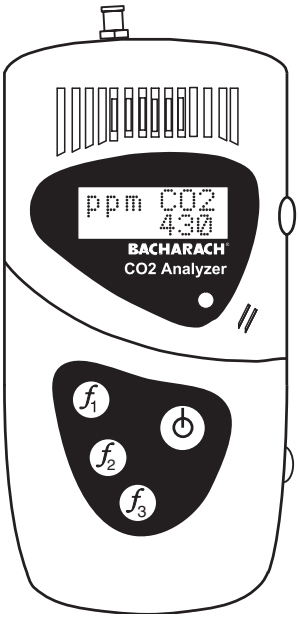
BACHARACH®
The Measurable Difference

CO_2 Analyzer
2810/2815/2820

Instruction 19-9222
Operation & Maintenance

Rev. 8 – March 2003



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1.0 INTRODUCTION

1.1 General

Bacharach's line of CO_2 Analyzers are easy to use, but it is essential that these Operating Instructions be read and understood by all operators and maintenance personnel prior to using or servicing the instrument.

The 2810/2815/2820 are compact and lightweight Carbon Dioxide analyzers that display the detected level of CO_2 in the range of either 0–10,000 ppm (2810/2815) or 0–60% (2820). The analyzer is based on the infrared-absorption principle to detect the presence of CO_2. The 2810 operates by diffusion only, while the 2815/2820 incorporates an internal pump for drawing in gas samples. Simply turn off the pump and the 2815/2820 samples by diffusion. A sampling tube and particulate filter are included with the 2815/2820 for remote sampling, while the 2820 also includes a desiccant filter to be used when sampling areas with high humidity. All analyzers can store gas readings in memory, which can later be downloaded to a personal computer via its integral IrDA communications link and the optional BACH-COM software.

1.2 Main Features

- Sampling modes:
  sample draw (2815/2820) and/or diffusion (2810/2815/2820)
- Automatic compensation for elevation and changes in barometric pressure
- Variable-pitch tone indicates CO_2 level (2815/2820)
- Integral pump (2815/2820)
- Battery capacity display
- Manual (snapshot) and continuous data logging of readings with time and date stamp
- Memory capacity for approximately 100 snapshot readings and 800 sets of continuous data logged readings
- IrDA link for downloading stored data to a personal computer
- Easy calibration in fresh air
- Run-while-charging capability

1.3 Units of Measurement

Depending the model ordered, the instruments's LCD shows CO_2 concentrations in either parts-per-million (2810/2815) or percent (2820). Please note that 1% = 10,000 ppm, and 0.01% = 100 ppm.

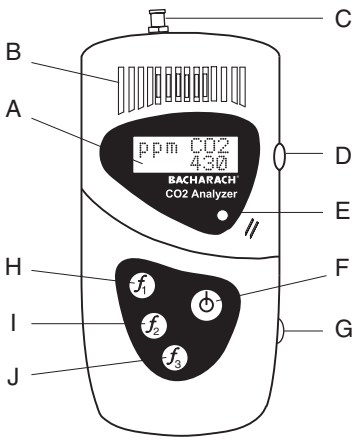
2.0 OPERATION

2.1 Important Note

Always ensure that the analyzer's gas inlet connector (Figure 1, Item C) and gas exhaust (Figure 1, Item B) are unobstructed and open to the atmosphere. Be careful not to breath directly on the analyzer while taking a measurement; otherwise, inaccurate CO_2 readings will result.

2.2 Switching the Analyzer ON/OFF

Switch ON the analyzer by pressing the ⏻ button. Switch the analyzer OFF by pressing the ⏻ button down for at least 3 seconds, or until the display goes blank. When first switched on, there is a warm-up period before the CO_2 level is displayed – approximately 60 seconds for the 2810/2815 analyzer, and 20 seconds for the 2820. Note that a normal fresh-air background reading of CO_2 is approximately 340 ppm.



