pHOENIX ELECTRODE COMPANY
IODIDE ION ELECTRODES
INSTRUCTION MANUAL

GENERAL INSTRUCTIONS

Introduction

The pHoenix Iodide Ion Electrodes are used to quickly, simply, accurately, and economically measure free iodide ion in aqueous solutions.

Required Equipment

1. A pH/mV meter or an ion meter, either line operated or portable.

2. Semi-logarithmic 4-cycle graph paper for preparing calibration curves when using the meter in the mV mode.

3. A magnetic stirrer.

4. The pHoenix Iodide Ion Electrode, Cat. No. I001501, (reference electrode necessary), the pHoenix Iodide Ion Combination Glass Electrode, Cat. No. I001502, or the pHoenix Iodide Ion Combination Epoxy Electrode, Cat. No. I001503.

5. The pHoenix Double Junction Reference Electrode, Cat. No. 5731429 (for use with the I001501) with pHoenix Filling Solution, Cat. No. R001011, in the inner junction and with pHoenix Filling Solution, Cat. No. R001015, in the outer junction.

6. pHoenix Polishing Paper, Cat. No. 948201, to polish dirty or etched electrode membranes.

Required Solutions

1. Deionized or distilled water for solution and standard preparation.

2. pHoenix Ionic Strength Adjuster (ISA), 5M $NaNO_3$, Cat. No. I00IS01. To prepare this solution from your own laboratory stock, half-fill a 1000 ml volumetric flask with distilled water and add 425 grams of reagent-grade sodium nitrate. Swirl the flask gently to dissolve the

solid. Fill to the mark with distilled water, cap, and upend the flask several times to mix the solution.

3.   pHoenix Iodide Standard, 0.1M NaI, Cat. No. I00AS01. To prepare this solution from your own laboratory stock, half-fill a one liter volumetric flask with distilled water and add 15.0 grams of reagent-grade sodium iodide, NaBr. Swirl the flask gently to dissolve the solid. Fill to the mark with distilled water, cap, and upend several times to mix the solution.

4.   pHoenix Iodide Standard, 1000 ppm I^{-1}, Cat. No. I00AS02. To prepare this solution from your own laboratory stock, half-fill a one liter volumetric flask with distilled water and add 1.18 grams of reagent-grade NaI. Swirl the flask gently to dissolve the solid. Fill the flask to the mark with distilled water, cap, and upend several times to mix the solution.

GENERAL PREPARATION

Electrode Preparation

Remove the rubber caps covering the electrode tips and the rubber insert covering the filling hole of the combination electrode or of the reference electrode. Fill the reference electrode or the combination electrode with the filling solution shipped with the electrode to a level just below the fill hole. No preparation is required with a sealed reference electrode.

Connect the electrodes to the proper terminals as recommended by the meter manufacturer.

Electrode Slope Check (with a pH/mV meter)
                    (check electrodes each day)

1.   To a 150 ml beaker, add 100 ml of distilled water and 2 ml of ISA. Place the beaker on a magnetic stirrer and begin stirring at a constant rate. After assuring that the meter is in the millivolt mode, lower the electrode tips into the solution.

2.   Using a pipet, add 1 ml of either the 0.1M or the 1000 ppm standard to the beaker. When the reading is stable, record the mV reading.

3. Using a pipet, add 10 ml of the same standard used
    above to the beaker. When the reading has stabilized,
    record the mV reading.

4. Determine the difference between the two readings. The
    electrode is operating correctly if the mV potential
    has

    changed by a difference of 57∀3 mV, assuming the
    solution temperature is 25°C. See the **TROUBLESHOOTING**
    sections if the potential change is not within this
    range.

Slope is defined as the change in potential observed when the
concentration changes by a factor of 10.

Electrode Slope Check (with an ion meter)
                    (check electrodes each day)

1. Prepare standard iodide solutions whose concentrations
    vary by tenfold. Use either the 0.1M or the 1000 ppm
    iodide standard. Use the serial dilution method for
    this preparation.

2. To a 150 ml beaker, add 100 ml of the lower value
    standard and 2 ml of ISA. Place the beaker on a
    magnetic stirrer and begin stirring at a constant rate.
    Lower the electrode tips into the solution. Assure
    that the meter is in the concentration mode.

