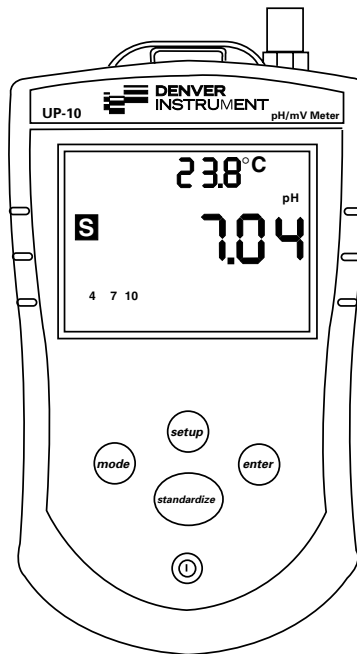




UltraBasic Series Meter

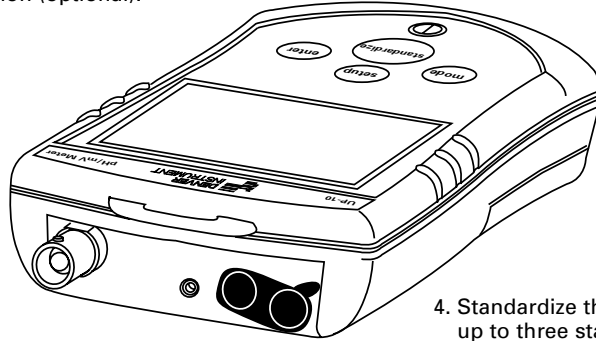
Operation Manual

UP-5	pH/Temp
UP-10	pH/mV/Temp
UP-25	pH/mV/ion/Temp

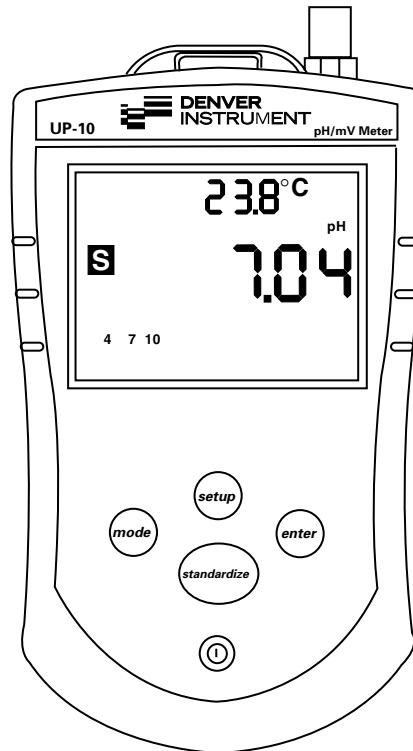


UltraBasic Meter Quick Reference

1. Install a 9 volt battery in the battery compartment or connect a AC adapter to the power connection (optional).
2. Connect an electrode to the Input and ATC connectors (optional).



3. Press **mode** until the display indicates the appropriate measurement mode (pH, mV/relative mV or ion).
4. Standardize the meter using up to three standards by immersing the electrode in a buffer/standard, stirring, then pressing **standardize** to enter each standard.



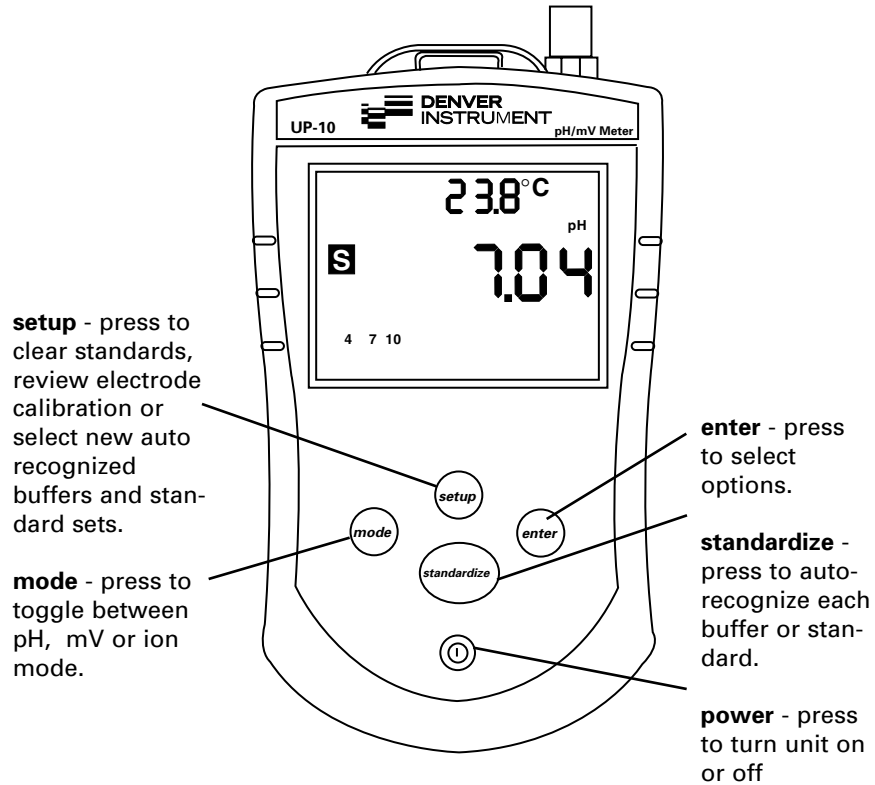
5. The display shows the current reading in pH, mV, relative mV or ion units.
6. Press **setup** to review electrode calibration and to clear or select buffers/standards.

