



Advanced Calibration Designs, Inc.

Cal 2000

Gas Generator

Release VI



Advanced Calibration Designs, Inc.

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Revision - 070620

INSTRUCTION MANUAL

www.goacd.com

IX. SPECIFICATIONS

Chlorine (Cl₂).....0.5 - 50.0 ppm
Chlorine Micro-Cell (Cl₂).....0.05 - 1.0 ppm
Hydrogen (H₂).....0.5 - 50.0 ppm
Hydrogen Cyanide (HCN)0.5 - 50.0 ppm
Hydrogen Sulfide Micro-Cell(H₂S).....0.05 - 1.0 ppm
Hydrogen Sulfide (H₂S).....0.5 - 50.0 ppm
Chlorine Dioxide (ClO₂).....0.5 - 5.0 ppm
(ppm is variable with flow rate, output given at 1/2 LPM)

Air Flow Rate (with internal pump).....0.2 to 1 LPM
Sample draw rate (with pump disabled).....0.1 to 5 LPM
Useful Cell Life.....50 hours
Warm-up time (to 90%).....Approximately 5 minutes
L x W x H.....8.5 x 4.25 x 3.0" (21.6 x 10.8 x 7.6 cm)
Weight.....3 lbs. (1360 g)
Operating Temperature.....0° C to 50° C
Relative Humidity (intermittent use).....0 -100%
Accuracy.....±10%
Repeatability.....±5%
Battery Power.....4 alkaline "C"
Battery Life.....20-30 hours (@ .5 LPM)

CSA Certified Intrinsically Safe

Class I, Division 1, Groups A, B, C & D
European Standards approval for Zone 0

Manufactured by:

Advanced Calibration Designs, Inc.

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Instruction Manual

Cal 2000 Gas Generator

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Para bajar la version del manual en Español visite:
<http://www.goacd.com/acd/Download/Download.html>

Vous pouvez télécharger une version française de ce manuel à:
<http://www.goacd.com/acd/Download/Download.html>

WARNING:

This instrument generates calibration gas for toxic gas detectors. The instruction manual should be read and understood prior to operation of the instrument. Failure to operate the instrument correctly can lead to improper calibrations.

This instrument conforms to the protection requirements of the **EC DIRECTIVE 89/336/EEC** on Electromagnetic Compatibility (EMC), in accordance with the provisions of Statutory Instrument 2372.

The following standards have been applied:

EN 50081-1
Emissions Standard (Residential Commercial and Light Industry)

EN 50082-1
Immunity Standard (Residential Commercial and Light Industry)

362-0600-00	AC Adaptor, 115 VAC, US style plug 7.5VDC, 300 mA
510-2000-00	Chlorine Cell, 50 hrs
510-2000-20	Chlorine Cell, 100 hrs
510-2000-05	Chlorine Micro-Cell, 50 hrs
510-2050-00	Hydrogen Sulfide Cell, 50 hrs
510-2050-05	Hydrogen Sulfide Micro-Cell, 50 hrs
510-2060-00	Chlorine Dioxide Cell, 50 hrs
510-2060-20	Chlorine Dioxide Cell, 100 hrs
510-2070-00	Hydrogen Cyanide Cell, 50 hrs
510-2090-00	Hydrogen Cell, 50 hrs
510-2090-20	Hydrogen Cell, 100 hrs
715-0403-0X	3 Foot Hose w/connector, low flow, 1/4" OD
715-0405-0X	5 Foot Hose w/connector, low flow, 1/4" OD
730-0615-00	Hard-body, Water Resistant, Padded Carrying Case
910-0603-00	Instruction Manual

VIII. Accessory Items / Parts List

The following items are available as accessories for the Cal 2000:

P/N	Description
113-0402-00	Male Hose Barb Quick Connector, 1/8" OD hose
150-0121-00	Charcoal Filter Element, one each
150-0131-00	Charcoal Filter Element, package of 12
180-0100-00	Empty Plastic Bottle with Pipette for Electrolyte
193-0100-00	Electrolyte, Chlorine (50 ml bottle)
193-0101-01	Electrolyte, Chlorine Dioxide (1 Qty. Refill)
193-0101-05	Electrolyte, Chlorine Dioxide (5 Qty. Refill)
193-0101-10	Electrolyte, Chlorine Dioxide (10 Qty. Refill)
193-0101-25	Electrolyte, Chlorine Dioxide (25 Qty. Refill)
193-0105-00	Electrolyte, Hydrogen Sulfide (50 ml bottle)
193-0107-00	Electrolyte, Hydrogen Cyanide (50 ml bottle)
193-0109-00	Electrolyte, Hydrogen (50 ml bottle)