3. Adjust the meter to the concentration of the standard
    and fix the value in the memory according to the meter
    manufacturer's instructions.

4. Rinse the electrodes with distilled water and blot dry.

5. To another 150 ml beaker, add 100 ml of the higher
    value standard and 2 ml of ISA. Place the beaker on a
    magnetic stirrer and begin stirring at a constant rate.
    Lower the electrode tips into the solution.

6. Adjust the meter to the concentration of the standard
    and fix the value in the memory.

7. Read the electrode slope according to the meter
    manufacturer's instructions. A slope of 93-100%
    indicates correct electrode operation. See the
    TROUBLESHOOTING sections if the slope is not within
    this range.

MEASUREMENT

Measuring Hints

All samples and standards should be at the same temperature for precise measurement. A difference of $1^{\circ}C$ in temperature will result in about a 2% measurement error.

Constant, but not violent, stirring is necessary for accurate measurement. Magnetic stirrers can generate sufficient heat to change the solution temperature. To counteract this effect, place a piece of insulating material, such as styrofoam sheet, between the stirrer and beaker.

Always rinse the electrodes with distilled water and blot dry between measurements. Use a clean, dry tissue to prevent cross contamination.

For samples with high ionic strength, prepare standards whose composition is similar to the sample. Dilute concentrated samples (>0.1M) before measurement.

Use fresh standards for calibration.

Use 2 ml of ISA for each 100 ml of sample or standard.

Always check to see that the membrane is free from air bubbles after immersion into the standard or sample.

Sample Requirements

All samples must be aqueous and not contain organics which can dissolve the epoxy electrode body and/or the cement bonding the sensing crystal to the electrode body. Infrequent measurements in solutions containing methanol, benzene, or acetonitrile are permitted. Highly polar solvents slowly attack the electrode. Please check with pHoenix Electrode Company before using these electrodes in other organic solvents.

The temperature of the sample solutions and of the standard solutions should be the same and below $80^{\circ}C$.

The pH range for the iodide ion electrode is 0-14. Neutralize samples outside this range with acid or base to bring them in range.

Interferences should be absent. If they are present, use the

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procedure found in the **Interference** and **Electrode Response** sections to remove them.

Units of Measurement

Iodide ions can be measured in units of moles/liter, parts/million, or any other convenient concentration unit. Table 1 indicates some of the concentration units.

TABLE 1: Concentration Unit Conversion Factors

| moles/liter	ppm I^{-1}
1.0×10^{-4}	12.7
1.0×10^{-3}	127.0
1.0×10^{-2}	1,270.0
1.0×10^{-1}	12,770.0

MEASUREMENT PROCEDURE

Direct Measurement

Direct measurement is a simple procedure for measuring a large number of samples. A single meter reading is all that is required for each sample. The ionic strength of samples and standards should be made the same by adjustment with ISA for all iodide solutions. The temperature of both sample solutions and of standard solutions should be the same.

Direct Measurement of iodide (using a pH/mV meter)

1. By serial dilution prepare three standard solutions from the 0.1M or 1000 ppm standard. The resultant concentrations should be 10^{-2}, 10^{-3}, and 10^{-4}M or 1000, 100 and 10 ppm iodide standards. Add 2 ml of ISA to each 100 ml of standard. Prepare standards with a composition similar to the samples if the samples have an ionic strength above 0.1M.

2. Place the most dilute solution (1.0×10^{-4}M or 10 ppm) in a 150 ml beaker on the magnetic stirrer and begin stirring at a constant rate. After assuring that the meter is in the mV mode, lower the electrode tips into the solution. When the reading has stabilized, record

the mV reading.

3.	Place the mid-range solution (1.0×10^{-3}M or 100 ppm) in a 150 ml beaker on the magnetic stirrer and begin stirring at a constant rate. After rinsing the electrodes in distilled water, blot dry and immerse the electrode tips in the solution. When the reading has stabilized, record the mV reading.

4.	Place the most concentrated solution (1.0×10^{-2}M or 1000 ppm) in a 150 ml beaker on the magnetic stirrer and begin stirring at a constant rate. After rinsing the electrodes in distilled water, blot dry and immerse the electrode tips in the solution. When the reading has stabilized, record the mV reading.

