IDs one time.

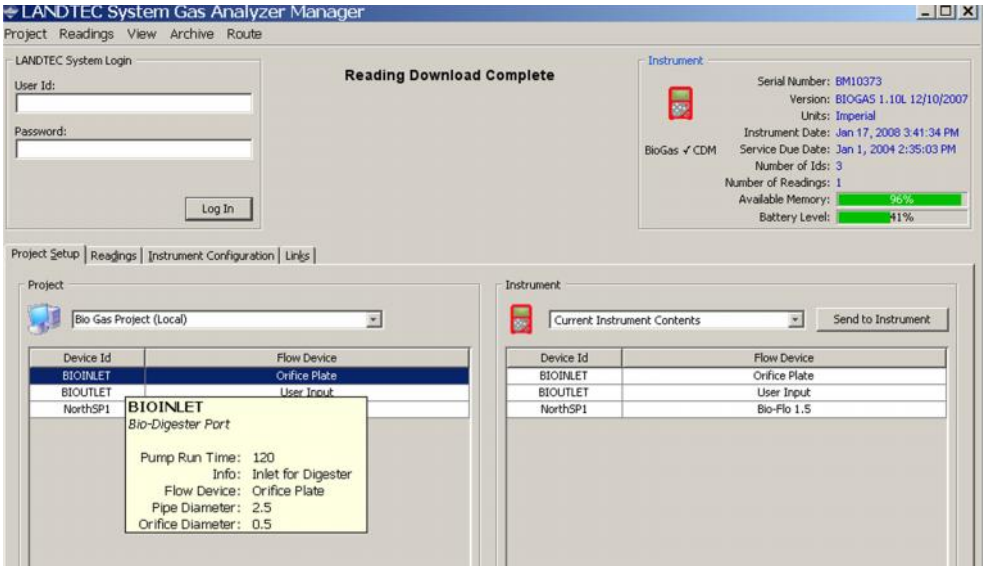


3.3 (Local) projects

After creating the project and saving the project it will be storied on you PC. All IDs, you have created for the project will remain together as one file to send to the instrument. These will all be available when you chose the (Local) project from the pull down.
The Projects will be there for you to choose from each time you connect LSGAM to your instrument.

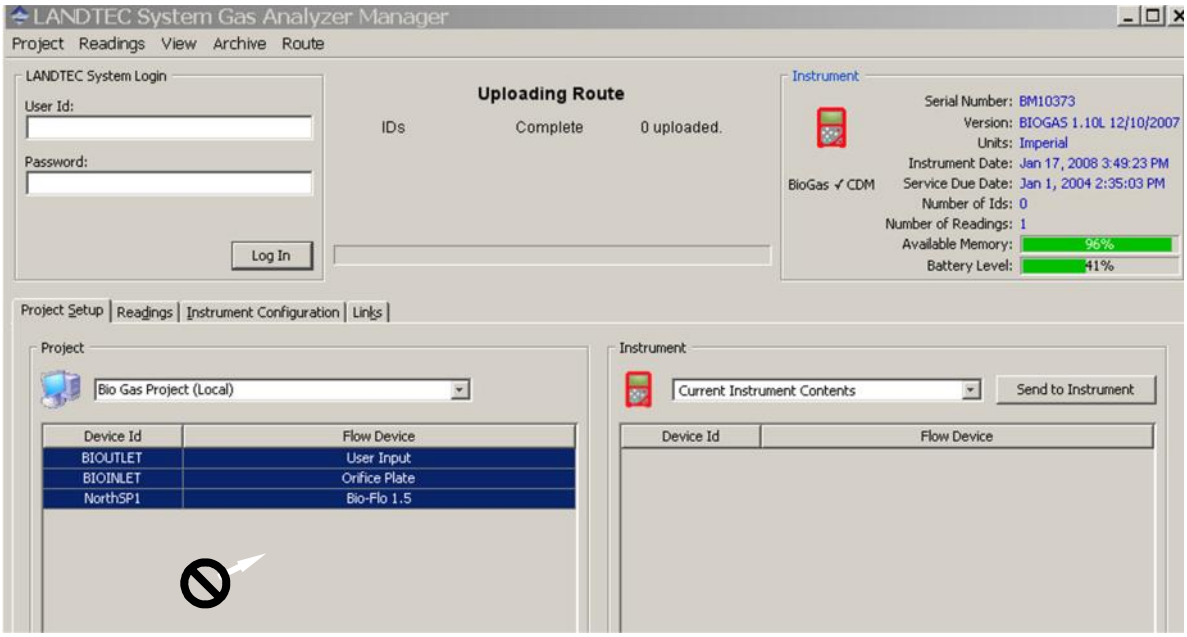


By placing the mouse arrow over the ID you will see the set up information for that ID.

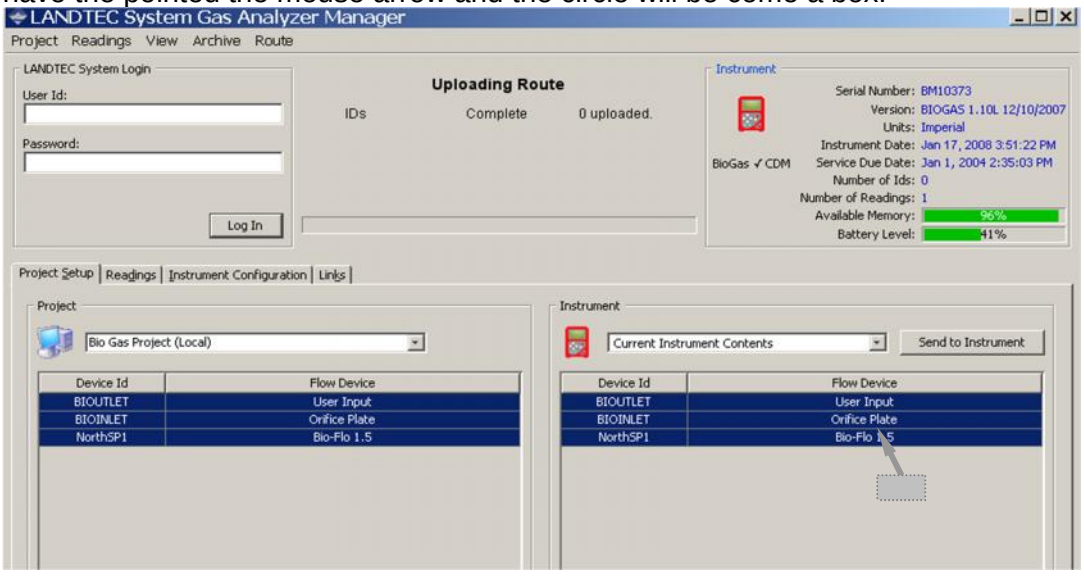


3.4 Moving IDs to send to the Instrument

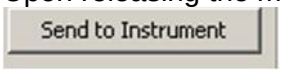
Place the mouse arrow at the edge of the first hold down the left key the arrow will change to select control then A on your key board to highlight all. You can now drag the list to the Instrument side of the screen.



Once you have dragged the list or any selection of IDs to the instrument side the line will change were you have the pointed the mouse arrow and the circle will be come a box.