I. GENERAL DESCRIPTION

The Cal 2000 is a battery-powered, portable electrochemical gas generator designed to calibrate toxic gas sensors. Fast warm-up time allows the instrument to be turned off between remotely located sensors saving battery life and avoiding generation of unwanted gas. A built-in mass flow sensor provides accurate flow control and the ability to measure externally provided sample draw flow rates. The Cal 2000 uses the following components to produce the calibration gas/air mixture:

Internal Micro Pump

A small, rotary vane, micro air pump draws in ambient air to blend with the generated gas. The pump may be disabled for use in calibrating sample draw instruments.

Electrochemical Generating Cell

The electrochemical generating cell contains an electrolyte solution and either inert or consumable electrodes, depending upon the gas being generated. A precise concentration of gas is produced when a known amount of current and a known amount of air is supplied continuously to the cell. Each cell has a built-in memory chip that tells the Cal 2000 instrument what type and range of gas can be generated and how much cell life is remaining. The electronics board mounted to the cell should never be removed from the cell. Removal of this board will void warranty and destroy the cell. Due to the design characterization of the cell, the unit must be oriented flat (on the units feet) for correct concentration output.



Cell Installation and Removal

There are no tools required by the end user for service of the instrument. The electrochemical cells are shipped separate of the unit and should be installed on receipt. To install the cell, remove the bottom cover of the instrument. This is done by pulling each of the 'plunger feet' on the bottom of the instrument. Once all of the plungers have been pulled out, the bottom cover is simply removed from the instrument.



The cell is keyed to ensure proper alignment into the instrument. When installed, the circuit board of the cell should be flat with the bottom of the instrument. Push up on the clear window at the back of the instrument to eject the cell.



warranty of fitness for a particular purpose. In no event shall Advanced Calibration Designs, Inc. be liable for direct, incidental or consequential loss or damage of any kind connected with the use of its products or failure of its products to function or operate properly.

The following is a listing of the available electrochemical Cal 2000 cells and their standard prorated warranty when installed in equipment manufactured and supplied by Advanced Calibration Designs, Inc.

50 Hour Generating Cells

1. Chlorine - One year or 50 hours of use.
2. Hydrogen Sulfide - One year or 50 hours of use.
3. Hydrogen Cyanide - One year or 50 hours of use .
4. Hydrogen - One year or 50 hours of use .
5. Chlorine Dioxide - One year, 50 hours of use .

100 Hour Generating Cells

1. Chlorine - One year or 100 hours of use.
2. Hydrogen Sulfide - One year or 100 hours of use.
3. Hydrogen Cyanide - One year or 100 hours of use .
4. Hydrogen - One year or 100 hours of use .
5. Chlorine Dioxide - One year, 100 hours of use .

VII. Standard Warranty

We warrant gas calibration equipment manufactured and sold by us to be free from defects in materials, workmanship and performance for a period of one year from date of shipment. Any parts found defective within that period will be repaired or replaced, at our option, free of charge, F.O.B. factory. This warranty does not apply to those items which by their nature are subject to deterioration or consumption in normal service, and which must be cleaned, repaired, or replaced on a routine basis.

Such items may include, but are not limited to:

- a. Electrochemical type generating cells
- b. Electrolyte
- c. Batteries

Warranty is voided by abuse including rough handling, mechanical damage, alteration, or repair procedures not in accordance with the instruction manual. This warranty indicates the full extent of our liability, and we are not responsible for removal or replacement cost, local repair costs, transportation costs or contingent expenses incurred without our prior approval.

Advanced Calibration Designs, Inc.'s obligation under this warranty shall be limited to repairing or replacing, and returning any product which shall be returned to Advanced Calibration Designs, Inc. at its manufacturing facilities, with transportation charges prepaid, and which Advanced Calibration Designs, Inc.'s Material Review Board examination shall disclose to its satisfaction to have been defective.