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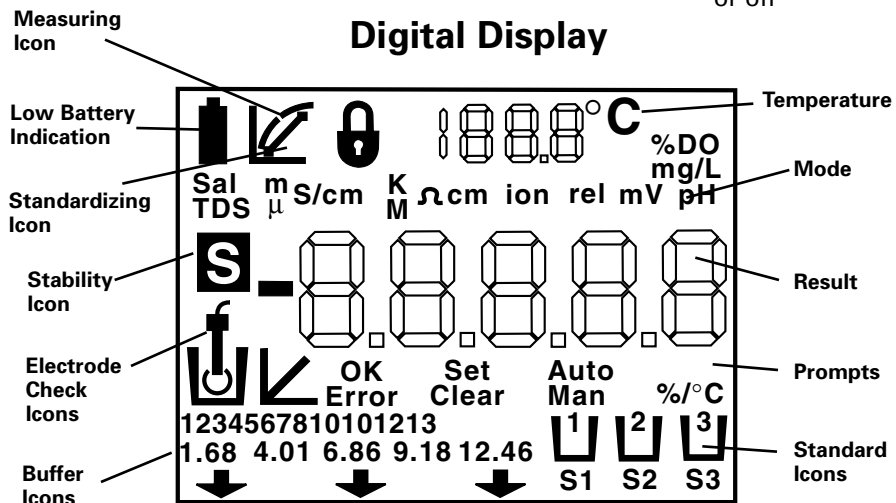
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Getting Started

Front Panel Controls

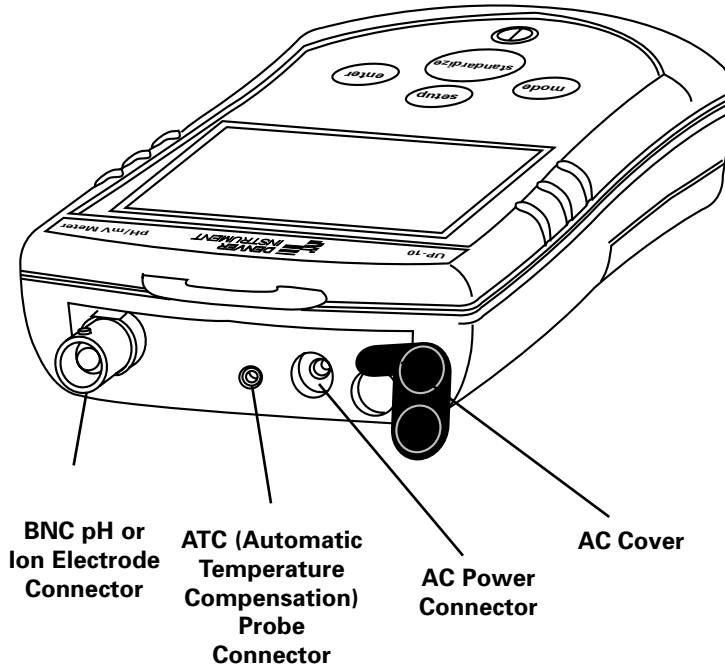


Digital Display



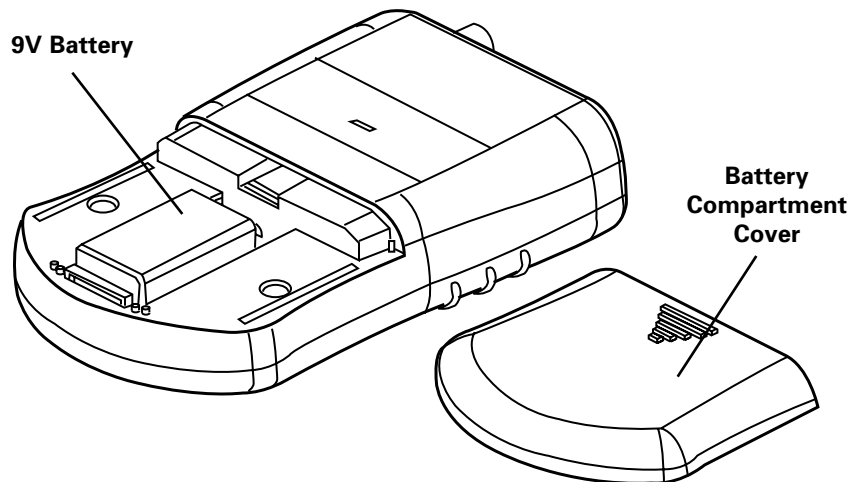
Note: Not all icons on display will be used.

