When using the electrode in solutions containing protein, the electrode should be soaked in an enzyme cleaning solution such as Terg-a-zyme, by Alconox Inc, or a chromic/sulfuric acid glass cleaning solution after each use for a few minutes to remove the protein from the glass and the reference juntion. This will prolong the useful life of the electrode.

Storing: Clean and rinse the electrode before storing.

Long-term (over 1 week): Remove the membrane housing from the electrode. Rinse the internal electrode with distilled water and pat dry. Place a new, unfilled membrane housing over the internal electrode and attach loosely (do not seat completely). This membrane will keep the dust off the electrode tip.

Short-term: The sensing tip of the electrode, with membrane housing still attached, can be left soaking in a small amount of the Carbon Dioxide Electrolyte.

Output Conversions

A. *Formula for conversion of percent carbon dioxide to solubility in moles/liter:*

S = (a/22.414) x [(760 – p)/760] x (r%/100) *where:*

S = solubility of gas, in moles, per liter
a = absorbtion coefficient of gas at temperature
p = vapor pressure of water at temperature
r% = actual reading in percent Carbon Dioxide

Temperature (T) vs. absorption coefficient (a) for Carbon Dioxide in water:

T	a	T	a	T	a	T	a
5	1.424	12	1.117	19	0.902	26	0.738
6	1.377	13	1.083	20	0.878	27	0.718
7	1.331	14	1.050	21	0.854	28	0.699
8	1.282	15	1.019	22	0.829	29	0.682
9	1.237	16	0.985	23	0.804	30	0.665
10	1.194	17	0.956	24	0.781	35	0.592
11	1.154	18	0.928	25	0.759	40	0.530

T = Degrees Celsius a = Absorption Coefficient

B. *Formula for conversion of percent Carbon Dioxide to mm of Hg (torr)*

P = (r%/100) x (Pb – Pw) *where:*

P = partial pressure of gas in mm of Hg (torr)
r% = percent Carbon Dioxide (calibrating standard)
Pb = barometric pressure
Pw = water vapor pressure at temperature

Troubleshooting

A. *Little or No Response*

1. Inspect the electrode for visible cracks (usually occurring around the tip of the electrode). If any exist, the electrode cannot be repaired and must be replaced.
2. Inspect electrolyte level for sufficient amount. If low, remove and replace membrane housing with a new one, filled with electrolyte.

B. *Sluggish Response*

If the electrode becomes sluggish in responding to changes in Carbon Dioxide levels, do the following, re-testing after each step (when readings normalize, no further action is required):

1. Replace the membrane housing with a new one.
2. Clean the glass face of electrode with fine-grit sandpaper (provided) as described earlier.
3. Check electrode slope and response time as a pH electrode

To test the internal pH electrode, the following procedure must be used:

1. Add 5.84 g of NaCl to 100 ml of pH 4 buffer. Also add 5.84 g of NaCl to 100 ml of pH 7 buffer.
2. Remove membrane housing and rinse the internal electrode with distilled water and dab dry.
3. Connect the electrode into the modified pH 7 buffer far enough to cover the Ag-AgCl coating of the electrode. Record the millivolt value after a stable reading is obtained. The reading will normally be in the -50 mv to -100 mv range.
4. Rinse the electrode with distilled water and place it into the modified pH 4 buffer. Record the millivolt reading. The reading will normally be in the 50 mv to 150 mv range.
5. Alternate between the buffers several times to determine response time.
6. The millivolt difference between the two buffers must be a minimum of 150 mv. The response time should be in the 30 to 60 second range. If the electrode meets these two tests, then continue with the following steps. If not, please call our Customer Service Department.
7. Rinse the electrode thoroughly with distilled water and pat dry (do not wipe).
8. Assemble with new membrane.

Sample Handling

The electrode measures dissolved carbon dioxide. Therefore, handling of the sample is critical for accurate measurement. For blood gases, samples should be measured immediately, minimizing exposure of the sample to room air. For measuring total Carbon Dioxide, samples must be pH adjusted to a pH of 5 using a citrate buffer for conversion of carbonate and bicarbonate ions to dissolved carbon dioxide.

For additional assistance, call our Customer Service Department at 1-(603) 668-0692.

For Faster Service When Calling!

Please have the following information available:

1. Model Number of the electrode (Ex. MI-720)
2. Serial Number (located on green sleeve on the electrode cable).

CO_2

MI-720

Operating Instructions

Microelectrodes, Inc.