5.	Using semi-logarithmic graph paper, plot the mV reading (linear axis) against the concentration (log axis). Extrapolate the curve down to about 1.0×10^{-5}M or 1 ppm. A typical calibration curve for iodide can be found in Figure 1.

Figure 1
Typical iodide electrode calibration curve
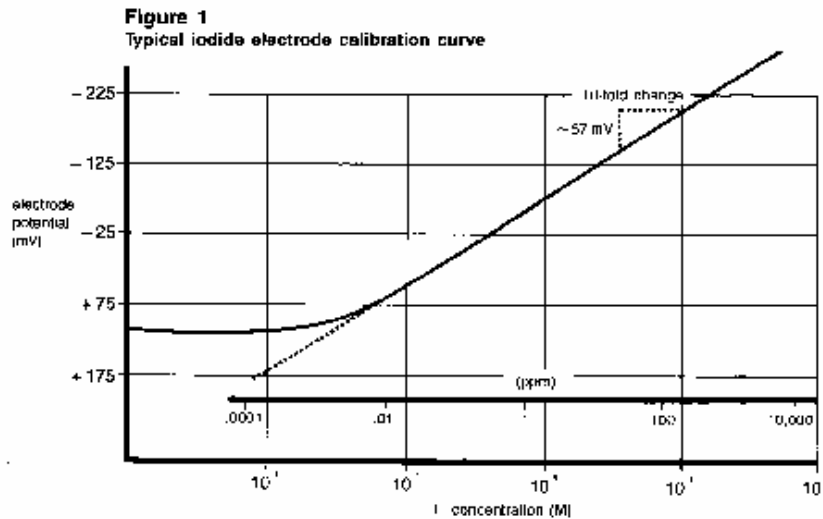
A calibration curve is constructed on semi-logarithmic paper when using a pH/mV meter in the millivolt mode. The measured electrode potential in mV (linear axis) is plotted against the standard concentration (log axis). In the linear region of the curve, only three standards are necessary to determine a calibration curve. In the non-linear

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region, additional points must be measured. The direct measurement procedures given are for the linear portion of the curve. The non-linear portion of the curve requires the use of low level procedures.

6. To a clean, dry 150 ml beaker, add 100 ml of the sample and 2 ml of ISA. Place the beaker on the magnetic stirrer and begin stirring at a constant rate. Rinse the electrode tips with distilled water, blot dry and lower into the solution. When the reading has stabilized, record the mV reading. Using the calibration curve, determine the concentration directly from the calibration curve.

7. The calibration should be checked every two hours. Assuming no change in ambient temperature, place the electrode tips in the mid-range standard. After the reading has stabilized, compare it to the original reading recorded in Step 3 above. A reading differing by more than 0.5 mV or a change in the ambient temperature will necessitate the repetition of Steps 2-5 above. A new calibration curve should be prepared daily.

Direct Measurement of iodide (using an ion meter)

1. By serial dilution of the 0.1M or 1000 ppm iodide standard, prepare two standards whose concentration is near the expected sample concentration. Measure 100 ml of each standard into individual 150 ml beakers and add 2 ml of ISA to each.

2. Place the more dilute solution on the magnetic stirrer and begin stirring at a constant rate. Assure that the meter is in the concentration mode. Lower the electrode tips into the solution.

3. Adjust the meter to the concentration of the standard and fix the value in the memory according to the meter manufacturer's instructions after stabilization of the reading.

4. Rinse the electrodes with distilled water and blot dry.

5. Place the more concentrated solution on the magnetic stirrer and begin stirring at a constant rate. Lower the electrode tips into the solution.

6. Adjust the meter to the concentration of the standard and fix the value in the memory according to the meter manufacturer's instructions after stabilization of the reading.

7. For low level iodide measurements, place the rinsed, dried electrodes into a solution containing 100 ml of distilled water and 2 ml of ISA. After stabilization, fix the blank value into the meter according to the meter manufacturer's instructions.

8. Place 100 ml of the sample and 2 ml of ISA in a 150 ml beaker, place it on the magnetic stirrer, and begin stirring.

9. Immerse the electrode tips in the solution and wait for the reading to stabilize. Read the concentration directly from the meter display.