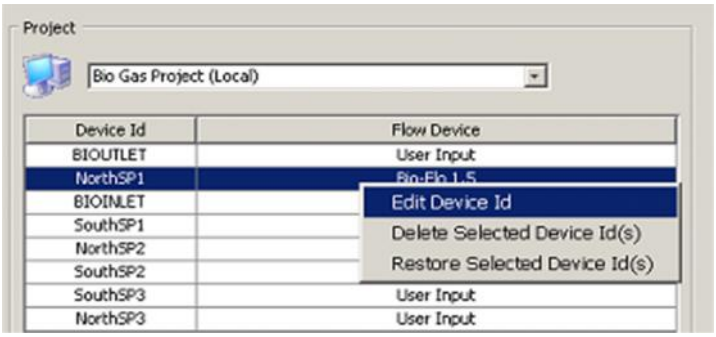


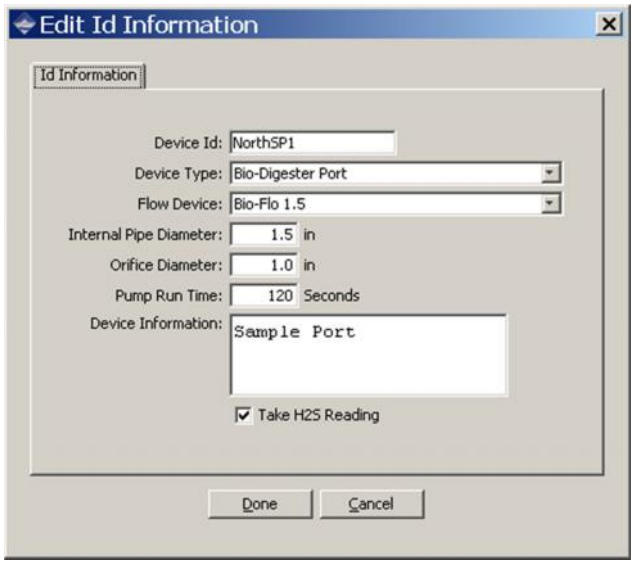
Upon releasing the mouse key your IDs will be in the instrument list. Now select Sent to Instrument.



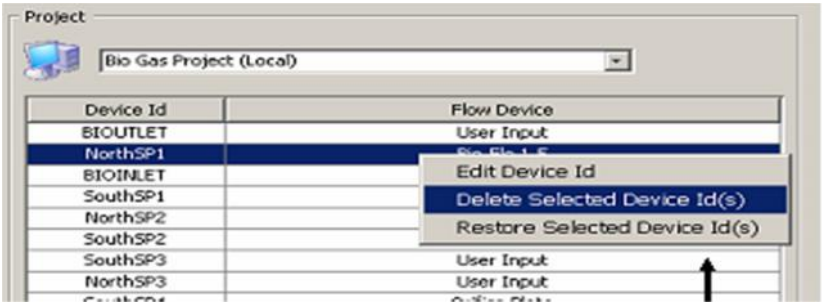
3.5 Editing a ID

Offline projects will have “(local)” next to their names. You can edit by highlighting the ID right click and choose from the menu.

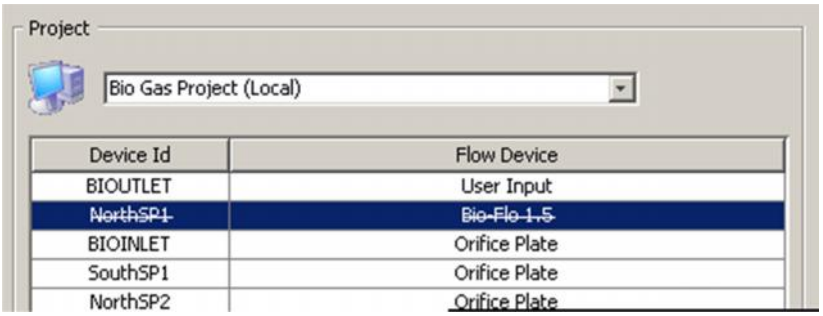




To delete a ID from the file

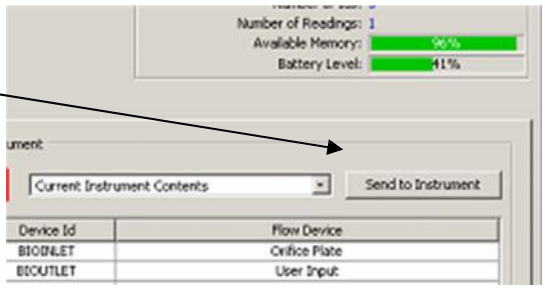


When a line is shown through the ID it is deleted as shown below

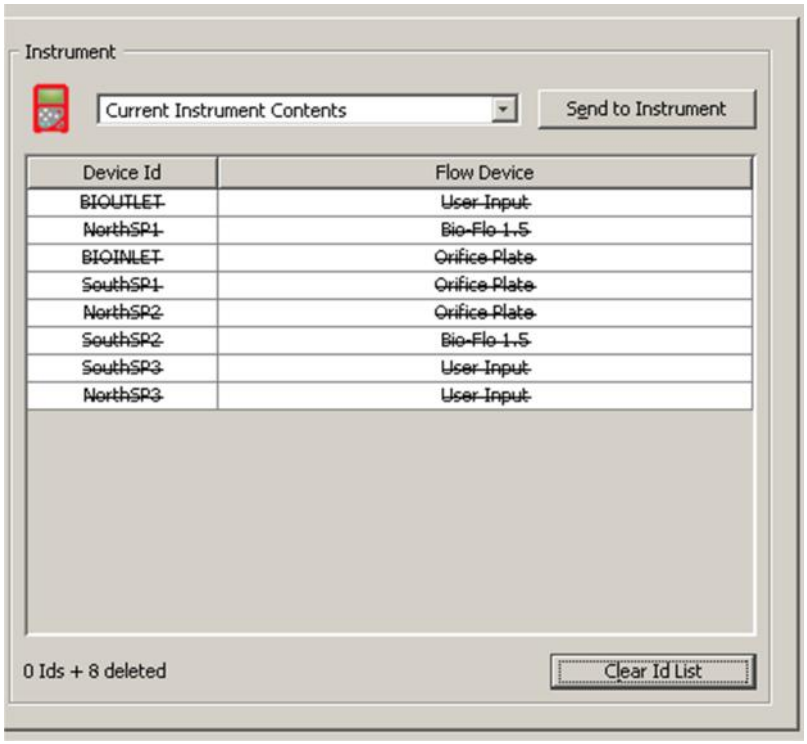


Select Restore ID from the same menu the line will be removed.

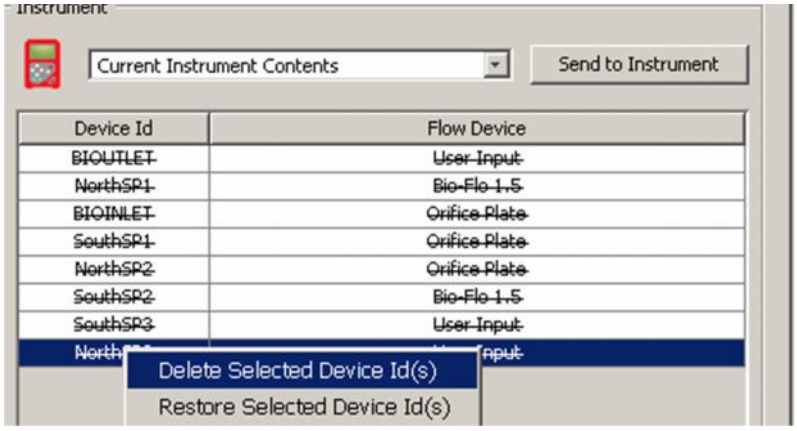
If you have the IDs set up correctly, moved them to the instrument side and are ready to load them to your Gem select the 



3.6 Clearing ID (s) from your instrument or Deleting a Project

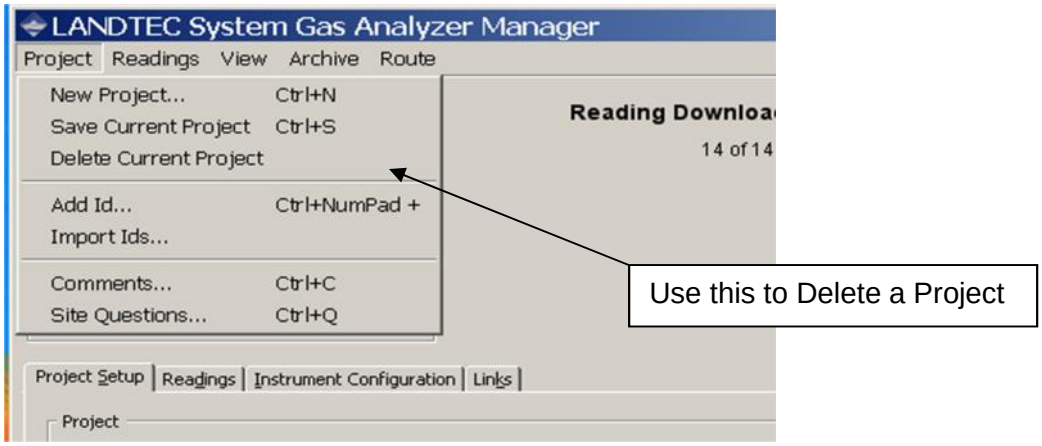


In current instrument contents when selecting the **Clear ID List** option it will draw lines through the IDS. You then need to select **Send to Instrument**. This will clear all IDs from the Instrument.

