



CAL 2000



Calibration Gas Generator Instruction Manual

Software Version 2.0

Instruction Manual

Cal 2000

Calibration Gas Instrument

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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)

VERSION 2.0 SOFTWARE REVISIONS

- Capable of supporting all new electro-chemical generating sources as they are developed (Initially NH₃ and NO₂).
- Intelligent adaptive warm-up times depending on gas and concentration change. Warm-up time has been much reduced.
- Reduced purge time accompanied by increased purge flow rate.
- Removal of generating source during purge will immediately shut the unit off for quick change over from gas to gas.
- By setting the unit to 0 LPM and 0 PPM the unit will operate as a digital mass flow meter.
- Removal of 'Quick cal' feature.
- Reduced flow capabilities in sample draw to 1.5 LPM from 5.0 LPM.

I. GENERAL DESCRIPTION

The Cal 2000 is a battery-powered, portable electro-chemical 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.

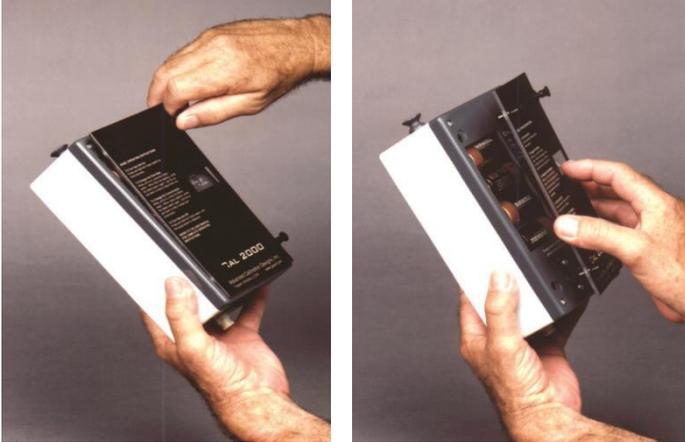
Electro-chemical Generating Source

The electro-chemical generating source 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 source. Each source has a built-in memory chip that tells the Cal 2000 instrument what type and range of gas can be generated and how much source life is remaining. The electronics board mounted to the source should never be removed from the source. Removal of this board will void warranty and destroy the source. Due to the design characterization of the source, the unit must be oriented flat (on the units feet) for correct concentration output.

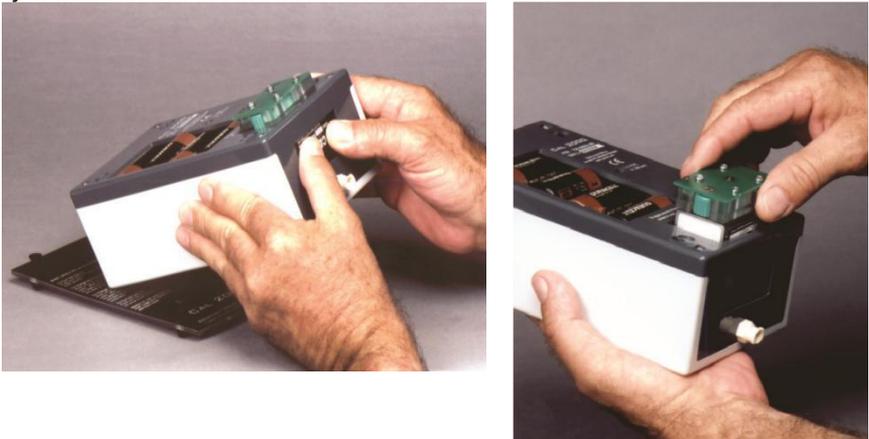


Source Installation and Removal

There are no tools required by the end user for service of the instrument. The electro-chemical sources are shipped separate of the unit and should be installed on receipt. To install the source, 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 source is keyed to ensure proper alignment into the instrument. When installed, the circuit board of the source should be flat with the bottom of the instrument. Push up on the clear window at the back of the instrument to eject the source.



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 source and battery usage, monitors the air flow rate and controls the source 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.

Delivery Hose

The instrument comes standard with a three (3) foot long, ¼ inch diameter Norprene 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 source 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 gray 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.



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 provided 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 sources.