10. The calibration should be checked every two hours. Assuming no change in ambient temperature, place the electrode tips in the first iodide standard. After the reading has stabilized, compare it to the original reading in Step 3 above. A reading differing by more than 0.5 mV or a change in the ambient temperature will necessitate the repetition of steps 2-6 above. The meter should be re-calibrated daily.

Low Level Iodide Determinations (using a pH/mV meter)

For the iodide electrodes, no special low level determination is necesary. Linear response is possible down to 2.0×10^{-8}M.

ELECTRODE CHARACTERISTICS

Reproducibility
Electrode measurements reproducible to $\forall 2\%$ can be obtained if the electrode is calibrated every hour. Factors such as temperature fluctuations, drift, and noise limit reproducibility. Reproducibility is independent of concentration within the electrode's operating range.

Interferences

A layer of silver may form on the electrode surface in the presence of strong reducing agents. Insoluble salts of silver may be deposited on the membrane, causing electrode malfunction

if high levels of ions forming these salts are present in the sample. Polishing can restore proper performance. See the section **Electrode Response** for proper polishing procedure.

Solutions containing oxidizing agents such as MnO_4^{-1}, Fe^{+3}, and Cu^{+2}, may be measured without problem. All samples must be free of mercury.

The maximum allowable ratio of interfering ion to iodide ion is given in Table 2. This ratio is expressed as the ratio of the interfering ion molarity to the iodide molarity. Readings will be in error if this ratio is exceeded. Neither accuracy of the measurement nor surface of the electrode membrane will be affected if the ratio is less than that listed in the table.

TABLE 2: **Maximum Allowable Ratio of Interfering Ion to Iodide Ion**

Interference	Maximum Ratio
Cl^{-1} (1)	1.0×10^6
$S_2O_3^{-2}$ (2)	1.0×10^5
Br^{-1} (1)	5.0×10^3
CN^{-1} (3)	4.0×10^{-1}
S^{-2} (3)	1.0×10^{-6}

(1) Gran's plot titration can be used to measure mixed halides in solution.

(2) These substances represent complexing species whose maximum level can be exceeded without electrode damage. Values shown represents a 1% error.

(3) Add Ni^{+2} to remove sulfide or cyanide interferences.

As an example of Table 2's use when using the iodide ion electrode:

What is the maximum level of iodide tolerable in a sample whose iodide concentration is 10^{-4}M?

Using Table 2, the maximum ratio is:

$$\frac{[Br^{-1}]}{[I^{-1}]} = 5X10^3$$

or $[Br^{-1}] = 5X10^3 [I^{-1}]$

$$= 5X10^3 (1X10^{-4})$$

$[Br^{-1}]$ = $5X10^{-1}M$ maximum bromide concentration for no
            interference

Complexation

Total concentration (Ct) consists of free ions (Cf) and complexed
or bound ions (Cc) in solutions:

$$Ct = Cf + Cc$$

Since the electrode only responds to free ions, any complexing
agent in the solution reduces the measured concentration of ions.

Iodide ions complex with some metal ions. Table 3 lists the
levels of complexing metals causing a 20% error.

TABLE 3: **Levels of Complexing Agents Causing a 20% Error at**
          $1.0X10^{-4}M$ Iodide

Ion	Concentration
Bi^{+3}	$2.0X10^{-5}M$ (4 ppm)
Cd^{+2}	$5.0X10^{-4}M$ (50 ppm)
Pb^{+2}	$5.0X10^{-3}M$ (1000 ppm)

Temperature Influences

Samples and standards should be at the same temperature since
electrode potentials are influenced by changes in temperature. A
$1^{\circ}C$ difference in temperature results in a 2% error at the
$1.0X10^{-3}M$ concentration level. Because of solubility equilibria
on which the electrode depends, the absolute potential of the
reference electrode changes slowly with the temperature. The
slope of the electrode, as indicated by the factor "S" in the
Nernst equation, also varies with temperature. Table 4 gives
values of the "S" factor in the Nernst equation for the iodide
ion.

TABLE 4:   Temperature vs. Values for the Electrode Slope

| Temp (°C)	"S"
0	54.2
10	56.2
20	58.2
25	59.2
30	60.1
40	62.1
50	64.1

If changes in temperature occur, the electrodes should be recalibrated.