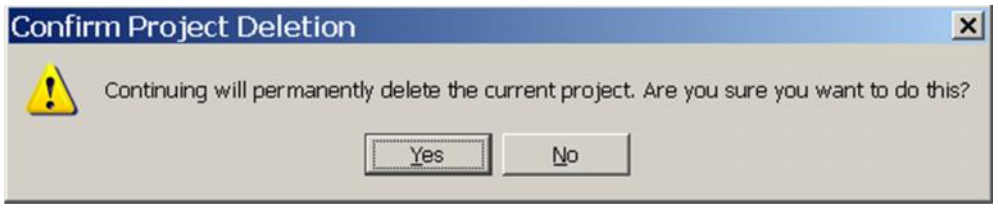


You may also delete one ID from a list by highlighting the ID RIGHT CLICK with your mouse and select the Delete Selected Device option. If you have selected the wrong ID and deleted then you may select the restore option to put the ID back in your list.

If you need to remove a project from your computer you chose the project you wish to remove on the project side then select Delete Current Project.

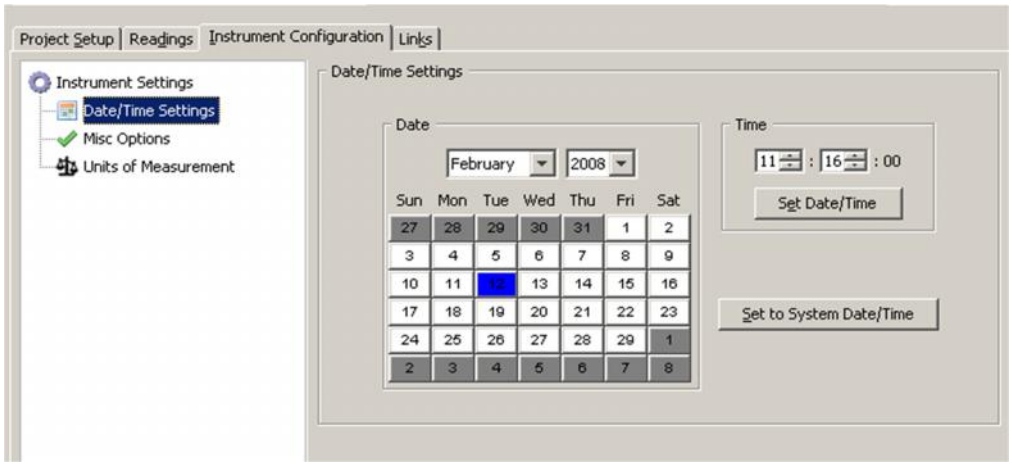


If Delete Current Project is chosen you will receive the message below

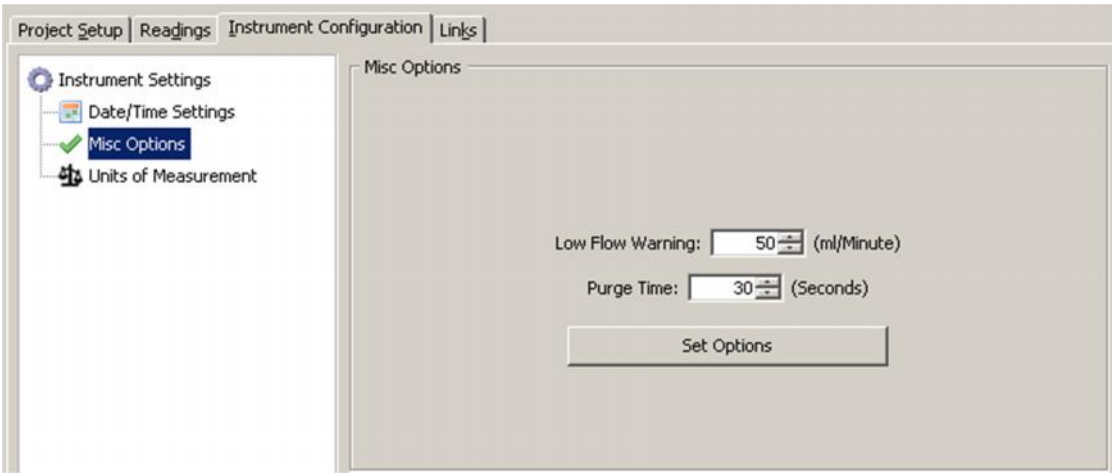


Yes will remove all files that have been created with this project.

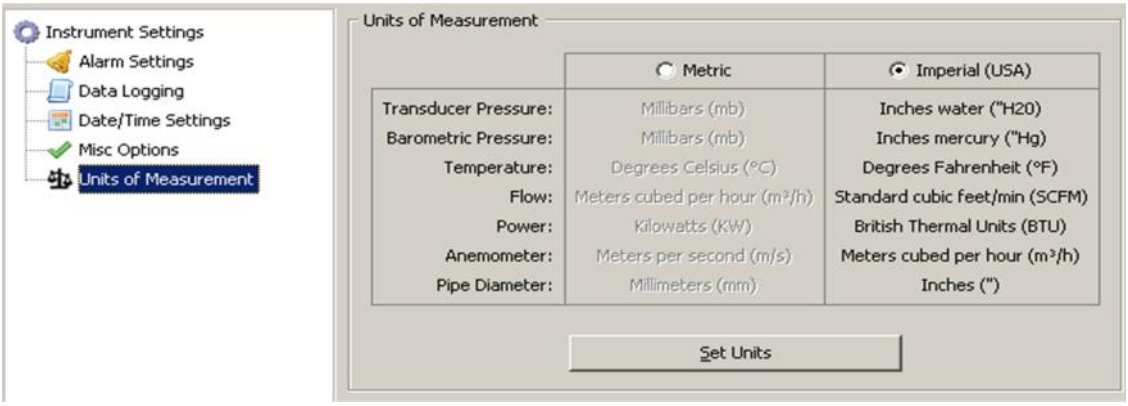
3.7 Instrument Configuration



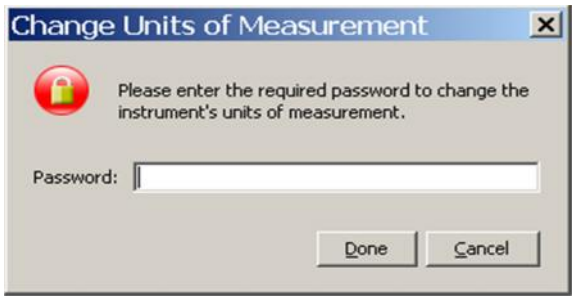
You will need to set your time and date from this screen if it is not correct.



These are options in the instrument that may be changed if you wish to. LANDTEC recommends leaving them set to the default values.