This warranty is expressed in lieu of any and all other warranties and representations, expressed or implied, and all other obligations or liabilities on the part of Advanced Calibration Designs, Inc. including, but not limited to, the

Alkaline "C" Batteries

A set of four fully charged, **heavy duty alkaline "C"** batteries provides 20-30 hours of operation at .5 LPM. **Note: Rechargeable or light duty batteries can be used, but they give significantly less operating time.**

Microprocessor-Based Circuitry

The Cal 2000 has microprocessor based circuitry that performs several different operations and offers the user many different features. The microprocessor tracks cell and battery usage, monitors the air flow rate and controls the cell and pump to give the selected ppm and flow rate. In addition to English, every Cal 2000 is capable of providing menu displays in French, German and Spanish. See section IV. Menu Options for instructions on how to change the menu language.

Digital Display

The Cal 2000 has a liquid crystal display (LCD) located on the front of the instrument. This display is protected by a thin, clear plastic cover that is part of the front label and may be replaced if it becomes scratched or unclear.

POWER and SELECT

The POWER and SELECT switches are momentary push button type switches activated through the front membrane panel. They are physical switches mounted directly on the circuit board.

Nylon Carrying Case

The Cal 2000 comes with a convenient, durable, nylon carrying case. It is adjustable to be worn as a hip pack, or the belt strap can be reattached to be worn around the neck or over the shoulder. The top of the carrying case is clear plastic, allowing the unit to be operated while within the case, and there is a convenient front pocket for storage of additional cells or the delivery hose.

Delivery Hose

The instrument comes standard with a three (3) foot long, ¼ inch diameter noreprene hose for delivering the gas to the sensor or calibration adapter. The hose has a male quick connect adapter for easy attachment to the instrument.

Mass Flow Sensor

The Cal 2000 has a built-in mass flow sensor that measures the flow rate of the instrument. This information is used in two ways. With the pump engaged, it is used to control the pump to the desired flow rate over a range of 0.2 to 1.0 LPM. With the pump disabled, it is used to measure the air flow rate drawn through the Cal 2000 by an external pump. This information is used to adjust the cell current to the desired ppm. The flow meter should be calibrated against a primary mass flow standard every 12 to 24 months.

Internal Charcoal Filter

An internal charcoal filter is provided to scrub contaminated air and provide a clean baseline for “zeroing” sensors. This filter should be replaced on a yearly basis and is removed by pulling out the grey plunger at the top of the unit. Spare filter elements can be purchased through ACD. Note: The charcoal filter must be fully installed into the instrument for correct operation.



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"Cell Failure!" *accompanied by an audible beep.*

There are two possible causes for a cell failure. One cause is that the instrument has not detected a cell. The other is that a high voltage has been detected across the cell.

If the cell is not initially detected by the processor, the unit will display cell failure and immediately shut down (without entering 'purge mode'). This failure can happen either because a cell is not inserted, connection to the cell is not made, or due to a failure of the circuit board on the generating cell.

The cell failure alarm will also engage if the microprocessor detects an abnormally high cell voltage condition. One possibility for this high voltage is that one of the pins may be making a faulty electrical connection. Another possibility is that the electrolyte level is too low. For instructions on how to replenish the electrolyte refer to

Section V: Maintenance.

If this message continues after the cell has been plugged in correctly and the electrolyte level has been confirmed to be sufficient, contact the factory and/or replace the cell.

"Cell is used up! " *accompanied by an audible beep.*

The cell life has expired and the display will show 0% cell life remaining. Replace the cell.

"Battery is low!" *accompanied by an audible beep.*

If battery power drops below 5% capacity, the screen will flash "Battery is low!". Replace the batteries or switch to AC power.

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VI. Troubleshooting

No Power To Instrument

There are two common causes for the unit to not power up when the POWER switch is pressed for three seconds.

The most common is that the batteries are dead. Try replacing the batteries with new alkaline batteries or try powering the unit from the AC power adapter.

The second most frequent cause for no power to the instrument is a blown protective fuse. **This fuse can be shorted out if the batteries have been removed from the instrument with a metallic object such as a screwdriver.** If the protective fuse has been blown contact the factory.

"Flow too low" / "Flow too high" *accompanied by an audible beep.*

Accurate air flow is critical to an accurate gas mixture. The microprocessor and built-in precision mass flow sensor continuously monitor the air flow. If, however, a flow problem develops (e.g. air blockage or kinked tubing) which cannot be corrected within ten seconds, the unit will display "Flow too low." If the problem cannot be cleared after an additional minute, the instrument will enter the purge mode and then power down.