A - Digital display
B - Gas exhaust
C - Gas inlet connector
D - IrDA link
E - Pump ON light
F - Power ON/OFF (2810/2815/2820); pump ON/OFF (2815/2820)
G - Battery charging socket
H - Store readings (f_1)
I - Battery status / calibrate (f_2)
J - Backlight (2810/2815/2820); Audible tone indicating CO_2 level (2815/2820) (f_3)

Figure 1. Components of the CO_2 Analyzer

2.3 Pump Operation (2815/2820)

With the analyzer already switched on, momentarily pressing the ⏻ button switches on the pump. Pressing the ⏻ button again turns the pump off. The supplied sampling probe and hose assembly can be connected to the gas inlet connector on the top of the analyzer for drawing in gas samples from hard-to-reach locations.

Particulate filter P/N 54-0548 is placed on top of the gas inlet to prevent dust or dirt from being drawn into the instrument. Replace the particulate filter about once a month, or when the filter is contaminated as evidenced by a slower response time.

Note that the combined sampling hose and probe length should not exceed 6 feet (1.8 m). Also note that the pump is intended for use only at normal atmospheric pressure, and is not designed to draw in gas samples against a vacuum or an obstruction such as a kink in the sampling hose. If an obstruction or negative-pressure gradient is present, then gas *will not* be drawn into the analyzer. Please consult the factory for applications where longer sampling lengths are required, or where it is necessary to draw against a vacuum.

2.4 Pump Contamination (2815/2820)

Over time the pump can become contaminated, leading to a slower response time and lower readings. To check for pump contamination, turn on the pump and hold your index finger over the inlet fitting. The pump should normally stall. If the pump, however, continues to run, then the pump is contaminated and the analyzer needs to be returned to Bacharach for repair.

2.5 High Humidity Gas Sampling (2820)

When using the 2820 to draw in gas samples from areas with high levels of humidity (e.g., incubators with water jackets), install both particulate filter P/N 54-0548 and desiccant filter P/N 07-1645 on the analyzer by first connecting the particulate filter to the analyzer's inlet. And then connecting the desiccant filter to the particulate filter using a 2–3 inch piece of rubber tubing (cut from the tubing supplied with the analyzer). Use the remaining piece of tubing to connect to the incubator.

After completing a test, continue to run the pump while sampling fresh air until the reading is below 0.1. This will purge out any residual CO_2 before proceeding to the next test.

Replace the desiccant filter when its silica gel turns a pinkish color. Note that the filter's silica gel can be rejuvinated by either running pure N_2 through the filter at a low flow rate, or by baking the filter in a 250°F (120°C) oven until its blue color returns.

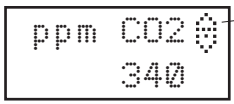
When storing the desiccant filter, install rubber caps P/N 19-0001 on both ends of the filter. The caps will seal the filter when not in use and extend its life.

2.6 Storing Readings

There are two reading-storage modes available:

- Snapshot
- Continuous Data Logging

Pressing the f_1 button once stores (takes a snapshot of) the reading shown on the display.



Clock icon is displayed once for a snapshot, and flashes during continuous logging.

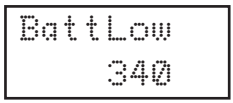
Pressing and holding down the f_1 button for at least 2 seconds starts the continuous data logging of the readings at a preset interval (factory set at 30 seconds).

The analyzer can store up to 100 snapshot readings and 800 sets of continuous-data-logged readings. Once the storage capacity has been exceeded, the latest readings will overwrite the oldest stored data.

The stored data can be downloaded to a personal computer using the analyzer's IrDA link and the optional BACH-COM software. This software can also be used to alter the data-logging interval, and produce tables and plots of time-based CO_2 readings.

2.7 Battery Low Display

When the battery voltage falls below a pre-determined level, the display will alternate between its normal gas display and



In addition, the beeper will emit three rapid notes every 30 seconds. At this time the analyzer should be given a full charge per Section 3.6 as soon as possible.

2.8 Battery Charge Display

The battery's remaining charge is displayed by pressing the f_2 button once. A bar graph in the lower part of this screen shows an approximation of the battery's remaining charge. As the charge reduces, the bar graph decreases in size. Typical operating time from a full charge is 7 hours with the pump running, and 10 hours with the pump off.

 = represents full charge

 = represents low charge

2.9 Backlight

To view the LCD in poor ambient lighting conditions, turn on the display's backlight by pressing the f_3 button once (with the analyzer on). The backlight stays on for 5 seconds and then automatically turns off.