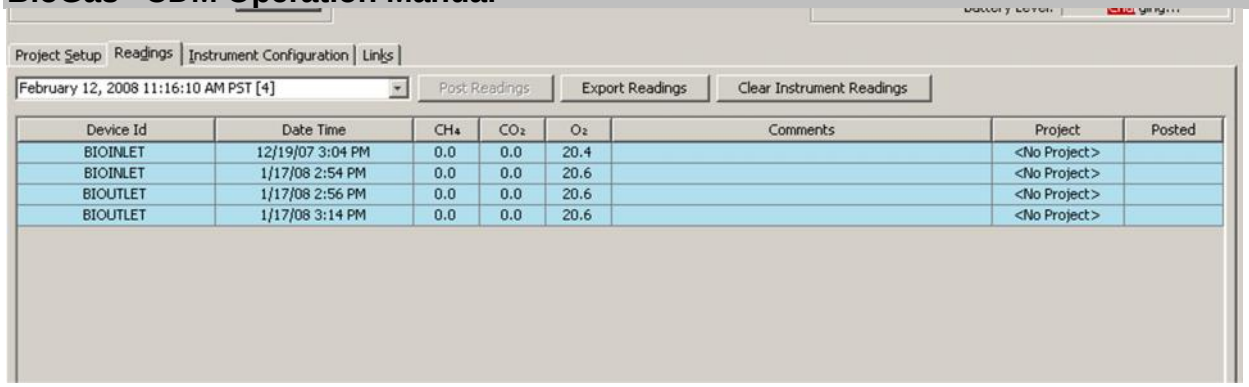
You may use Imperial or Metric unites of measurement. To change unites a Password is needed. This may be obtained from LANDTEC.



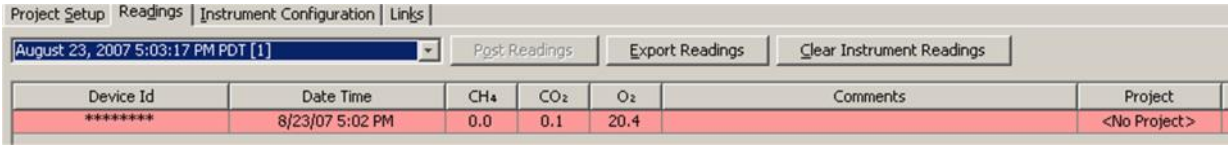
3.8 Instrument Readings

3.8.1 To save your readings file

When you open the readings file your project will be listed **ONLY** if you have created a project with these IDs that you have taken readings. Your readings will be shown with no project listed



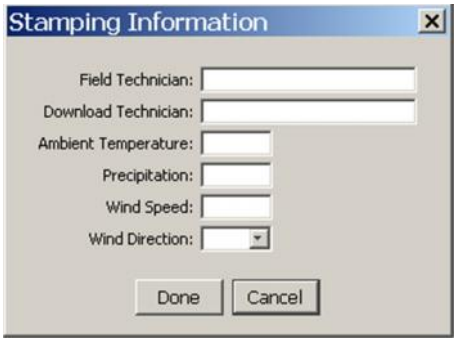
Example of a file if you have no ID or have not created a project .



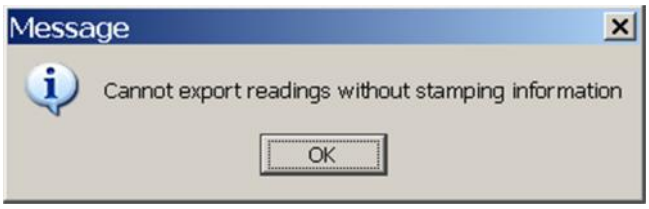
3.8.2 Export Readings

To save your readings to an csv file for your excel work sheet you will choose the Export Readings button.

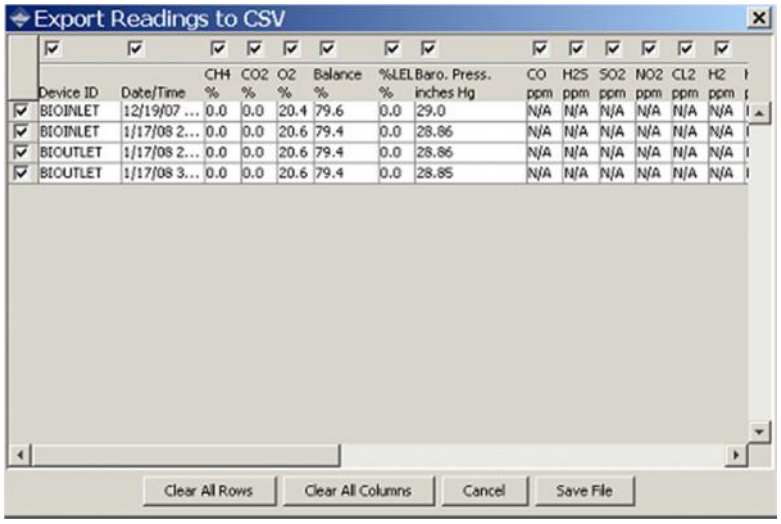
You will now see the stamp readings screen.

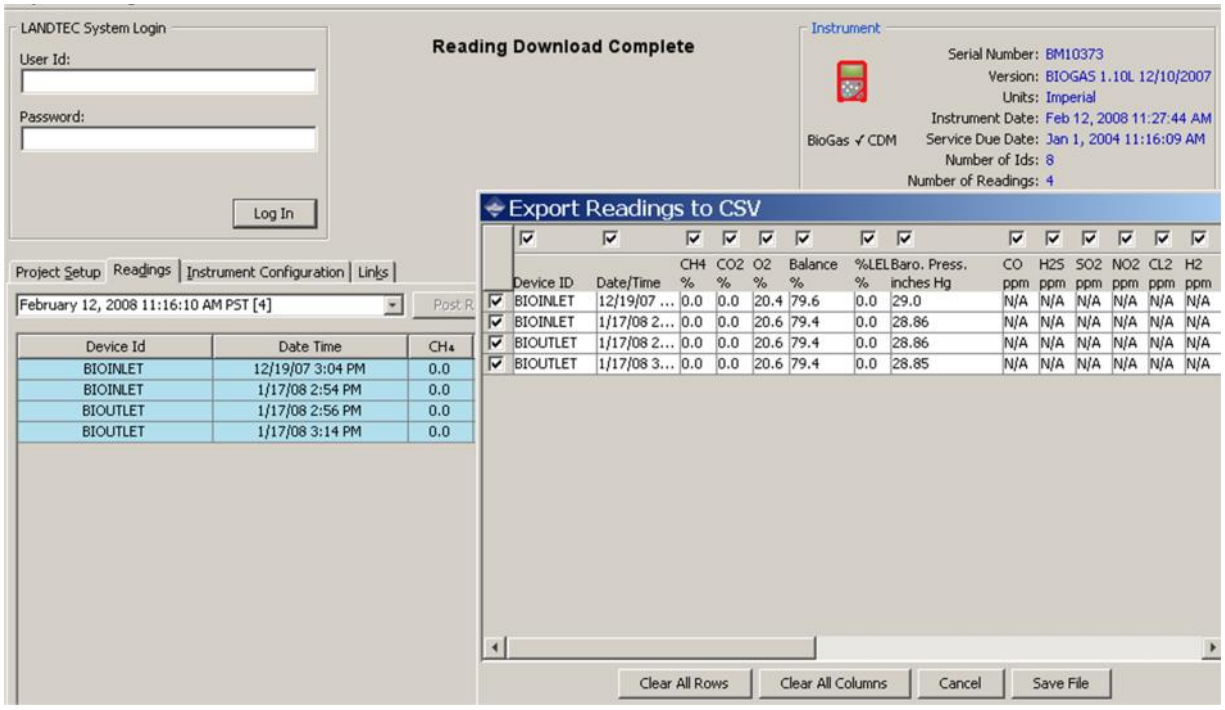


You need to fill in the above information. or receive the message below if you do not fill in the above screen.