If the pump was not disabled prior to attaching an external pump device, or the sample draw flow rate is greater than 5.0 LPM, the unit will display "Flow too high." If the problem is not cleared within one minute, the instrument will enter purge mode as above.

Optional items available for the Cal 2000 include:

AC Adapter

The Cal 2000 may also be operated from an AC adapter. The AC adapter converts the AC voltage supplied from the main power lines to 6 VDC which is used in lieu of the batteries. The adapter plugs into the instrument from the underside of the case directly into the power board and is independent of polarity. If needed, contact the factory for exact specifications of the AC adapter.

Hard Body Instrument Case

A water resistant, padded instrument case is available for storage and shipping of the Cal 2000. The case is made out of rugged, high impact resistant plastic and will help protect the instrument in harsh environments. The foam insert may be customized to hold additional items like spare batteries and cells.

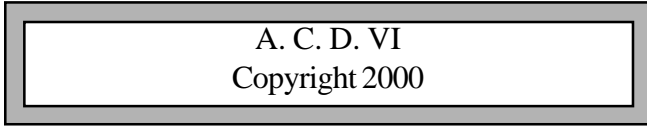
Extension Hoses

Longer sample hoses may be purchased for use with the Cal 2000 in lengths up to 20 feet. Note: the internal pump may not be capable of overcoming flow restrictions associated with extreme hose lengths when operating at 1.0 LPM.

II. Normal Operation: Diffusion Mode

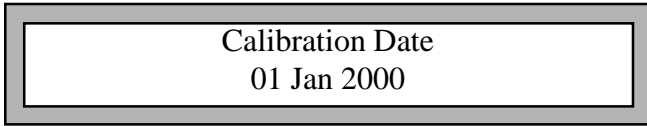
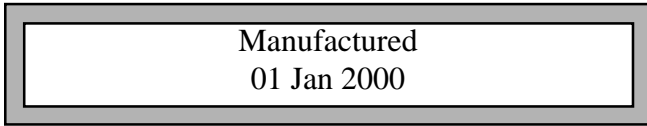
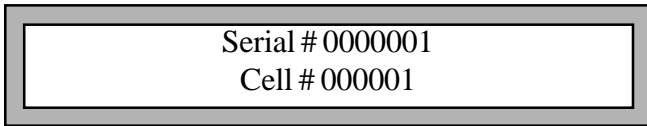
To start the generator, **press and hold** the POWER switch, located in the middle left front of the instrument, until the display reads A. C. D., approximately **three (3) seconds**. Release the switch immediately thereafter.

The instrument will sequence through several screens as follows:



Please Note: If you would like to change the language of the menus, see section IV. Menu Options: Foreign Language Option, for instructions.

The instrument will display the Serial Number and Cell Number, followed by the manufactured date.



V. Maintenance

The electrochemical cells of the CAL 2000 require periodic maintenance to provide optimum performance. It is recommended that the electrolyte solution be replaced on an annual basis for most gases generated by the CAL 2000. The exception to this is the ClO₂ electrolyte. Please refer to the instructions enclosed with every chlorine dioxide cell or replacement electrolyte pack.

If the instrument is returned with the cell on an annual basis to maintain NIST certification, the electrolyte will be replaced by the factory.

The following steps should be taken to replace electrolyte.

- a. Remove cell as described in section I. General Description: Cell Installation and Removal.
- b. Unscrew solid fill plugs on reservoir and remove liquid.
- c. Use syringe (provided with electrolyte) to add liquid to within 1/8 inch from the bottom of fill hole.

Warning: Do not over-fill reservoir. Trapped air must be allowed to escape through vent plug as fill screw is replaced. Contact the factory for more information.

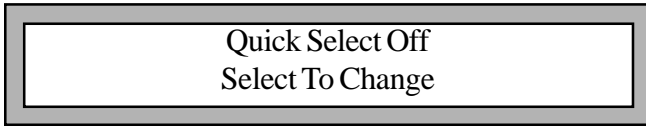
- d. Replace fill plugs.