Rear Panel Connectors



Note: AC cover must be in place for IP-67 protection

Battery Installation

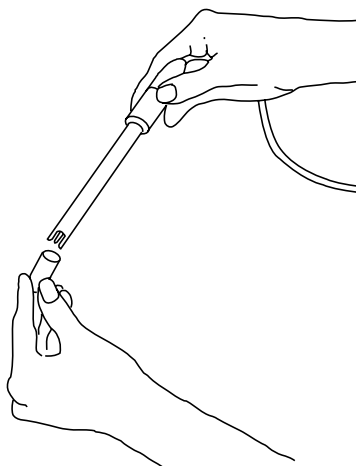


Installing and Maintaining Electrodes

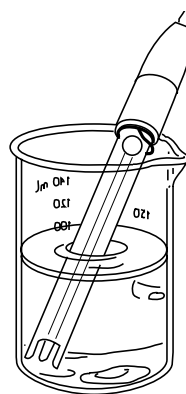
This meter allows you to use:

- Combination pH electrode with BNC connector
- 3-in-1 combination electrode with BNC connector and 2.5 mm phone jack for ATC
- Separate 2.5 mm phone jack for ATC
- Ion selective or ORP electrode with BNC connector.

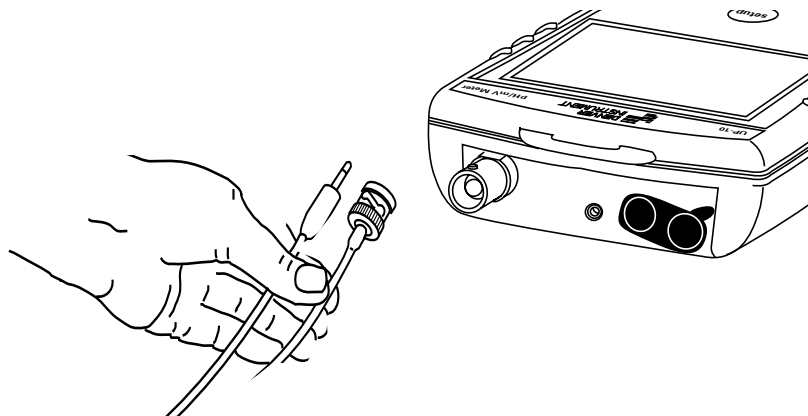
1. Remove the protective end cover from electrode.



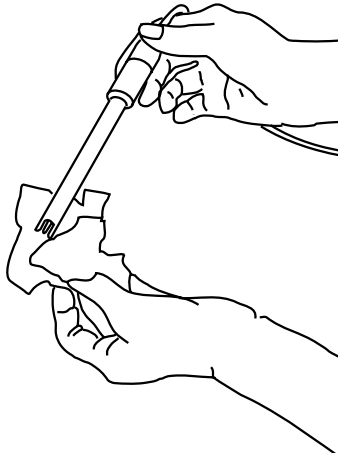
2. Before using your pH electrode, or whenever the electrode is dry, soak over-night in an Electrode Filling Solution, KCl solution or Electrode Storage Solution.



3. Remove the shorting cap on the BNC connector. Install the electrode by plugging it into the **input** connection (push on and twist to lock). An accessory ATC probe can be installed in the **ATC** port for the most accurate pH measurements.

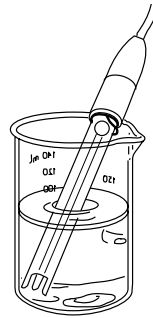


4. Rinse and blot-dry electrodes between each measurement (**do not wipe**). Rinse electrodes with distilled water or deionized water, or part of the next solution to be measured.



5. Store pH electrodes in KCl solution or Electrode Storage Solution. Always leave the filling hole open when in use and closed when in storage. Refill with Filling Solution when the internal solution level gets 1" below fill hole.

Note: The electrode that comes with the UltraBasic kit is gel-filled. It has no fill solution or filling hole.