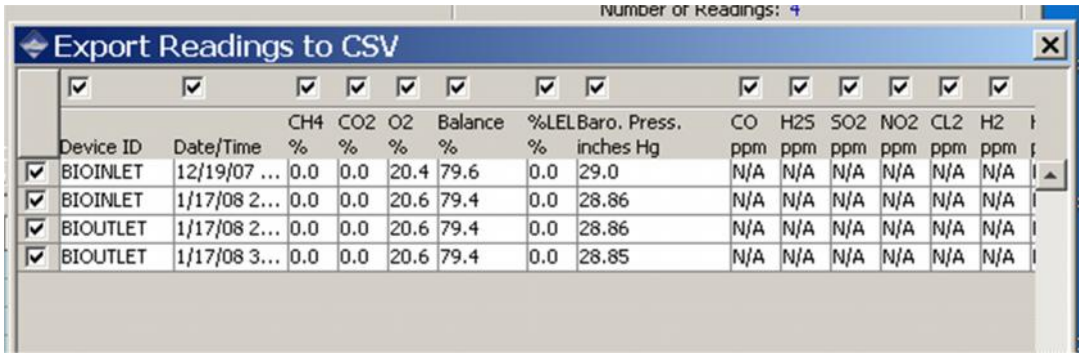


This screen will allow you to review you readings before saving

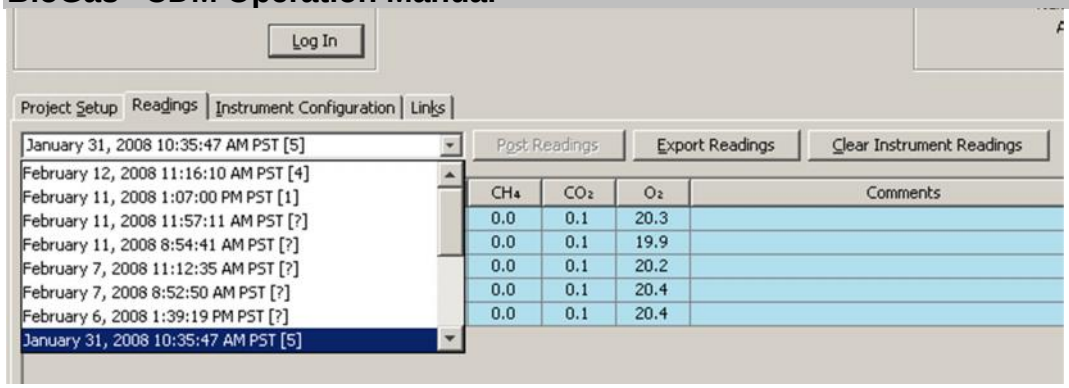


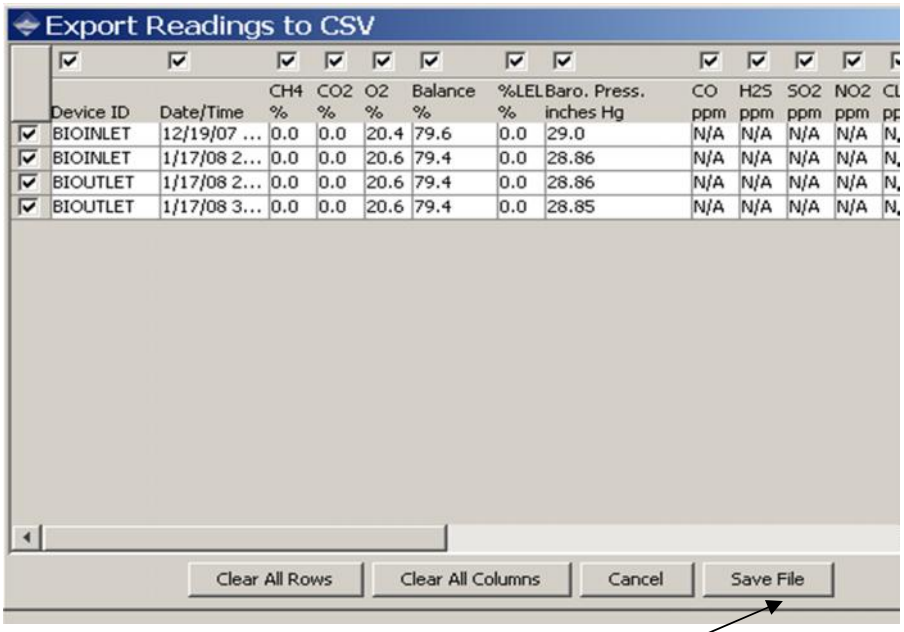


Example of how the export screen will appear.

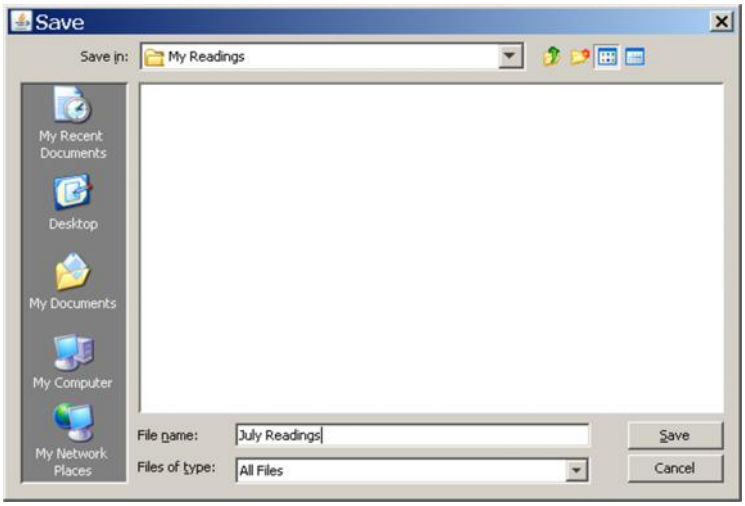


Taking the check mark out of the box beside a row will remove that reading or above will remove the column you do not want in the csv file you are saving. All downloaded will be saved by time



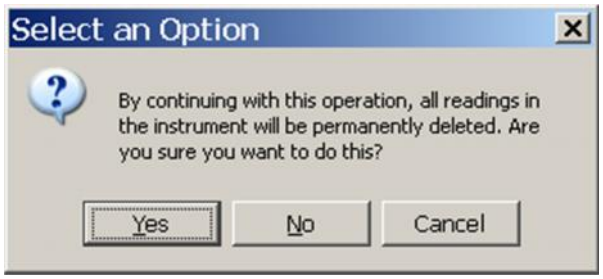


Select the Save File button to save to a csv file.
When saving the Readings File you will receive this screen to select the location and give the file a name



3.8.3 Clearing Readings from your Instrument

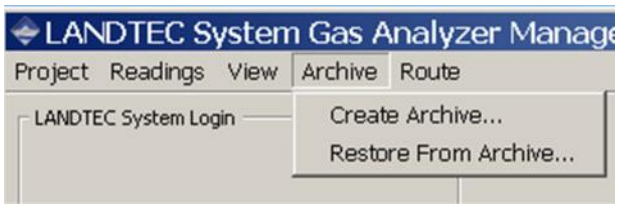
Then to clear readings from the instrument choose this button

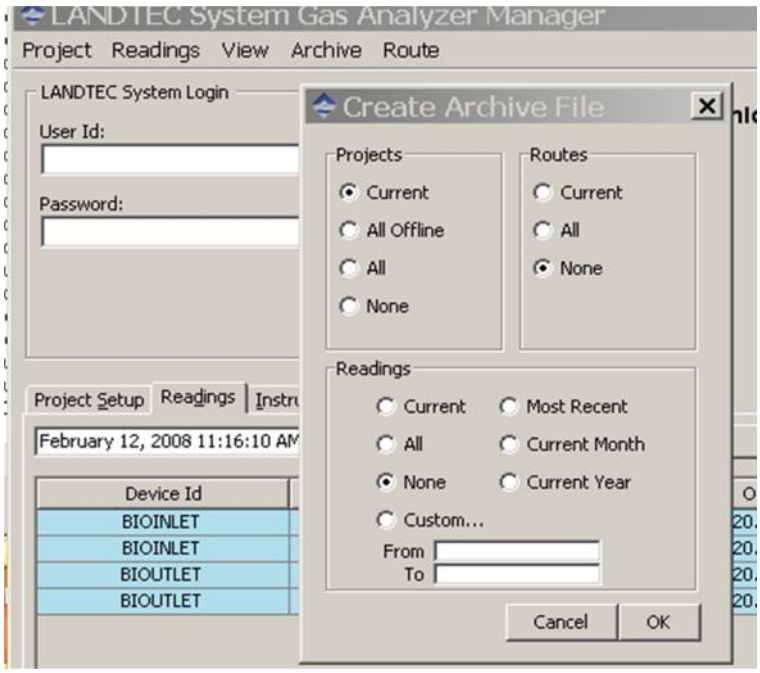


You will receive this message to make sure you wish to delete the readings.