The temperature range of the pHoenix Iodide Ion Electrodes is 0°-80°C, provided that temperature equilibrium has occurred.
If the temperature varies substantially from room temperature, equilibrium times up to one hour are recommended.

Electrode Response

Plotting the electrode mV potential against the iodide concentration on semi-logarithmic paper results in a straight line with a slope of about 57 mV per decade. (Refer to Figure 1.)

The time needed to reach 99% of the stable electrode potential reading, the electrode response time, varies from several seconds in highly concentrated solutions to several minutes near the detection limit. (Refer to Figure 2.)

Figure 2
Typical electrode time response to step changes in NaI
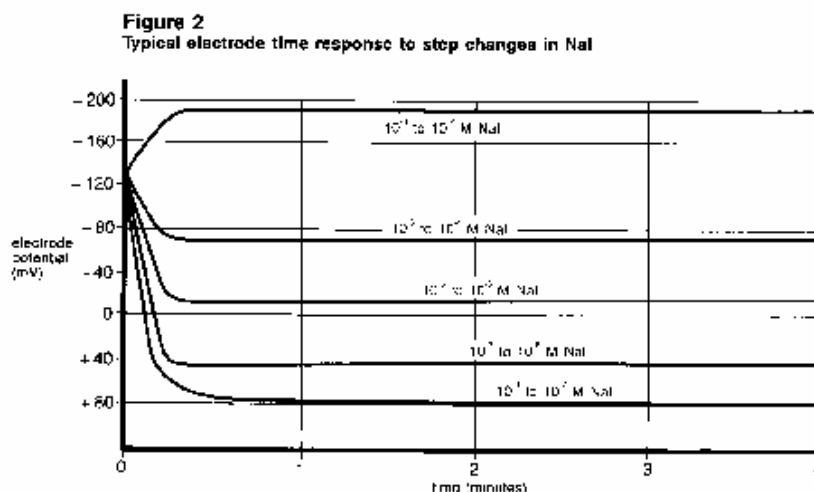
A drifting potential reading or a decrease in electrode slope may mean that the electrode membrane needs polishing.

To polish the membrane:

1. If using polishing paper, cut off a 1-2" piece and place it face up on the lab bench.

2. Put a few drops of distilled or deionized water in the center of the paper.

3. Holding the paper (cotton) steady with one hand, bring the membrane of the electrode down perpendicular to the paper and, with a slight swirling motion, gently polish the tip of the electrode against the surface of the polishing paper (cotton) for a few seconds.

4. Rinse the electrode surface with distilled or deionized water and soak the electrode tip in standard solution for about five minutes before use.

5. If using jeweller's rouge, place a cotton ball on the table top and flatten it using the bottom of a beaker.

6. Put 1-2 drops of distilled or deionized water in the center of the cotton pad.

7. Add a small amount of jeweller's rouge to the damp cotton.

8. Continue with Steps 3 and 4 above.

Limits of Detection

The upper limit of detection in pure sodium iodide solutions is 1M. In the presence of other ions, the upper limit of detection is above 1.0×10^{-1}M iodide, but the possibility of a liquid junction potential developing at the reference electrode and the "salt extraction effect" are two limiting factors. Some salts may infuse into the electrode membrane at high salt concentrations, causing deviation from the theoretical response. Either dilute samples between 1M and 1.0×10^{-1}M or calibrate the electrode at 4 or 5 intermediate points.

The lower limit of detection is influenced by the slight water solubility of the electrode pellet. Refer to Figure 1 for a comparison of the theoretical response to the actual response at low levels of iodide.

pH Effects

The electrode can be used over the pH range 0-14.

Electrode Life

The iodide electrode will last six months in normal laboratory use. On-line measurements might shorten operational lifetime to several months. In time, the response time will increase and the calibration slope will decrease to the point calibration is difficult and electrode replacement is required.

Electrode Storage

The pHoenix Iodide Electrodes may be stored for short periods of time in 1.0×10^{-2}M iodide solution. For longer storage (longer than two weeks), rinse and dry the sensing pellet and cover the membrane tip with any protective cap shipped with the electrode. The reference portion of the combination electrode (or the outer chamber of the reference electrode) should be drained of filling solution, if refillable, and the rubber insert placed over the filling hole.