2.10 Audible Gas-Level Tone (2815/2820)

An audible tone, which will increase in pitch with increasing CO_2 levels, is activated by pressing and holding down the f_3 button for 3 seconds. The tone is turned off by again pressing and holding down the f_3 button for 3 seconds.

2.11 Fault Condition Warning

The analyzer is capable of alerting the operator of an internal fault condition (i.e., a sensor failure or blockage in the infrared path). If a fault occurs, the analyzer's beeper will sound continuously, and the following message is displayed until the analyzer is turned off.

If the fault warning is displayed at any time, then the analyzer must be returned to Bacharach for servicing.

2.12 Powering Analyzer from Charger

The analyzer can be continuously powered by its charger by connecting the charger as follows:

1. Switch ON the analyzer *without* the charger attached.

   Note: *Connecting a charger to an analyzer that is switched OFF causes the analyzer to enter its charging mode, which in turn prevents the analyzer from being switched ON.*

2. Plug the charger into the appropriate AC wall socket (or 12 VDC when using the optional cigarette lighter adapter). Then plug the charger's output connector into the analyzer's charging socket (Figure 1, Item G).

The analyzer will now continuously run until it is switched OFF.

2.13 Troubleshooting for Slow or Low Readings (2820)

It normally takes between 1 and 2 minutes to obtain a peak reading when testing an incubator. A slow or low reading can be caused by either a clogged desiccant filter or a contaminated CO_2 sensor. Do the following to test for slow or low readings:

1. Remove both filters and sample again.

2. If this cures the problem, first replace the desiccant filter (P/N 07-1645) and sample again. Note that the particulate filter rarely becomes clogged, but if the problem returns with both fiters installed, replace the particulate filter (P/N 54-0548).

3. If the problem persists with the filters removed, reset the instrument to the factory settings per Section 3.5. If the reset is OK, then calibrate the instrument per Section 3.7.2.

4. If the factory reset fails, the CO_2 sensor is contaminated and the instrument needs to be returned to Bacharach for repair and calibration.

2.14 Testing Incubators (2820)

When testing incubators with the Model 2820, it is important to keep moisture from entering the instrument. Moisture can contaminate the IR cell and affect the readings.

A desiccant filter is provided with the instrument to remove excess water vapor (humidity), refer to Section 2.5. When testing water-jacketed incubators, however, the potential exists to draw condensation—water droplets that form inside the incubator's internal sample line—through the desiccant filter and into the instrument.

Bacharach offers a water trap as an accessory (P/N 19-3265) to help prevent water from being drawn into the instrument. It is used in-line between the incubator and desiccant filter as shown in Figure 2.

> **Important!** *Remove the water trap's internal particulate filter element before testing.*