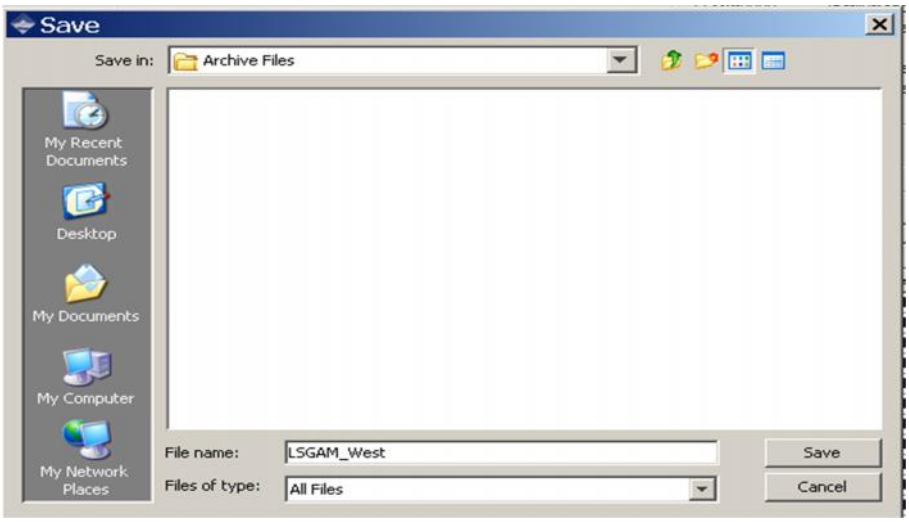
3.8.4 Archiving

To archive a project and/or readings file Choose the Create Archive from the Archive options.



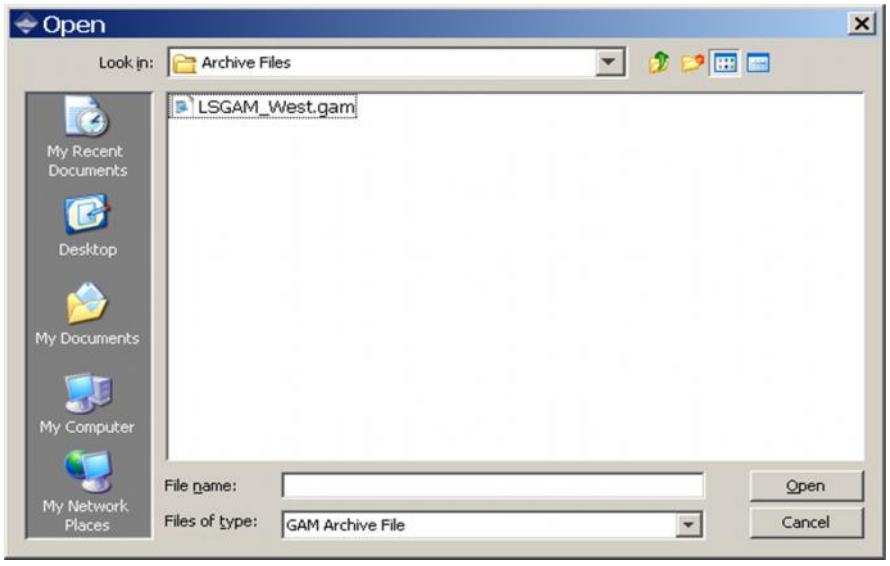


You will see this screen to save your archived file.



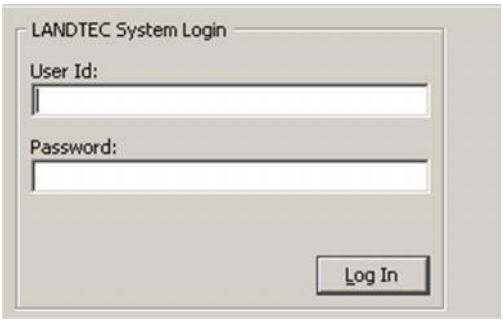
This archive file will give you the ability to e mail a file to another user of the LSGAM program.
To put the files in the LSGAM program select the Restore from Archive option

The screen below will open for you to select the file.



3.9 LANDTEC System Login

The on line user will login to LANDTEC System site.
This login screen will always be in the left hand corner of the screen but unless your company is a subscriber to the LANDTEC System EnviroComp internet service you will not use this login or have a User ID and password.



4 General Operations Menu

The following features and functions are selectable from the main;

- ① -Field Calibration
- ② -Instrument Information
- ③ -Adjust screen contrast
- ④ -Take Reading
- ⑤ -View Data
- ⑥ -Reset Functions

4.1 Field Calibration

Whenever carrying out a user calibration function it is important to ensure the correct value gas is entered into the instrument. Additionally, in the case of a zeroing function, ensure only certified gas or ambient air is used and no connection is made to a sample point during the process. The calibration cylinders sold by LANDTEC have a volume of 17 liters. The regulator, sold by same, is set to 0.5 liters per minute and 5 psig maximum flow pressure. A normal field calibration usually requires the gas to be running for about two minutes.

A field calibration should be carried out prior to use or when the ambient operating temperature changes greater than +/- 20 degrees Fahrenheit.

Upon selecting '① **Field Calibration'** the instrument will display a summary of the last gas calibration and the date it was done (if available in memory). The Field Calibration Summary is broken up into five stages;

Stage 1 – Zero CH_4 (and H_2S if optional pod is being used)
Stage 2 – Span CO_2 and CH_4
Stage 3 – Zero O_2
Stage 4 – Span O_2
Stage 5 – Span H_2S (if optional pod is being used)

There are three options available from the Field Calibration Summary Screen;

- ① -Calibrate Now
- ② -Calibration Check
- ③ -Main Menu

The calibration and calibration check procedures follow the five stages shown above. The instrument has extensive instructions to walk the user though each stage.

4.1.1 Calibrate Now

Stage 1
Selecting ① -Calibrate Now brings up the Clean Air Purge Screen. All hoses should be disconnected from sample points and optional gas pod should be attached, if being used. Pressing '①' Begins the purge cycle. Typically the purge is set to 30 seconds but can be changed though LSGAM. It is important to allow the purge to occur especially if using the optional gas pod.

After the purge is complete the Zero CH_4 and H_2S screen is displayed. Press the '✇' pump key to draw fresh air through the instrument or allow certified gas with no CH_4 or H_2S to flow through the instrument. Wait until the gas readings are stable then press '①' to zero the channels. The instrument will display a 'user zero complete' message and proceed to the Span CH_4 and CO_2 screen.

Stage 2
On all the span screens the "Target" value is the certified value of the calibration gas being used, it is crucial that this value is correct. If the target value shown is not the same as the gas being used, press the '⑤' to change the certified target value. Once the target value is correct flow the calibration gas through the instrument, the pump can be used if necessary. Wait until the gas readings are stable then press '①' to span calibrate the channels. The instrument will display a 'Calibration Complete' message and proceed to the Zero O_2 screen.