40 Harvey Road
Bedford, NH 03110-6805 USA
Tel 1-(603)-668-0692 Fax 1-(603)-668-7926
Website: www.Microelectrodes.com
Email: Info@Microelectrodes.com

Micro-Carbon Dioxide Electrode Operating Instructions

Contents

The MI-720 Electrode Kit contains the following:

1	Carbon Dioxide Electrode with Membrane Housing
6	Replacement Membrane Housings
1	Bottle of Electrolyte
1	Bulb Pipette
1	Set of Instructions
5	Polishing Pads

Electrode Assembly and Preparation

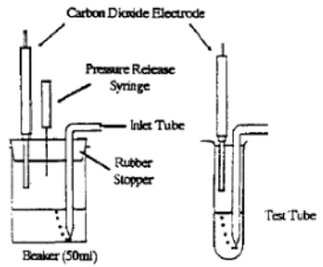
1. Remove the acrylic housing from the Carbon Dioxide electrode by unscrewing the housing from the electrode body. This housing, with affixed teflon membrane, does not contain the necessary Carbon Dioxide electrolyte solution.
2. Add Carbon Dioxide Electrolyte solution to the acrylic housing. This is done by first filling the included Bulb Pipette with electrolyte. Then, the electrolyte solution is added to the housing to a minimum height of 6 mm by gently placing the bubble-free end of the filling tip against the teflon membrane surface and releasing electrolyte to the minimum height. To ensure that no air bubbles are trapped in the solution, shake the housing in short, vigerous, and abrupt motions while grasping the threaded end of the housing.
3. Connect the housing to the Carbon Dioxide electrode, being careful not to trap air bubbles near the electrode tip. Screw the housing clockwise into the body of the electrode until it stops. Check the tip of the electrode for proper seating of the housing against the electrode. The electrode is properly seated if the electrode protrudes slightly beyond the end of the housing.

Calibration

Calibration of the electrode requires the use of two (2) standard gases with percent values that are close to the percent valuse of Carbon Dioxide to be measured. Common values used are 5% Carbon Dioxide for zeroing, and 10% Carbon Dioxide for sloping or gain. A working calibration curve must be constructed using semilog graph paper. Following the calibration procedures is an example of a working calibration curve.

A. Calibration for Gas Samples

When samples to be measured are gaseous, calibration should be performed with humidified gases. Two possible setups for calibrating the electrode are shown below. Keep the tip of the electrode as far as possible from the surface of the water. The bubbling rate of the gas should be slow (3 to 6 bubbles per second). Although bubbling at a faster rate will flush the chamber more quickly, it will also cause a cooling effect on the electrode.

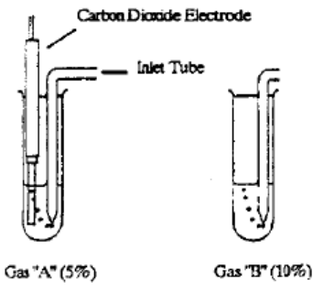


1. Bubble the 5% gas through the chamber and record the millivolt value after a stable reading is obtained. It may take up to 15 minutes to de-gas the chamber of contaminants. However, bubbling the gas vigorously will cause droplets to collect on the tip of the electrode. This will make the response time appear to be slow.
2. Bubble the 10% gas (or any other percent value used for the application) through the chamber until a stable reading is obtained. Record the reading.

This procedure of alternating between the two gases should be continued until you become confident of stability and reproducibility. After creating a working calibration curve, the electrode is now ready to use.

B. Calibration for Liquid Samples

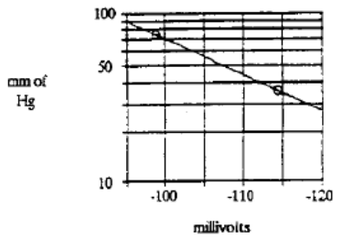
To decrease calibration time, two separate calibration chambers should be used. One for the 5% gas and another for the sloping gas such as 10%. When setting up the calibration chambers initially, it may take up to 30 minutes to flush each chamber to obtain a steady-state Carbon Dioxide level and a constant temperature. Again, the bubbling rate should be carefully regulated (3 to 6 bubbles per second) so that both calibrating liquids are at the same temperature.



Calibrating standards and samples must be at the same temperature for accurate Carbon Dioxide measurements.

1. Immerse the tip of the electrode into the 5% standard and record the millivolt value after a stable reading is obtained.
2. Remove the electrode from the first standard and place it into the second standard. Record the reading after a stable readiing is obtained.

Alternate between the two standards until you are confident of stability and reproducibility. After creating a working calibration curve, the electrode is now ready to use.



Handling, Cleaning, and Storing the Electrode

Handling: Always handle with care, as glass electrodes are fragile. When necessary, the membrane of the electrode can be replaced by following the assembly procedure above. When removing and replacing a membrane, as well as when calibrating or making measurements, be careful not to apply pressure against the internal electrode. Any excessive pressure against the internal electrode can cause the electrode to crack, rendering it useless and unrepairable.

Cleaning: To clean the glass face of the electrode, remove membrane housing and rinse internal electrode with distilled water. Place polishing pad on a flat surface. Place a drop of the included Carbon Dioxide electrolyte onto the abrasive side of the disc. Grasping the sides of electrode around the exposed glass (below the electrode body), hold the electrode vertically with the face flat against the pad. Gently polish the face of the electrode by rubbing the glass face against the disc in a circular motion (10-20 cycles). Rinse with distilled water, pat dry, and place new membrane filled with electrolyte onto electrode.