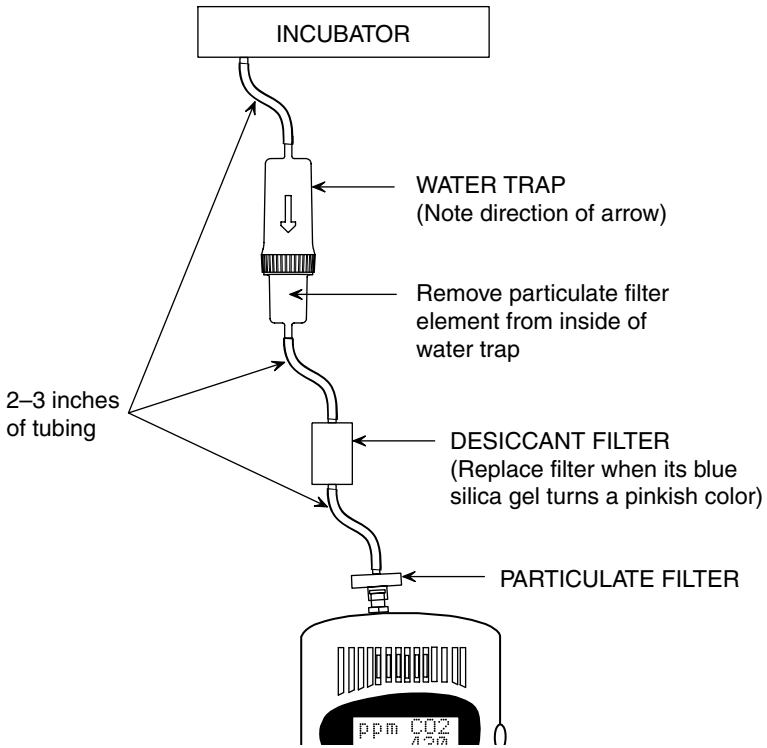


Figure 2. Installation of Water Trap Accessory

3.0 MAINTENANCE

3.1 Cleaning

Keep the analyzer clean by wiping it with a soft cloth dampened with a mild detergent solution.

3.2 Sunlight

The unit should not be left out in direct sunlight, or in other areas where excessive heat exists, for long periods since component damage due to overheating may result.

3.3 Servicing

There are no user-serviceable parts inside the analyzer. Unauthorized disassembly of the unit will invalidate the warranty.

3.4 Software Version / Serial Number

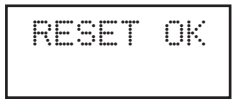
With the analyzer switched OFF, and while holding down the f_1 button, switch ON the analyzer to display its software version and issue date. Releasing the f_1 button displays the analyzer's ID number for 5 seconds.

3.5 Factory Settings

Important! *The analyzer should only be returned to its factory settings when advised by a Bacharach Service Representative.*

With the analyzer switched OFF, and while holding down the f_2 button, switch ON the analyzer. The display will show

Keep the f_2 button depressed until the display shows



Release the f_2 button and follow the instructions from your local service representative.

> **WARNING:** *After resetting the analyzer to its factory settings, it must be calibrated as described in Section 3.7 or erroneous gas reading may result.*

3.6 Battery Charging

When the 'BattLow' message is displayed (refer to Section 2.7), the analyzer must be recharged using the supplied battery charger.

> **Important!** *The battery has a long shelf life, but it is recommended that the battery be* ***recharged once a month*** *if left unused. Batteries that have not been charged for several months should be given at least two charge/discharge cycles before using the analyzer.*

As with all rechargeable batteries, there are guidelines that should be observed: The battery should normally be charged at room temperature. Charging at temperatures below 54 °F (12 °C) should be avoided since this may cause a false indication of when the battery is charged, and could also damage the battery.

Before beginning the charging process, first ensure that the analyzer is switched OFF. Next, plug the supplied charger into the appropriate AC wall socket (an optional 12 VDC charger with cigarette lighter adapter is also available). Then plug the charger's output connector into the analyzer's charging socket (Figure 1, Item G).

The word "CHARGING" appears while the battery is being charged. Charging time is approximately 2 hours.

> **Note:** *If the battery is deeply discharged, the display will remain blank for a few minutes before the battery begins charging.*

Once the battery is fully recharged, the analyzer will emit a beeping tone for 30 seconds and display the word "CHARGED". At this time unplug the charger and remove its output connector from the analyzer.

3.7 Calibration

Calibration of a 2810/2815/2820 CO_2 Analyzer consists of first performing either an *Air Calibration* on a 2810/2815 analyzer that zeros the instrument using fresh ambient air, or an *N_2 Calibration* on a 2820 analyzer that zeros the instrument using 100% N_2.

Factory calibration provides the best accuracy over the analyzer's entire detection range; however, the user can perform the optional *Gas Calibration* procedure that will improve the analyzer's accuracy at a pre-programmed calibration point of 2,500 ppm CO_2 for the 2810/2815, and 5% CO_2 for the 2820. Note that the pre-programmed calibration point can be changed using BACH-COM software version 2.22 or higher.

It is recommended that an Air Calibration or N_2 Calibration be performed at the beginning of each work day or each time the instrument is switched OFF/ON. The analyzer should also be checked on a periodic basis with a higher concentration of CO_2 to ensure that it still meets its accuracy specification.

Follow the procedure under Section 3.7.1 to calibrate a 2810/2815 Low Range (LR) Analyzer, or the procedure under Section 3.7.2 to calibrate a 2820 High Range (HR) Analyzer.