ELECTRODE THEORY

Electrode Operation

The pHoenix Iodide Ion Electrode consists of a sensing membrane bonded into a glass or an epoxy body. The membrane is composed of silver iodide/silver sulfide. When an electrode potential develops across the membrane, the electrode is in contact with solution containing iodide ions and is capable of measuring free iodide ions. This electrode potential is measured against a constant reference potential, using a standard pH/mV meter or an ion meter. The level of the iodide ions, corresponding to the measured potential, is described by the Nernst equation:

$$E = E_o - S \log X$$

where:

E = measured electrode potential
E_o = measured potential (a constant)
S = electrode slope (-57mV/decade)
X = level of iodide ions in solution

The activity, X, represents the effective concentration of the ions in solution. The activity is related to the free ion concentration, Cf, by the activity coefficient, γ, by:

$$X = \gamma Cf$$

Activity coefficients vary, depending on total ionic strength, I, defined as:

$$I = 2 \ 3C_x Z_x^2$$

where:

C_x = concentration of ion x
Z_x = charge of ion x
3 = sum if all the types of ions in the solution

In the case of high and constant ionic strength relative to the sensed ion concentration the activity coefficient, γ, is constant and the activity, X, is directly proportional to the concentration.

To adjust the background ionic strength to a high and constant value, ionic strength adjuster is added to samples and standards. The recommended ISA for iodide ions is $NaNO_3$. Solutions other than this may be used as ionic strength adjusters as long as ions that they contain do not interfere with the electrode's response to the iodide ions. Samples with high ionic strength (greater than 0.1M) do not need ISA added and standards for these solutions should be prepared with a composition similar to the samples.

The reference electrode must also be considered. When two solutions of different composition are brought into contact with one another, liquid junction potentials arise. Millivolt potentials occur from the inter-diffusion of ions in the two solutions. Electrode charge will be carried unequally across the solution boundary resulting in a potential difference between the two solutions, since ions diffuse at different rates. When making measurements, it is important to remember that this potential be the same when the reference is in the standardizing solution as well as in the sample solution or the change in liquid junction potential will appear as an error in the measured electrode potential.

The composition of the liquid junction filling solution in the

reference electrode is most important. The speed with which the positive and negative ions in the filling solution diffuse into the sample should be equitransferent. No junction potential can result if the rate at which positive and negative charge carried into the sample is equal.

Strongly acidic (pH=0-2) and strongly basic (pH=12-14) solutions are particularly troublesome to measure. The high mobility of hydrogen and hydroxide ions in samples make it impossible to mask their effect on the junction potential with any concentration of an equitransferent salt. One must either calibrate the electrodes in the same pH range as the sample or use a known increment method for ion measurement.

TROUBLESHOOTING GUIDE

The goal of troubleshooting is the isolation of a problem through checking each of the system components in turn: the meter, the glassware, the electrodes, the standards and reagents, the sample, and the technique.

Meter

The meter may be checked by following the checkout procedure in the instrument instruction manual.

Glassware

Clean glassware is essential for good measurement. Be sure to wash the glassware well with a mild detergent and rinse very well with distilled or deionized water. Clean glassware will drain without leaving water droplets behind.

Electrodes

The electrodes may be checked by using the procedure found in the section entitled **Electrode Slope Check**.

1. Be sure to use distilled or deionized water when following the procedures given in **Electrode Slope Check**.

2. If the electrode fails to respond as expected, see the sections **Measuring Hints** and **Electrode Response**. Repeat the slope check.

3. If the electrodes still fail to respond as expected,

substitute another iodide ion electrode that is known to be in good working order for the questionable electrode. If the problem persists and you are using an electrode pair, try the same routine with a working reference electrode.

4. If the problem persists, the standards and/or reagents may be of poor quality, interferences in the sample may be present or the technique may be faulty. (See **Standards & Reagents**, **Sample**, and **Technique** sections below.)

5. If another electrode is not available for test purposes, or if the electrode in use is suspect, review the instruction manual and be sure to:

    - Clean and rinse the electrodes thoroughly.
    - Prepare the electrodes properly.
    - Use the proper filling solution.
    - Adjust the pH and the ionic strength of the solution by the use of the proper ISA.
    - Measure correctly and accurately.
    - Review **TROUBLESHOOTING HINTS**.