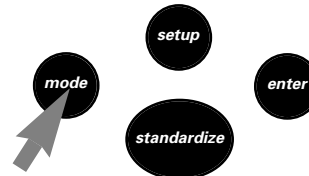
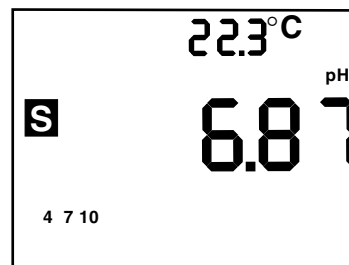
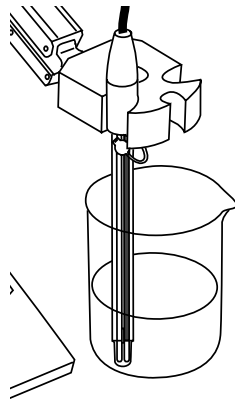


Standardizing for pH Measurement

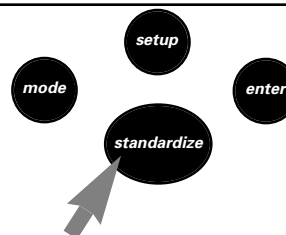
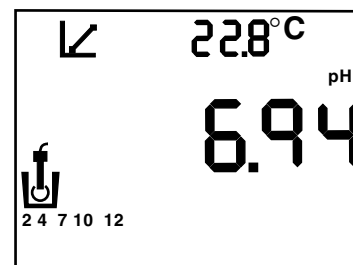
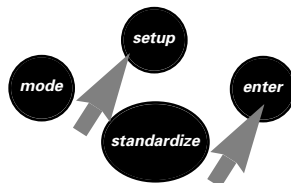
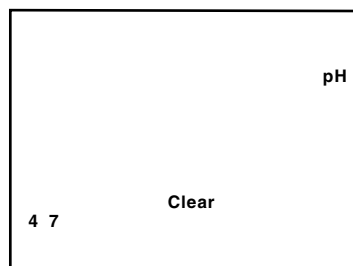
Because electrodes vary in their response, you must standardize your pH meter and electrode to compensate for electrode variation. The more frequently you standardize, the more accurate your measurements. Standardize daily, or more often, for accurate results.

NOTE: To escape standardizing mode press **Standardize** again

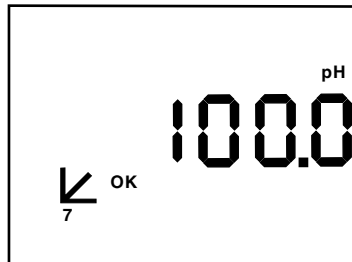
1. Immerse electrode in a buffer solution. Stir gently. Allow the electrode to reach a stable value.
2. Press and release the **mode** button until your digital display indicates pH mode.



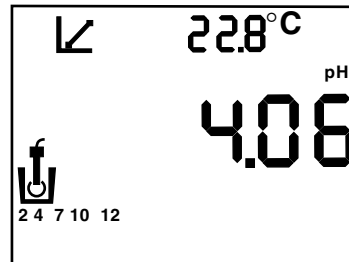
3. Clear existing buffers when doing a new 2 or 3 point standardization. Use the **setup** and **enter** buttons to clear existing buffers.
4. Press **standardize**. The meter flashes the current buffer set and recognizes the flashing buffer. When the signal is stable, or when you press **enter**, the buffer is entered.



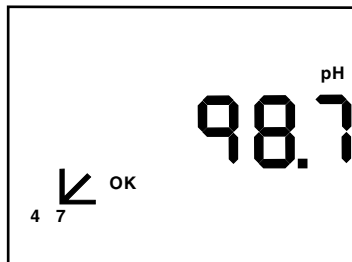
5. The meter displays the percent slope of the electrode as 100.0% on the first buffer. On entering a second or third buffer, the meter performs a diagnostic check on the electrode and displays the slope.



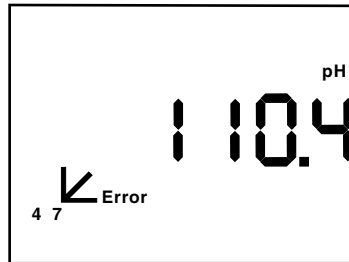
6. To enter a second buffer, place the electrode in the second buffer solution, stir, allow time for the electrode to stabilize, and press **standardize** again. The meter recognizes the buffer.



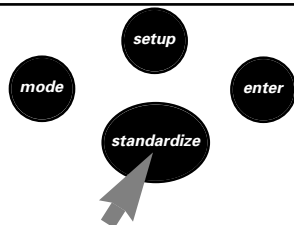
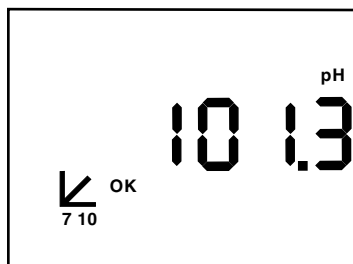
7. Next, the meter performs a diagnostic test of the electrode. The display indicates electrode condition. The meter displays the % slope of the electrode.