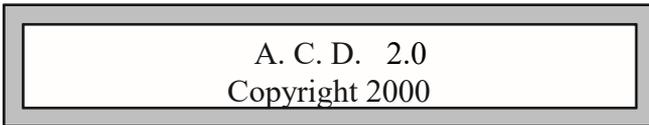
Extension Hoses

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

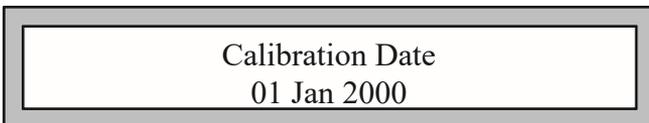
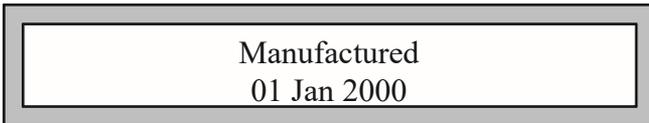
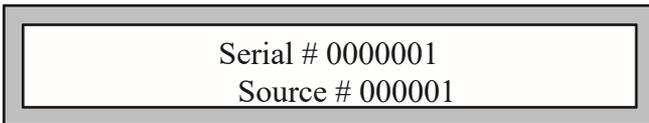
To start the generator, **press and hold** the POWER switch, located in the middle left front of the instrument, until the display reads A. C. D., approximately **three (3) seconds**. Release the switch immediately thereafter.

The instrument will sequence through several screens as follows:



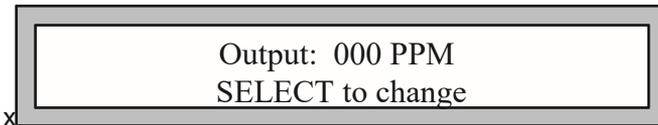
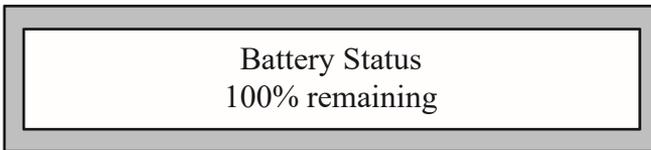
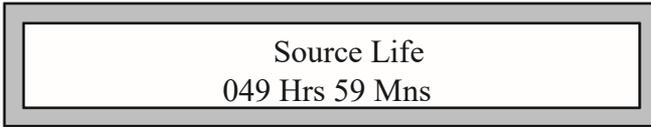
Please Note: If you would like to change the language of the menus, see section IV. Menu Options: Foreign Language Option, for instructions.

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

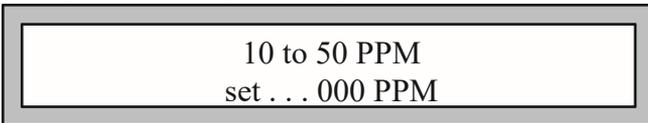


The Calibration Date refers to when the instrument itself was last calibrated at the Factory. It does not refer to the calibration date of the generating sources, which are field replaceable.

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



You may change the PPM by pressing the SELECT switch.



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 source installed in the instrument. The Cal 2000 will read the memory chip inside the generating source and automatically display the minimum and maximum PPM available for the flow rate that the instrument is set to. The total range of the source is divided into three sub ranges to allow for appropriate resolution in each sub range. For all sources (excepting CLO₂ and the Micro-sources) the sub ranges at .5 LPM are .5 to 1 PPM,

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 PPM00:00:00

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.

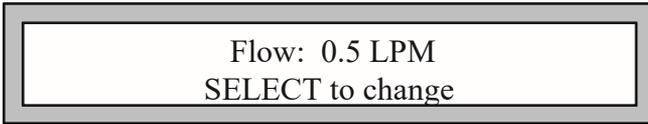
Purging ...
Standby: 300 sec

The instrument will purge itself of gas for 300 seconds and then automatically shut off. If you remove the generating source at any time during the purge cycle the unit will shut off. The generating sources should always be removed from the unit for storage. 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.

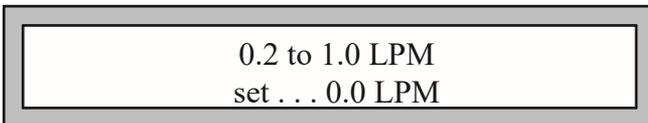
III. NORMAL OPERATION: SAMPLE DRAW MODE

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.