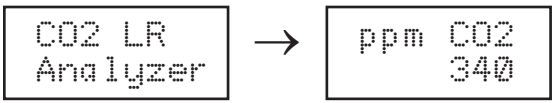
3.7.1 2810/2815 Calibration Procedure

3.7.1.1 Air Calibration

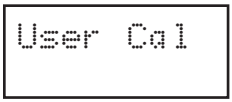
Perform this procedure in an uncontaminated enviroment such as outside fresh air, an empty room, or corridor where the air is assumed to contain 340 ppm CO_2.

> **Important!** *DO NOT perform an air calibration after sampling high concentrations of CO_2 gas. Also, be careful that your breath does not affect this procedure.*

1. Switch ON the analyzer, and then allow it to sample fresh air for 5 minutes. During this time, the internal pump of a 2815 Analyzer should be turned OFF.



2. Press and hold down the f_2 button until the 'User Cal' screen is displayed. Note that battery status is first displayed for approximately 2 seconds.



   Wait until the analyzer automatically switches to its 'Air/Gas' screen before proceeding.

3. Press the f_1 button to zero the analyzer using fresh ambient air. If the air calibration procedure was successful, the display will show

   If the procedure was unsuccessful, the message

   will be displayed. If this happens, retry the Air Calibration procedure, ensuring that the analyzer is only exposed to fresh air. If the procedure is still unsuccessful, then the analyzer must be returned to a Bacharach Service Center for evaluation.

4. This completes the Air Calibration procedure. If desired the analyzer can now be spanned to a known concentration of CO_2 gas per Section 3.7.1.2.

3.7.1.2 Gas Calibration

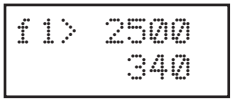
WARNING: *This procedure assumes that you are using the Bacharach Calibration Kit as listed in Section 4.1, Calibration Accessories. When using a non Bacharach gas regulator, however, you must also use an in-line flowmeter to ensure that the gas flow to the analyzer is between 100 and 200 cc/minute.* ***Improper flow can cause erroneous gas readings!***

Important! *Always perform an Air Calibration first.*

1. Press and hold down the f_2 button until the 'User Cal' screen is displayed.

Wait until the analyzer automatically switches to its 'Air/Gas' screen before proceeding.

2. Press the f_3 button to display the Gas Calibration screen.



The top line shows the preset calibration gas value that must be applied to the analyzer's inlet. The bottom line shows the current CO_2 reading.

Note: *The analyzer is most accurate around the calibration gas value. If the analyzer, however, is routinely used to monitor CO_2 levels that are much higher or lower than the preset value, then it is recommended that the analyzer be calibrated on a concentration of gas that is close to the gas level being monitored. This operation requires that the preset calibration gas value be reset higher or lower using the optional BACHCOM software, version 2.22 or higher.*

3. Using the Calibration Accessories listed in Section 4.1, attach a CO_2 calibration gas cylinder to the inlet of the analyzer as shown in Figure 3. The applied CO_2 concentration must equal the gas value displayed in the *top* line of the Gas Calibration screen.

   Important! *Do not attempt to calibrate the analyzer if the pressure gauge closest to the tank reads below 5 psi.*

4. Adjust the regulator attached to the gas cylinder for an outlet pressure of 2 psi (equivalent to a flow rate of approximately 120 cc/minute). Observe that the gas level displayed on the second line of the Gas Calibration screen should slowly rise to the value displayed in the top line.

5. Allow the calibration gas to flow until the *second* line of the Gas Calibration screen stabilizes, then press the f_1 button.

   If the gas calibration procedure was successful, the display will show

   ```
   GasCal
     OK
   ```

   If the procedure was unsuccessful, the message

   ```
   GasCal
   Failed
   ```

   will be displayed. If this happens, retry the Gas Calibration procedure, ensuring that the analyzer is exposed to the correct concentration of calibration gas. If the procedure is still unsuccessful, then the analyzer must be returned to a Bacharach Service Center for evaluation.

6. This completes the Gas Calibration procedure. Shut off the regulator; then remove and store the calibration accessories.