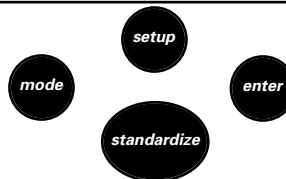
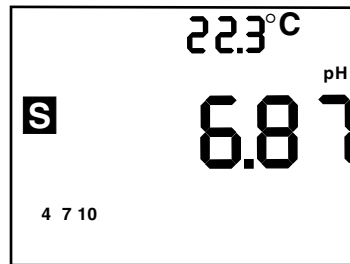
8. **Slope Error** indicates that your electrode is not working properly. The electrode response must be between 90 and 105% slope. Measurements causing Slope Error are not accepted, used or stored by the meter. Press **enter** to continue.



9. To enter a third standard, place the electrode in the third buffer solution, stir, allow to stabilize, and press **standardize**. The results will be the same as in steps 7 and 8.



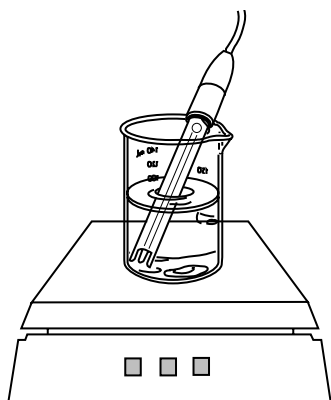
10. After entering each buffer, the *Standardizing* icon goes off and the *Measuring or Stable* icon appears on the display to indicate that the meter returns to *Measuring* operation.



11. Standardize your meter and electrode using at least two buffers with pH values bracketing the expected pH of your samples. Stirring with a magnetic stir bar and stirrer provides faster electrode response.

NOTE: If an ATC probe is used, the meter continually adjusts for temperature. Therefore, buffers may vary slightly from the nominal values because of temperature. Default temperature is 25 oC

NOTE: The temperature is only displayed when an ATC probe is attached.

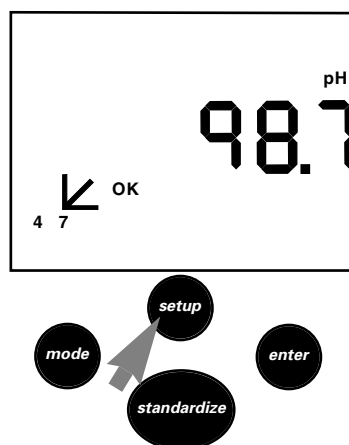
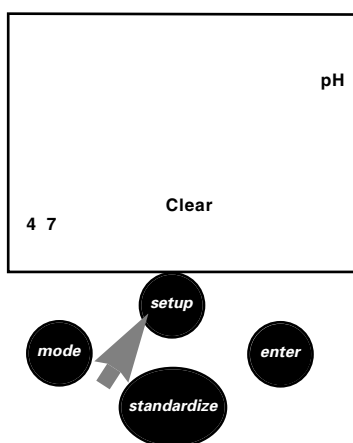


Using Setup in pH Mode

The **setup** button lets you clear all the buffers/standards that you have entered, review calibration information, or select the buffer/standard set that you want.

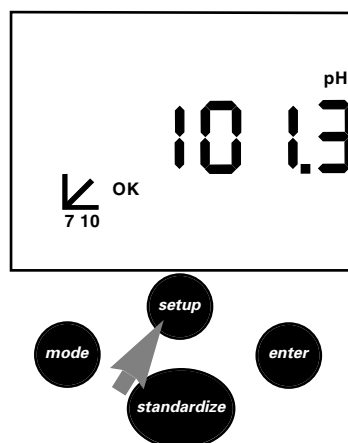
NOTE: Continuing to press **Setup** will return you to measurement mode.

1. Press **setup** and the meter displays a flashing *Clear* icon. Use this step only when you wish to clear all buffers you have entered. To clear all existing buffers, press **enter**. The meter clears all buffers and returns to *Measuring* screen.
2. Press **setup** again to show electrode performance. If the meter has accepted two buffers, it will display *Good Electrode*, display the slope between the first and second buffers and display the two buffer icons.

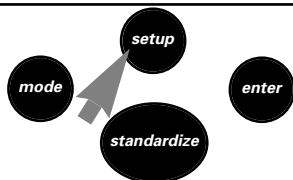
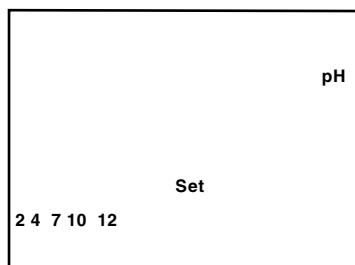


3. Pressing **setup** again shows the electrode slope between the second and third buffers (if three buffers have been entered) and shows the second and third buffer icons.

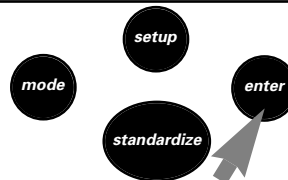
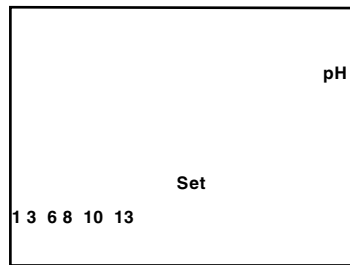
Note: These screens will only be displayed if buffers are stored.