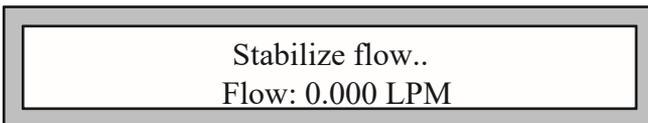
To enter the sample draw mode, press the SELECT switch when the flow status screen is displayed.



When the flowset 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.



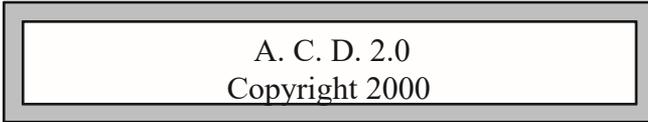
Once the instrument has achieved a stable flow rate, it will alternate between the PPM, air flow rate and stabilization screen as described previously. At this point, you may press SELECT to go to the status screens and adjust the PPM as described earlier. If the flow rate changes significantly during 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.

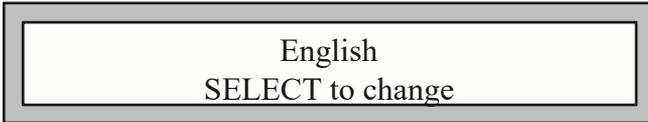
IV. MENU OPTIONS

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,



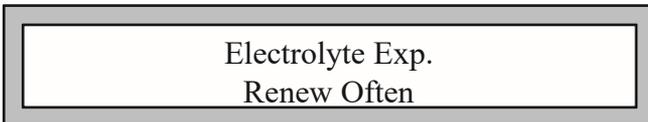
press the SELECT button. This will bring up the following screen:



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.

CIO2 Source Reminder Screen

After the Battery Status screen appears during the start up of the instrument, if a CIO2 source is in the instrument, a reminder message will appear to change the Chlorine Dioxide Electrolyte.



Please read section VI. Source Maintenance for detailed information on changing your electro-chemical generating source's electrolyte.

V. MAINTENANCE

The electro-chemical sources 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 CIO2 electrolyte.

Please refer to the instructions enclosed with every chlorine dioxide source or replacement electrolyte pack.

If the instrument is returned with the source 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 source as described in section I. General Description: Source 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 electro-chemical source and the alkaline batteries used in the CAL 2000 instrument contain corrosive chemicals. In addition, depending on the type of source 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 source before this purge cycle is completed. While it is not expected that the chemicals in the source or alkaline batteries will leak during normal operation, it is recommended that both the generating source and the alkaline batteries be removed from the instrument if it is being stored for periods longer than one week between use.

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. 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.

“Source Failure!” *accompanied by an audible beep.*

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

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

The source failure alarm will also engage if the microprocessor detects an abnormally high source 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 source has been plugged in correctly and the electrolyte level has been confirmed to be sufficient, contact the factory and/or replace the source.

“Source is used up!” *accompanied by an audible beep.*

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

“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.

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. Electro-chemical type generating sources
- 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 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 electro-chemical Cal 2000 sources and their standard prorated warranty when installed in equipment manufactured and supplied by Advanced Calibration Designs, Inc.

Sources

All sources are warranted for one year or the source defined hours of use.

VIII. ACCESSORY ITEMS / PARTS LIST

Source Definitions for CAL 2000

510-2000-00

00 = Chlorine
 20 = Nitrogen dioxide
 50 = Hydrogen sulfide
 60 = Chlorine dioxide
 70 = Hydrogen cyanide
 90 = Hydrogen

00 = 50 hr
 05 = 50 hr micro
 10 = 10 hr
 15 = 10 hr micro
 20 = 100 hr

Sources

(PPM ranges are specified for .5LPM flow. The range expands inversely with flow.)

Note: New gases will be available as they are developed.