Standards & Reagents

Whenever problems arise with the measuring procedure that has been used successfully in the past, be sure to check the standard and reagent solutions. If in doubt about the credibility of any of the solutions, prepare them again. Errors may result from contamination of the ISA, incorrect dilution of standards, poor quality distilled/deionized water, or a simple mathematical miscalculation.

Sample

Look for possible interferences, complexing agents, or substances which could affect the response or physically damage the sensing electrode (or the reference electrode) if the electrodes work perfectly in the standard, but not in the sample.

Try to determine the composition of the samples prior to testing to eliminate a problem before it starts. (See **Measuring Hints**, **Sample Requirements**, and **Interferences**.)

Technique

Be sure that the electrode's limit of detection has not been

exceeded. Be sure that the analysis method is clearly understood and is compatible with the sample.

Refer to the instruction manual again. Reread **<u>GENERAL PREPARATION</u>** and **<u>ELECTRODE</u> <u>CHARACTERISTICS</u>**.

If trouble still persists, call pHoenix Electrode Company at 1-800-522-7920 and ask for the Technical Services Department.

TROUBLESHOOTING HINTS

Symptom	Possible Causes	Next Step
Out of Range Reading	defective meter	check meter with shorting strap (see meter instruction manual)
	defective electrode	check electrode operation
	electrodes not plugged in properly	unplug electrodes and reset
	reference electrode not filled	be sure reference electrode is filled
	air bubble on membrane	remove bubble by redipping electrode
	electrodes not in solution	put electrodes in solution
Noisy or Unstable Readings (readings continuously or rapidly changing)	defective meter	check meter with shorting strap
	air bubble on membrane	remove bubble by re-dipping electrode
	electrode exposed to interferences	soak electrode in iodide standard
	defective electrode	replace electrode
	ISA not used	use recommended ISA
	meter or stirrer not grounded	ground meter or stirrer
Drift (reading slowly changing in one direction)	samples and standards at different temperatures	allow solutions to come to room temperature before measurement
	electrode exposed to complexing	check section entitled

	agents	**Complexation**
	incorrect reference filling solution	use recommended filling solution
Low Slope or No Slope	standards contaminated or incorrectly made	prepare fresh standards
	ISA not used	use recommended ISA
	standard used as ISA	use ISA
	electrode exposed to complexing agents	check section entitled **Complexation**
	air bubble on membrane	remove bubble by re-dipping probe
"Incorrect Answer" (but calibration curve is good)	incorrect scaling of semi-log paper	plot millivolts on the linear axis. On the log axis, be sure concentration numbers within each decade are increasing with increasing concentration.
	incorrect sign	be sure to note sign of millivolt number correctly
	incorrect standards	prepare fresh standards
	wrong units used	apply correct conversion factor: $10^{-3}M = 127.0$ ppm as I^{-1}
	complexing agents in sample	check section entitled **Complexation**

SPECIFICATIONS

Concentration Range: 1M to 1.0×10^{-8}M
                            127,000 ppm to 0.4 ppm

pH Range: 0-14

Temperature Range: 0° to 80°C

Resistance: <1 Mohm

Reproducibility: $\forall$2%

Samples: Aqueous sloutions only;
                            avoid organic solvents

Size: 110 mm in length
                            12 mm in diameter
                            1 m cable length

Storage: Store in iodide solution

ORDERING INFORMATION

P/N   DESCRIPTION

I001501   Iodide Ion Electrode, mono (reference
                electrode necessary), epoxy body

I001502   Iodide Ion Electrode, combination, glass body
I001503   Iodide Ion Electrode, combination, epoxy body

5731429   Reference Electrode, double junction, sleeve,
epoxy
                body, for use with the I001501

I00AS01   Iodide Standard, 0.1M NaI

I00AS02   Iodide Standard, 1000 ppm NaI

I00IS01   Ionic Strength Adjuster (ISA), 5M $NaNO_3$

R001011   Electrode Filling Solution, 4M KCl/AgCl, for the
                5731429 inner chamber

R001015   Electrode Filling Solution, 1M KNO_3, for the
5731429

outer chamber and the I001502 electrode

R001046   Electrode Filling Solution, 1M KNO_3/0.1M KCl, for
the I001503 electrode

948201   Polishing Paper for the Iodide Ion Electrodes