4. Press **Setup** again to display a flashing *Set Buffers* icon and to display the first buffer set (U.S. buffer set) icons.



5. Press **Enter** to select the set of buffers shown on the display or
Press **Setup** again to view the next set of buffers. Continue pressing **Setup** to view the third buffer set (NIST buffer set).

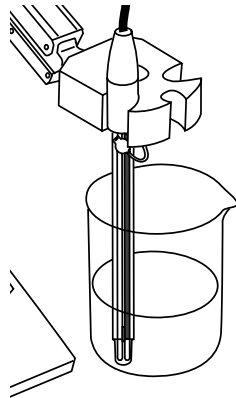


Standardizing for Millivolt Measurement (Relative Millivolts)

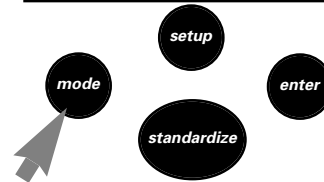
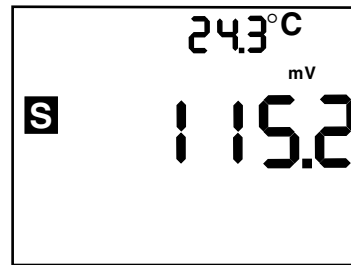
NOTE: UP-5 does not include mV mode.

You use millivolt measurement for electrode diagnostics, titration or measuring redox potential (also called ORP, oxidation reduction potential). ORP measurements indicate the oxidizing or reducing capability of a solution. You can use ORP values to monitor or control solutions requiring a set amount of oxidants or reductants.

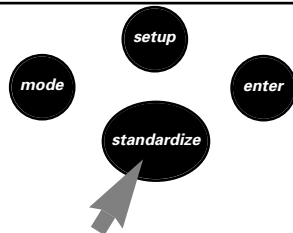
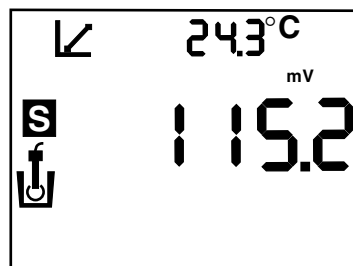
1. Immerse electrode in a standard solution.



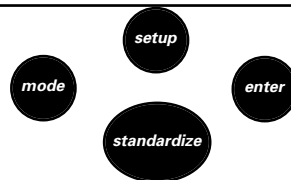
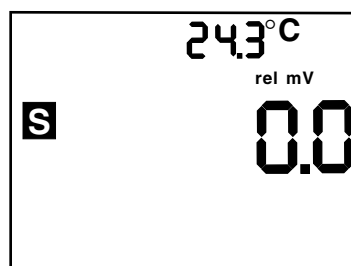
2. Press the **mode** button until your digital display indicates mV mode.



3. Press **standardize** to enter a mV standard and read relative mV.

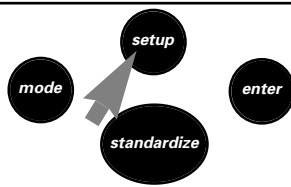
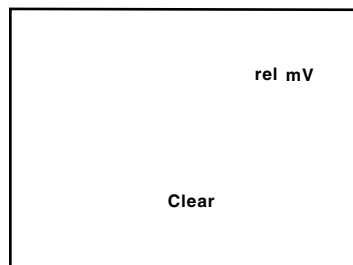


4. When the signal becomes stable, or when you press **enter**, the current absolute mV value becomes zero relative millivolts.

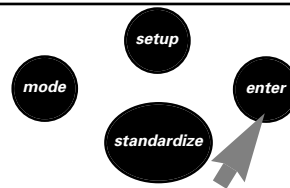
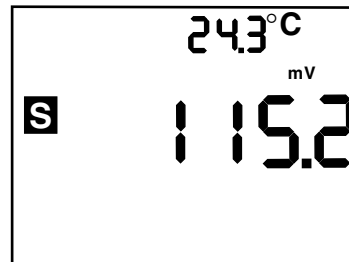


Using Setup in mV Mode

1. To clear a mV offset and return to absolute millivolt mode, press **setup**. The meter displays a flashing *Clear* icon, and shows the current relative millivolt offset.