Caution

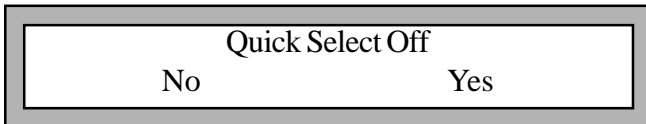
Both the electrochemical cell and the alkaline batteries used in the CAL 2000 instrument contain corrosive chemicals. In addition, depending on the type of cell being used, the gas being generated can be corrosive. The design of the instrument takes this into consideration, and the 300 second purge cycle allows the corrosive gases to be swept out of the instrument. It is important not to remove the generating cell before this purge cycle is completed. While it is not expected that the chemicals in the cell or alkaline batteries will leak during normal operation, it is recommended that both the generating cell and the alkaline batteries be removed from the instrument if it is being stored for periods longer than one week between use.

H2S Quick Select Option

After the Battery Status screen appears during the start up of the instrument, if a H2S cell is in the instrument, a message will appear offering the option of changing to Quick Select mode.



You can switch to the quick select mode by pressing the SELECT switch. If you do you will enter the Quick Select choice screen.



You can turn the Quick Select mode off by pressing the POWER switch (arrow up) or you can turn it on by pressing the SELECT switch (arrow down).

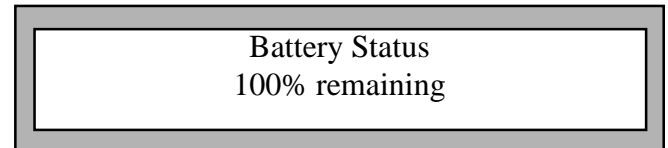
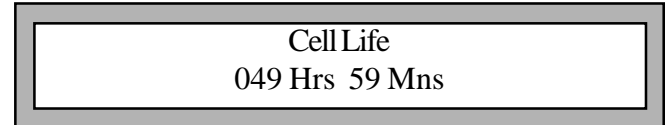
At any time during the operation of the unit or during the stabilization period you can enter the menu to change the Quick Select mode by pressing the SELECT switch (arrow down).

It is important to note that when you enter the Quick Select mode for the H2S cell, you cannot change the flow rate of the instrument. The Cal 2000 instrument will automatically vary the flow rate to achieve the different ppm concentrations of H2S.

Once you have entered the Quick Select mode for the Cal 2000, you can only adjust the ppm concentration in fixed 10 ppm increments, between 20 ppm and 100 ppm.

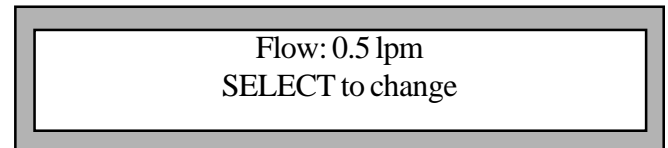
The Calibration Date refers to when the instrument itself was last calibrated at the Factory. It does not refer to the calibration date of the generating cells, which are field replaceable.

The following status screens indicate the remaining cell life and battery status.

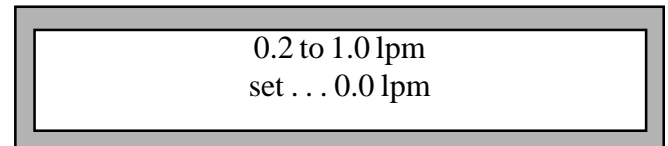


Please Note: If you have a ClO2 or H2S cell in the unit you will receive an additional message at this time. Please refer to section IV. Menu Options for additional information.

When the air flow rate screen appears,



you may adjust your flow rate by pressing the SELECT switch. If you do, you will enter the flow adjust screen.



You may adjust the flow upwards by pressing the POWER switch (arrow up) or downwards by pressing the SELECT switch (arrow down). If you set the flow to 0.0 LPM, the instrument will disable the pump and enter the flow draw mode. **Please refer to section III. Normal Operation: Sample Draw Mode for more information.** If you set the flow between 0.2 and 1.0 LPM, the instrument will automatically adjust the pump to the requested flow rate using feedback from the built-in mass flow sensor.

Immediately after the flow rate screen appears, the ppm screen appears.

Output: 000 ppm
SELECT to change

You may change the ppm by pressing the SELECT switch.

10 to 50 ppm
set . . . 000 ppm

You may adjust the ppm upwards by pressing the POWER switch (arrow up) or downwards by pressing the SELECT switch (arrow down). If you set the ppm to 000 ppm, the instrument will not generate any gas, although it will continue to pump.