Stage 3
If using a gas mix with no oxygen for the CH_4 and CO_2 span, it can be left attached and flowing gas. Wait until the gas reading for O_2 is stable, and has settled to its lowest value, then press the '①' to zero the channel. The instrument will display a 'user zero complete' message and proceed to the Span O_2 screen.

Stage 4
Ensure that the gas being supplied has the desired amount of oxygen and that the Target value matches the gas being supplied. If the target value shown is not the same as the gas being used, press the '⑤' to change the certified target value. Once the target value is correct flow the calibration gas through the instrument, the pump can be used if necessary. Wait until the gas reading is stable then press '①' to span/calibrate the channel. The instrument will display a 'Calibration Complete' message and proceed to the Span H_2S screen.

Stage 5
If using the optional gas pod ensure that the pod is connected and ensure that the gas being supplied has the desired amount of Hydrogen Sulfide and that the Target value matches the gas being supplied. If the target value shown is not the same as the gas being used, press the '⑤' to change the certified target value. Once the target value is correct flow the calibration gas through the instrument, the pump can be used if necessary. Wait until the gas reading is stable then press '①' to span/calibrate the channel. The instrument will display a 'Calibration Complete' message and proceed to the field calibration summary screen.

If not using the optional gas pod press the '②' to Skip the H_2S span and the instrument will proceed to the field calibration summary screen.

Field Calibration Summary
Upon completion of the stages above the field calibration summary screen will detail the results from each stage. The values shown are the values after the stage was completed. If there are dashes '----' it indicates that this stage was skipped or not successfully completed. There are three options available. Pressing the '①' will store the calibration record, display a 'calibration complete and stored in memory' message and continue to the main menu.

Pressing the '②' will start the calibration process over again and press the '③' will return to the main menu without storing the results.
Note, once one or more of the calibration zero or span operations is/are preformed the instrument will be using those calibration parameters even if the results are not stored.

4.1.2 Calibrate Check

The calibration check process is identical to the calibration process but it does not adjust the instruments channels it only checks the channels against known gas values.

Stage 1
Selecting ① -Calibrate Now brings up the Clean Air Purge Screen. All hoses should be disconnected from sample points and optional gas pod should be attached, if being used. Pressing '①' Begins the purge cycle. Typically the purge is set to 30 seconds but can be changed though LSGAM. It is important to allow the purge to occur especially if using the optional gas pod.

After the purge is complete the Zero CH_4 and H_2S screen is displayed. Press the '✇' pump key to draw fresh air through the instrument or allow certified gas with no CH_4 or H_2S to flow through the instrument. Wait until the gas readings are stable then press '①' to continue. The instrument will proceed to the Span CH_4 and CO_2 screen.

Stage 2
On all the span screens the "Target" value is the certified value of the calibration gas being used, it is crucial that this value is correct. If the target value shown is not the same as the gas being used, press the '⑤' to change the certified target value. Once the target value is correct flow the calibration gas through the instrument, the pump can be used if necessary. Wait until the gas readings are stable then press '①' to continue. The instrument will proceed to the Zero O_2 screen.

Stage 3
If using a gas mix with no oxygen for the CH_4 and CO_2 span, it can be left attached and flowing gas. Wait until the gas reading for O_2 is stable, and has settled to its lowest value, then press the '①' to continue. The instrument will proceed to the Span O_2 screen.

Stage 4
Ensure that the gas being supplied has the desired amount of oxygen and that the Target value matches the gas being supplied. If the target value shown is not the same as the gas being used, press the '⑤' to change the certified target value. Once the target value is correct flow the calibration gas through the instrument, the pump can be used if necessary. Wait until the gas reading is stable then press '①' to continue. The instrument will proceed to the Span H_2S screen.

Stage 5
If using the optional gas pod ensure that the pod is connected and ensure that the gas being supplied has the desired amount of Hydrogen Sulfide and that the Target value matches the gas being supplied. If the target value shown is not the same as the gas being used, press the '⑤' to change the certified target value. Once the target value is correct flow the calibration gas through the instrument, the pump can be used if necessary. Wait until the gas reading is stable then press '①' to continue. The instrument will proceed to the calibration check summary screen.

Calibration Check Summary
Upon completion of the stages above the calibration check summary screen will detail the results from each stage. The values shown are the values after the stage was completed. If there are dashes '----' it indicates that this stage was skipped or not successfully completed. There are three options available.

Pressing the **'①'** will store the calibration check record, display a 'cal. check complete and stored in memory' message and continue to the main menu.
Pressing the **'②'** will start the calibration process and press the **'③'** will return to the main menu without storing the results.
Note, once one or more of the calibration zero or span operations is/are preformed the instrument will be using those calibration parameters even if the results are not stored.

4.2 Instrument Information

This function allows the user to view a verity of information about the instrument including;

- Serial number
- Service Plan
- When Service is due
- Last Field Calibration date
- Operating Language
- Communication baud rate
- Number for readings in memory
- Number of IDs in memory
- Date format
- Current time and date setting

4.3 Adjust Screen Contrast

The BioGas✓CDM automatically adjusts the screen contrast according to the ambient temperature to maintain normal viewing.

The contrast can be manually adjusted by pressing **'③'** from the main menu. This will bring up the Adjust Contrast screen. The **'④'** and **'⑥'** keys can be used as cursor keys to adjust the contrast. The manual contrast setting is stored when the **'①'** key is pressed.

5 Taking Readings

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

- All necessary ID codes have been uploaded via LSGAM software.
- The time and date are correct.
- The water trap has a clean and dry filter fitted.
- The inlet-port particulate filter is clean and dry.
- A supply of spare filters is available in case of accidental water blockage or contamination.
- The battery has a good charge (minimum 25% charge, even if only a few readings are required).
- The memory has sufficient space available.
- The CH_4, CO_2 and O_2 (H_2S for Gas Pod if fitted) readings have been zeroed without gas concentration present.
- Check the span calibration with a known concentration calibration gas.

Travel to the site with the 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 analyzer against anything hot (e.g. gas extraction pipe, car body or in an unattended car during the summer). This may cause erroneous readings.

When moving around a site, protect the instrument from strong direct sunlight, heavy rain or wind-chill. Strong direct sunlight can raise the temperature of the instrument beyond its operating range. If this occurs, the LCD display will appear almost black and the contrast setting cannot alter the contrast. Typically no permanent damage is done and after the instrument cools the screen will become readable again.

Always use the water trap! If the water trap becomes flooded, change the filter immediately and ensure all tubes are clear before re-use.
Readings can be taken with or without IDs loaded in the instrument. However an ID must be used if the instrument is going to calculate flow. When using IDs it is essential that the relevant ID be uploaded to the Instrument. An ID **cannot** be entered from the Instrument.

5.1 Select ID

To take a reading press **'④'** from the main menu, if IDs are loaded in the instrument select the ID by pressing the appropriate number. If none of the IDs are to be used, press the 'ý' key to continue with out an ID. The process begins with information about the ID selected or lack of an ID selected. Then a clean air purge will be completed. After the purge cycle the instrument will proceed to the zero pressure transducers screen.

5.2 Pressure Readings

Zeroing the pressure transducers is recommended if accurate pressure readings or flow calculations are necessary. The instrument has complete on screen instructions on how to perform this operation. After the transducers are zeroed the hoses can be attached to the sample points where pressure readings are required and the pressure can be stored. It is important to allow the pressure to stabilize, this typically takes 15 to 30 seconds, after connecting or disconnecting the hoses to obtain accurate pressure readings.

5.3 Temperature Readings

Temperature readings can be manually input or obtained automatically by the optional temperature probe. If using the instrument to calculate flow a temperature reading is required. Once a temperature is stored the instrument will automatically proceed to the gas readings screen.