2. To clear the mV standard, press **enter**. You then return to absolute mV mode.

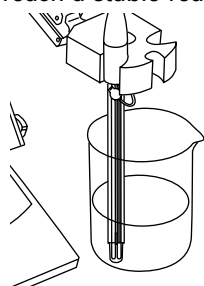


Standardizing for Ion Measurement

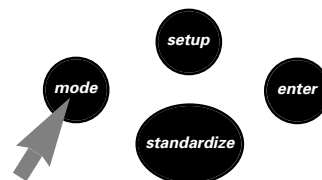
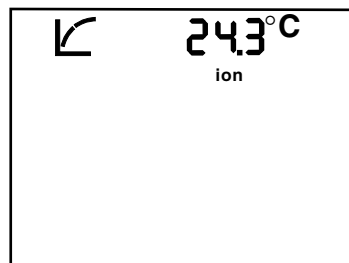
Because electrodes vary in their response, you must standardize your meter and electrode to compensate for electrode variation. The more frequently you standardize, the more accurate your measurements. Standardize daily, or more often, for accurate results.

Note: You must first setup your standard values in setup mode.

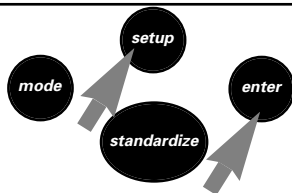
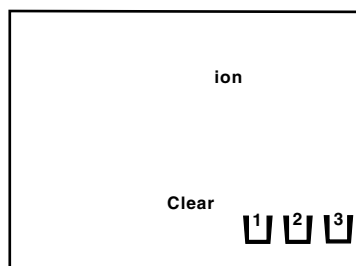
1. Immerse electrode in standard solution. Stir gently. Allow the electrode to reach a stable value. Ion Selective Electrodes may take up to 10 minutes to reach a stable reading.
2. Press and release the **mode** button until your digital display indicates ion mode.



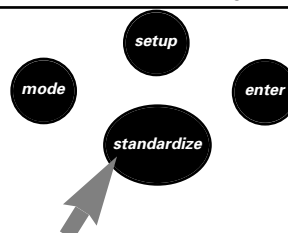
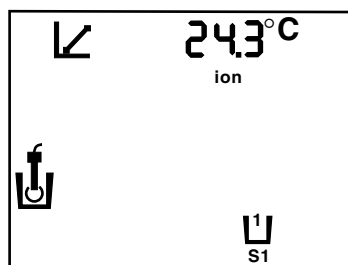
Note: No measurement will display on screen if less than two standards are stored.



3. Clear existing buffers when doing a new 2 or 3 point standardization. Use the **setup** and **enter** buttons to clear existing standards.



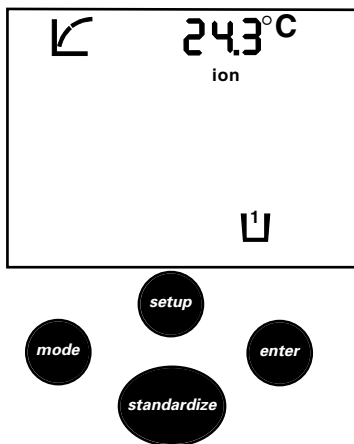
4. Press **standardize**. The meter flashes "S1". After 2 seconds the \sqcup will appear. When the signal is stable, or when you press **enter**, the standard is entered.



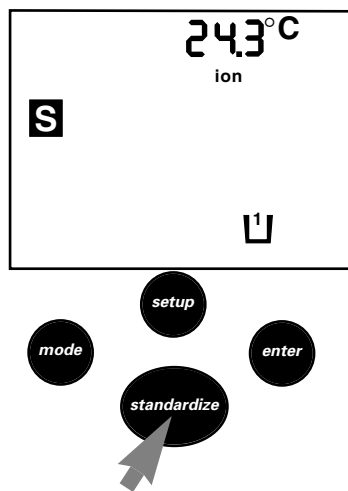
Note: If desiring to enter only S2 and S3, press the **standardize** key when "S1" flashes. The meter will standardize at "S2".

- The meter returns to measurement mode and $\square 1$ is displayed indicating the first standard is stored.

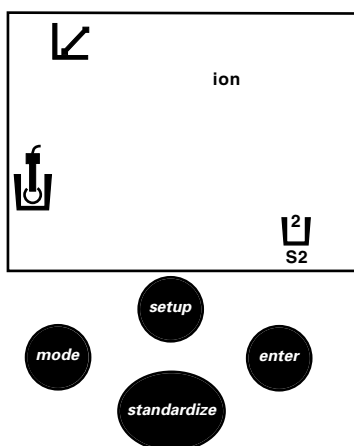
Note: No measurement will display on screen if less than two standards are stored.



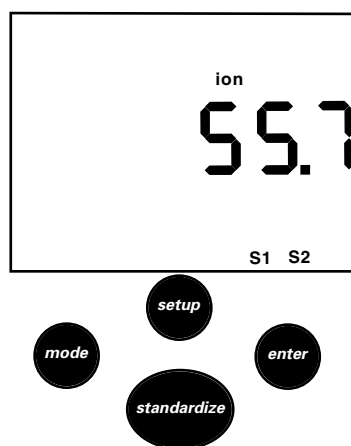
- To enter a second standard, place the electrode in the second standard solution, stir, allow time for the electrode to stabilize, and press **standardize** again.