Part Number	Item Description	Capacity (Hrs.)	PPM Range Adjustable
510-2000-10	Cl ₂ (chlorine)	10	0.5 - 50
510-2000-00	Cl ₂ (chlorine)	50	0.5 - 50
510-2000-20	Cl ₂ (chlorine) double life	100	0.5 - 50
510-2000-15	Cl ₂ (chlorine) micro	10	0.05 - 1.0
510-2000-05	Cl ₂ (chlorine) micro	50	0.05 - 1.0
510-2000-25	Cl ₂ (chlorine) micro	100	0.05 - 1.0
510-2060-10	ClO ₂ (chlorine dioxide)	10	0.5 - 5
510-2060-00	ClO ₂ (chlorine dioxide)	50	0.5 - 5
510-2060-20	ClO ₂ (chlorine dioxide) double life	100	0.5 - 5
510-2090-10	H ₂ (hydrogen)	10	0.5 - 50
510-2090-00	H ₂ (hydrogen)	50	0.5 - 50
510-2090-20	H ₂ (hydrogen) double life	100	0.5 - 50
510-2050-10	H ₂ S (hydrogen sulfide)	10	0.5 - 50
510-2050-00	H ₂ S (hydrogen sulfide)	50	0.5 - 50
510-2050-20	H ₂ S (hydrogen sulfide) double life	100	0.5 - 50
510-2050-15	H ₂ S (hydrogen sulfide) micro	10	0.05 - 1.0
510-2050-05	H ₂ S (hydrogen sulfide) micro	50	0.05 - 1.0
510-2050-25	H ₂ S (hydrogen sulfide) micro double life	100	0.05 - 1.0
510-2070-10	HCN (hydrogen cyanide)	10	0.5 - 50
510-2070-00	HCN (hydrogen cyanide)	50	0.5 - 50
510-2070-20	HCN (hydrogen cyanide) double life	100	0.5 - 50
510-2070-25	HCN life (hydrogen cyanide) micro double life	100	0.1 - 2.0
510-2070-15	HCN (hydrogen cyanide) micro	10	0.1 - 2.0

Part Number	Item Description	Capacity (Hrs.)	PPM Range Adjustable
510-2070-05	HCN (hydrogen cyanide) micro	50	0.1 - 2.0
510-2020-15	NO2 (nitrogen dioxide) micro	10	0.5 - 5
510-2020-05	NO2 (nitrogen dioxide) micro	50	0.5 - 5

Accessories

Part Number	Item Description
150-0121-00	Charcoal filter element
150-0131-00	Charcoal filter element, package of 12
362-0600-00	Continuous operation adapter, 115VAC with US plug
193-0101-01	Electrolyte, ClO ₂ , 15 ml vial
193-0101-05	Electrolyte, ClO ₂ , 15 ml vial, 5 pack
193-0101-10	Electrolyte, ClO ₂ , 15 ml vial, 10 pack
193-0101-25	Electrolyte, ClO ₂ , 15 ml vial, 25 pack
113-0402-00	Hose connector, insert (hose barb) quick connect
715-0405-0X	Hose, with quick connect, 5'
730-0215-03	Hard body case, CAL 2000, CAL 2000LT
113-0400-00	Outlet fitting, body (1/8 NPT) quick connect
106-0603-00	Plunger feet fastener

IX. SPECIFICATIONS

Ammonia (NH₃)	0.5 to 50 PPM
Chlorine (Cl₂)	5 - 50.0 PPM
Chlorine Dioxide (ClO₂)	0.5 - 5.0 PPM
Chlorine Micro-Source (Cl₂)	0.05 - 1.0 PPM
Hydrogen (H₂)	0.5 - 50.0 PPM
Hydrogen Cyanide (HCN)	0.5 - 50.0 PPM
Hydrogen Sulfide (H₂S)	0.5 - 50.0 PPM
Hydrogen Sulfide Micro-Source(H₂S)	0.05 - 1.0 PPM
Nitrogen Dioxide (NO₂)	0.5 - 5 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 1.2 LPM
Useful Source Life	10, 50 or 100 hours depending on purchased source (Note: sources do not degrade when not in use).
Warm-up time (to 90%)	Varies depending on concentration change. Always less than 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.

2024 W. McMillan Street

Tucson, Arizona 85705 USA

Phone: 520 290 2855 - Fax: 520 290 2860

Int'l Phone: 001 520 290 2855 - Fax: 001 520 290 2860 email:

ACD@goacd.com

website: www.GoACD.com



2024 W. McMillan St.
Tucson, Arizona 85705 USA
Telephone: (520) 290-2855
Fax: (520) 290-2860
Toll Free: (800) 737-0223
Email: acd@goACD.com
Web: www.goACD.com

P/N 910-0603-00