5.4 Gas Readings

When the instrument enters the gas reading screen the pump will automatically come on and run for the specified sampling duration. The pump key can be pressed to extend the sample time if necessary. It is important to allow the gas readings to stabilize before storing the reading.
On the gas readings screen the previously stored pressure and temperature readings are shown. If any of these values are incorrect pressing the **'②'** key will allow re-reading the pressures and temperature. If the data is good and the gas readings are stable pressing the **'①'** key will store the reading and the instrument will display a 'complete reading stored' message and return to the main menu.

5.5 View Readings

The readings stored can be viewed by pressing the **'⑤'** key from the main menu. Any calibration or calibration check information as well as gas sample readings can be viewed. When viewing the calibration data there are three readings stored for each calibration. One labeled **'C_BEFORE'** which is what the instrument was reading before the field calibration. One labeled **'C_AFTER'** which is what the instrument read after the field calibration and one labeled **'C_TARGET'** which is the target values that were used during the field calibration.
Calibration check readings have two readings associated to each one. The first labeled **'C_CHECK'** which is what the instrument read during the check and the last labeled **'C_TARGET'** which is the target values that were used during the calibration check process.

5.6 *Cross-Gas Effect*

5.6.1 Methane, Carbon Dioxide and Oxygen

The Methane reading is filtered to an infrared absorption frequency of 3.41μm (nominal), the frequency specific to hydrocarbon bonds. Instruments are calibrated using certified Methane mixtures and will give correct readings provided there are no other hydrocarbon gasses present within the sample (e.g. ethane,

propane, butane, etc.). If there are other hydrocarbons present, the Methane reading will be higher (never lower) than the actual Methane concentration being monitored.

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

The Carbon Dioxide reading is filtered to an infrared absorption frequency of 4.29µm (nominal), the frequency specific to Carbon Dioxide. Therefore, any other gases usually found on landfill sites will not affect the Carbon Dioxide reading.

The Oxygen sensor is a newly developed 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. Normal operation will resume as soon as the gas sample has been purged.

Note - there has been one reported incident of a high reading due to the presence of Carbon Disulfide, which has a similar absorption frequency to Carbon Dioxide.

5.6.2 H_2S Optional Gas Pods

The Gas Pods used to measure H_2S and CO do suffer from cross-gas effects. Such effects are not accurately specified. However, the following table may be useful as a guide. This table represents how many ppm would be read by a Gas Pod if 100ppm of the interfering gas was applied, (with no other cross-contaminates being present in the sample).

Cell	CO	H_2S	SO_2	NO_2	CL_2	H_2	CH_4	CO_2
CO	100	<3	0	<-20	0	<40	0	0
H_2S	<0.5	100	~20	~-20		~0.1	0	0

NOTE: All readings are given in parts per million (ppm). The life of an electrochemical cell is determined by exposure to gasses, typical life being one to two years. It is recommended that Gas Pods be field calibrated at regular intervals.

4.7 Troubleshooting

Problem	Corrective Action/Reason
Unit does not turn on or operation is erratic	Battery charge is too low-recharge batteries. Unit is too hot - cool down unit and try again. Contact Factory Service.
"Flow Fail" is displayed and an audible alarm is heard	The inlet is blocked. Remove blockage and retry. The particulate filter or water trap filter needs replacing.
Readings taken are not what was expected	Unit may be out of calibration. Calibrate unit with known gas concentration. Water trap or particulate filters are clogged. Replace filter(s).
Readings swing up or down wildly as they are being taken	Cell phones and other sources of RF interference can affect Methane readings. Don't use your cell phone while taking readings.
Unit displays***** or >>>>>	These symbols are substituted when the measured reading is out of range of the instruments capabilities in some fields or when a value needs to be entered manually such as temperature.
Oxygen reading is high on all wells	Check that the water trap housing is screwed on tight. Check or replace O-rings on the water trap and instrument inlet. Check the wellhead inset for cracks, replace O-ring on insert. Field calibrate Oxygen channel.
Unit will not download readings or an error occurs while downloading.	Verify that the communications software is the right version for the instrument being used. Check that the proper serial port is selected in the software. Contact Factory Service.
Methane and Carbon Dioxide readings drift	Perform a field calibration and check well again. Verify cal gas is flowing when regulator is turned on. Verify all connections are tight and filters are not clogged. Contact Factory Service.
Oxygen readings drift	Perform a field calibration - zero and span. Contact Factory Service.
Black screen displayed when unit turned On	Charge unit over night and try again. Unit too hot - cool down and try again. Try adjusting contrast level. Contact Factory Service.
Nothing happens when the Gas Pod is installed	Remove and re-seat the Gas Pod. Contact Factory Service.
Temperature does not update when temperature probe is installed	Check the probe fitting is fully seated. Check the probe plug is screwed together tightly. Contact Factory Service.

6 Technical Specifications

6.1 Physical

Weight	4.4 lbs.
Size	L 2.48” x W 7.48’’ x D 9.92”.
Case material	Anti-static ABS.
Keys	Membrane panel.
Display	Liquid Crystal Display 40 x 16 characters. Fiber optic woven backlight for low light conditions.
Filters	User replaceable integral fiber filter at inlet port and external PTFE water trap filter.

6.2 General

Certifications	UL Certified to Class 1, Zone 1, AEx Ib d IIa T1
Temperature measurement	With optional probe 14°F to 167°F.
Temperature accuracy	±3.6ºF (with optional temperature probe).
Communications	RS232 protocol via download lead with variable baud rate.
Relative pressure	±250 mbar from calibration pressure

6.3 Power supply

Battery type	Rechargeable Nickel Metal Hydride battery pack containing six 4AH cells. **Not user replaceable**. Lithium Manganese battery for data retention.
Battery life	Typical use 10 hours from fully charged condition.
Battery charger	Separate intelligent 2A battery charger powered from AC voltage supply (110-230V).
Charge time	Approximately 2 hours from complete discharge.
Alternative power	Can be powered externally for fixed-in-place applications only. Contact CES-LANDTEC for further information.
Battery lifetime	Up to 1,000 charge/discharge cycles.

6.4 Gas Ranges

Detection principle	CO_2 and CH_4 by dual wavelength infrared cell with reference channel. O_2 by internal electrochemical cell.			
Oxygen cell lifetime	Approximately 18 months in air.			
Typical Accuracy 0 - Full Scale	**Gas**	**0-5% volume**	**5-15% volume**	**15%-FS**
	CH_4	±0.5%	±1%	±3% (70%)
	CO_2	±0.5%	±1%	±3% (40%)
	O_2	±1%	±1%	±1% (25%)
Response time, T90	CH_4	≤20 seconds		
	CO_2	≤20 seconds		
	O_2	≤20 seconds		
Range	CH_4	0-70% to specification, 0-100% reading.		
	CO_2	0-40% to specification, 0-100% reading.		
	O_2	0-25%		

6.5 Pump

Typical flow	300 cc/min.
Flow fail point	50 cc/min approximately.
Flow with 200 mbar vacuum	250 cc/min approximately.
Vacuum	70 inches H_20.

6.6 Operating Conditions

Operating temp range	32°F to 104°F.
Relative humidity	0-95% non-condensing.
Atmospheric pressure range	700-1200 mbar. Displayed in Inches of Mercury (5.9 – 35.4“Hg). Not corrected for sea level.
Atmospheric pressure accuracy	±5 mbar approximately.
Case seal	IP65.

6.7 Optional Gas Pods

Typical Accuracy (Subject to User calibration).	**Gas** H_2S	**0-Full Scale** ±10% FS
Response time, T90	H_2S	≤60 seconds
Range	H_2S	0-50 ppm 0-200 ppm 0-5,000 ppm

7.0 Service

The Biogas Check CDM instrument should be regularly serviced to ensure correct and accurate operation. LANDTEC recommends a service and factory recalibration **every 6 months**.