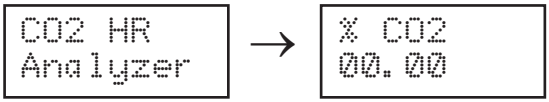
3.7.2 2820 Calibration Procedure

3.7.2.1 N_2 Calibration

The following procedure uses 100% N_2 to zero the analyzer. (Fresh ambient air that is assumed to contain 340 ppm CO_2 can be used if N_2 is not available.)

> **Important!** *DO NOT perform an N_2 calibration after sampling high concentrations of CO_2 gas. Also, be careful that your breath does not affect this procedure.*

1. Switch ON the analyzer. But before proceeding, allow the analyzer to sample fresh air for 5 minutes with its internal pump turned OFF.



2. Press and hold down the f_2 button until the 'User Cal' screen is displayed. Note that battery status is first displayed for approximately 2 seconds.

   Wait until the analyzer automatically switches to its 'N2/Gas' screen before proceeding.

3. Using the calibration accessories listed in Section 4.1, attach a 100% N_2 gas cylinder to the inlet of the analyzer as shown in Figure 3. Then adjust the regulator attached to the gas cylinder for an outlet pressure of 2 psi (equivalent to a flow rate of approximately 120 cc/minute). If N_2 is unavailable, turn ON the analyzer's pump and allow it to draw in fresh air for at least 30 seconds before proceeding.

   > **Important!** *When using N_2 gas, do not attempt to calibrate the analyzer if the pressure gauge closest to the tank reads below 5 psi.*

4. Press the f_1 button to zero the analyzer using 100% N_2 or fresh air. If the N_2 Zero procedure was successful, the display will show

   ```
   N2 Cal
     OK
   ```

   If the procedure was unsuccessful, the message

   ```
   N2 Cal
   Failed
   ```

   will be displayed. If this happens, retry the N_2 Zero procedure, ensuring that the analyzer is only exposed to either 100% N_2 or fresh air. If the procedure is still unsuccessful, then the analyzer must be returned to a Bacharach Service Center for evaluation.

5. This completes the N_2 Calibration procedure. If desired the analyzer can now be spanned to a known concentration of CO_2 gas per Section 3.7.2.2.

3.7.2.2 Gas Calibration

WARNING: *This procedure assumes that you are using the Bacharach Calibration Kit as listed in Section 4.1, Calibration Accessories. When using a non Bacharach gas regulator, however, you must also use an in-line flowmeter to ensure that the gas flow to the analyzer is between 100 and 200 cc/minute.* ***Improper flow can cause erroneous gas readings!***

Important! *Always zero the analyzer first using 100% N_2 or fresh ambient air.*

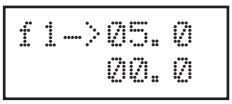
1. If the pump is running, turn it OFF.

2. Press and hold down the f_2 button until the 'User Cal' screen is displayed.

   ```
   User Cal
   ```

Wait until the analyzer automatically switches to its 'N2/Gas' screen before proceeding.

3. Press the f_3 button to display the Gas Calibration screen.



The top line shows the preset calibration gas value that must be applied to the analyzer's inlet. The bottom line shows the current CO_2 reading.

Note: *The analyzer is most accurate around the calibration gas value. If the analyzer, however, is routinely used to monitor CO_2 levels that are much higher or lower than the preset value, then it is recommended that the analyzer be calibrated on a concentration of gas that is close to the gas level being monitored. This operation requires that the preset calibration gas value be reset higher or lower using the optional BACHCOM software, version 2.22 or higher.*

4. Remove the 100% N_2 cylinder (if used); then attach a CO_2 calibration gas cylinder to the inlet of the analyzer as shown in Figure 3. The applied CO_2 concentration must equal the gas value displayed in the *top* line of the Gas Calibration screen.

Important: *Do not attempt to calibrate the analyzer if the pressure gauge closest to the tank reads below 5 psi.*

5. Adjust the regulator attached to the gas cylinder for an outlet pressure of 2 psi (equivalent to a flow rate of approximately 120 cc/minute). Observe that the gas level displayed on the second line of the Gas Calibration screen should slowly rise to the value displayed in the top line.

6. Allow the calibration gas to flow until the *second* line of the Gas Calibration screen stabilizes, then press the f_1 button.