The minimum and maximum ppm settings are dependent upon the flow rate and the type of generating cell installed in the instrument. The Cal 2000 will read the memory chip inside the generating cell and automatically display the minimum and maximum ppm available for the flow rate that the instrument is set to. The total range of the cell is divided into three sub ranges to allow for appropriate resolution in each sub range. For all cells (excepting ClO_2 and the Micro-cells) the sub ranges at .5 LPM are .5 to 1 PPM,

IV. Menu Options

Foreign Language Option

The menu options can be adjusted to read in German, French, or Spanish. To change the language, start the unit as you normally would. When the ACD screen appears,

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press the SELECT button. This will bring up the following screen:

English
SELECT to change

Press the SELECT button to choose the preferred language. When the language is displayed, press the POWER button to continue with the start up sequence.

ClO₂ Cell Reminder Screen

After the Battery Status screen appears during the start up of the instrument, if a ClO₂ cell is in the instrument, a reminder message will appear to change the Chlorine Dioxide Electrolyte.

Electrolyte Exp.
Renew Often

Please read section VI. Cell Maintenance for detailed information on changing your electrochemical generating cell's electrolyte.

Once the instrument has achieved a stable flow rate, it will alternate between the ppm, air flow rate and stabilization screen as described previously. At this point, you may press SELECT to go to the status screens and adjust the ppm as described earlier. If the flow rate changes significantly during this period, the instrument will attempt to re-stabilize at the new flow rate. The instrument operates identically to the diffusion mode at this point.

WARNING: Do not adjust the flow rate to more than 0.0 LPM while the Cal 2000 is attached to a sample draw unit or damage may occur to the instrument. Also, do not attach the Cal 2000 to pumps drawing more than 5 LPM.

1.0 to 10.0 PPM and 10 to 50 PPM. When the end of a given range is reached, pressing the appropriate up or down arrow will automatically toggle the display to the next appropriate range. Note that to obtain higher concentrations of gas simply reduce the flow rate of the instrument.

Once the flow and concentration have been set, the instrument will enter the stabilization period and the display will alternate between the following three screens:

Stabilizing ...
Standby: 146 sec

1.00 ppm CL2
Standby: 145 sec

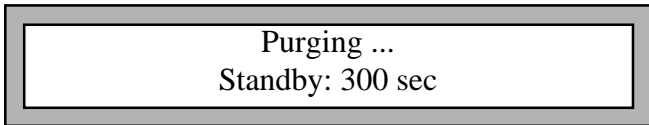
Flow: 0.5 lpm
Standby: 144 sec

When the instrument has finished counting down to zero (0) seconds, it has reached 90% of its final output and will enter the gas generating mode. In this mode, the instrument will display the gas being generated, the flow rate, the ppm setting and the time while running at these settings as follows:

CL2 @ 0.5 lpm
1.0 ppm 00:00:00

At any time you may reset either the flow rate or the ppm rate by pressing the SELECT button and entering the status screens as described above.

When you are finished generating gas and wish to turn off the instrument, **press and hold** the POWER switch until the purge screen is displayed.

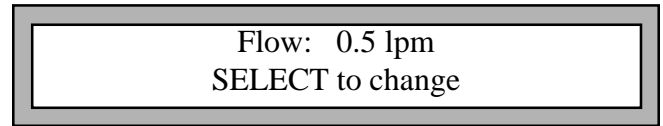


The instrument will purge itself of gas for 300 seconds and then automatically shut off. At any time during this period, you may turn the instrument back on by pressing the SELECT switch and entering the status screens as described above. You must change either the flow rate or the ppm setting and then the instrument will immediately go to the stabilization screen and continue to run at the new settings. The amount of stabilization time will depend upon how long the instrument was in the purge mode.

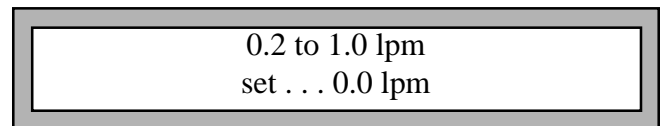
III. Normal Operation: Sample Draw Mode

The instrument may also be operated in a sample draw mode where the internal pump is disabled and the air is drawn through the instrument by an external pump. This mode is used for calibrating sample draw instruments.

To enter the sample draw mode, press the SELECT switch when the flow status screen is displayed.



When the flow set screen appears, adjust the flow to read 0.0 LPM.



The ppm output screen will then read 000 ppm. You will be unable to set the ppm until the sample draw instrument has been attached to the outlet hose and a stable flow rate has been established. While the instrument is waiting for the sample draw unit to be attached, it will display the flow stabilization screen.