   If the gas calibration procedure was successful, the display will show

   ```
   GasCal
     OK
   ```

   If the procedure was unsuccessful, the message

   ```
   GasCal
   Failed
   ```

   will be displayed. If this happens, retry the Gas Calibration procedure, ensuring that the analyzer is exposed to the correct concentration of calibration gas. If the procedure is still unsuccessful, then the analyzer must be returned to a Bacharach Service Center for evaluation.

7. This completes the Gas Calibration procedure. Turn off the regulator; then remove and store the calibration accessories.

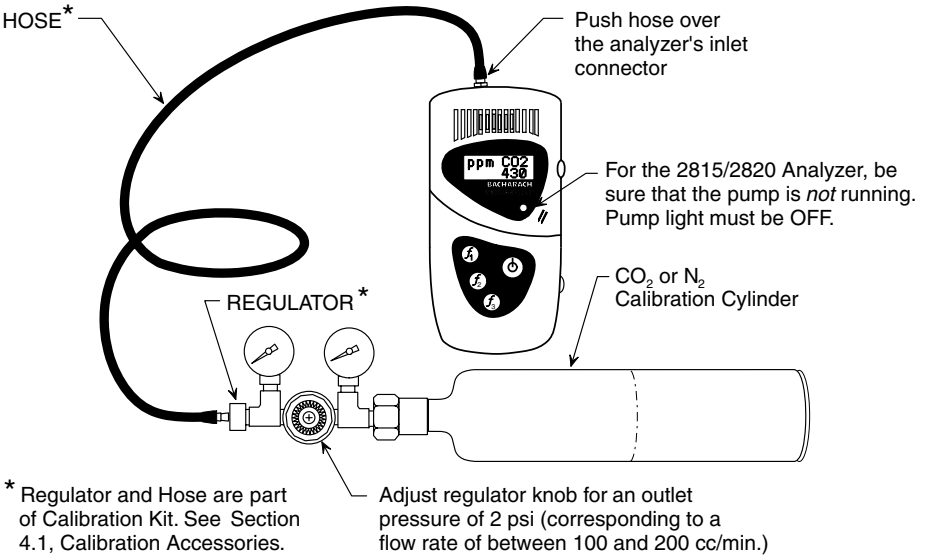


Figure 3. Calibration Equipment

4.0 PARTS & SERVICE

4.1 Replacement Parts and Accessories

Complete Kits

CO_2 Analyzer 2810 – measures 0 to 10,000ppm CO_2, includes table top stand, particulate filter & wall charger 19-8023
CO_2 Analyzer 2815 – meausres 0 to 10,000 ppm CO_2, includes internal pump, table top stand, particulate filter, wall charger, & sampling tube.....19-8028
CO_2 Analyzer 2820 – measures 0 to 60% CO_2, includes internal pump, wall charger, sampling tube, particulate filter & desiccant filter.....19-8025

Replacement Parts

110/240 VAC USA & European Wall Charger (all).....19-3312
Table Top Stand (2810/2815).....19-3307
Luer Fitting (2815/2820) 103-2563
Sampling Tube, 6 inches (2815/2820) 11-0118
Particulate Filter (2815/2820).....54-0548
Desiccant Filter (2820) 07-1645
Rubber Caps for Desiccant Filter (package of 6) (2820) 19-0001

Accessories

12 VDC Charger w/ Cigarette Lighter Adapter 19-3302
Carrying Case, Small (10 $^5/_8$"L x 8 $^1/_2$"W x 3 $^3/_{16}$"H) 19-3337
Carrying Case, Large (13 $^1/_2$"L x 10 $^{13}/_{16}$"W x 4"H) 19-3311
IrDA Interface Kit & BACH-COM Software.....19-3301
Protective Boot.....19-3304
Water Trap (2820).....19-3265

Calibration Accessories

Calibration Kit(w/ regulator and tubing) 19-8027
Air Cal Check Gas, 340 ppm CO_2, 17 liter tank (2810/2815) 24-1125
Calibration Gas, 2,500 ppm CO_2, 17 liter tank (2810/2815).....24-1130
Calibration Gas, 100% N_2, 17 liter tank (2820).....23-4003
Calibration Gas, 5.0% CO_2, 17 liter tank (2820) 24-1126

4.2 Bacharach Service Centers

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