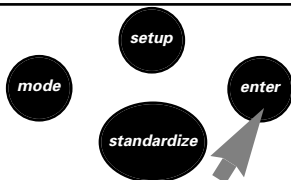
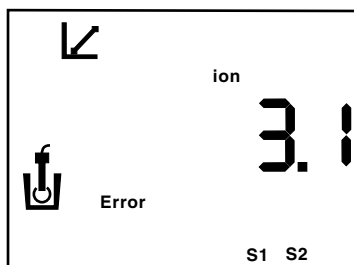
- The meter will flash "S2" and after two seconds the $\square 1$ will appear. When the signal is stable, the meter recognizes the standard.



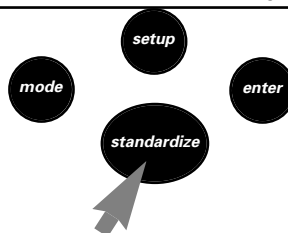
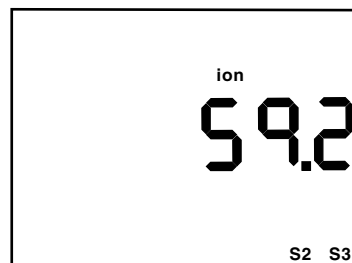
- "S1" and "S2" are both displayed along with the change in mV/decade. Typical mV change for a monovalent ISE is 59 mV/decade and 27 mV/decade for a divalent ISE. Refer to the ISE instructions for acceptable mV change.



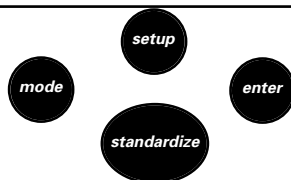
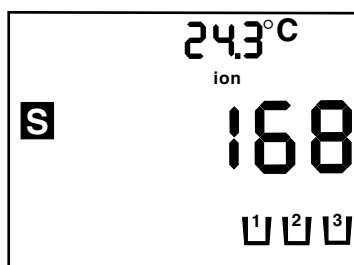
9. **Slope Error** indicates that the change in mV between the standards displayed is too small and accurate ion measurements cannot be taken. Press **enter** to continue.



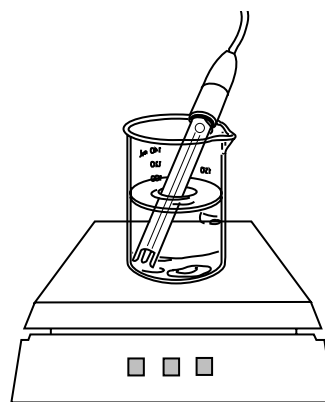
10. To enter a third standard, place the electrode in the third standard solution, stir, allow to stabilize, and press **standardize**. The results will be the same as in steps 7 and 8.



11. After entering each standard, the *Standardizing* icon goes off and the *Measuring or Stable* icon appears on the display to indicate that the meter returns to *Measuring* operation.



12. Standardize your meter and electrode using at least two standards with concentrations bracketing the expected range of your samples. Stirring with a magnetic stir bar and stirrer provides faster electrode response.

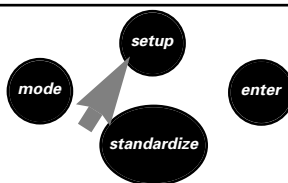
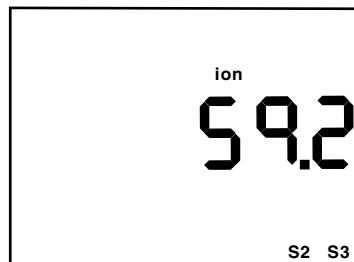
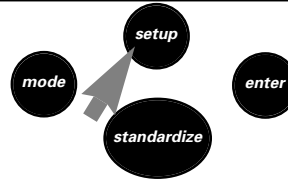
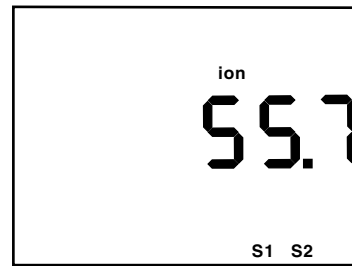
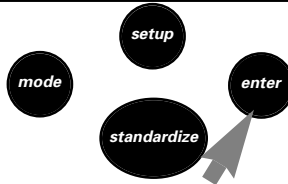
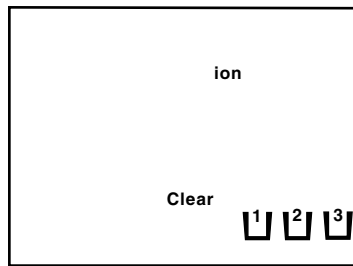


Using Setup in Ion Mode

The **setup** button lets you clear all the standards that you have entered, review calibration information, or enter the standard values that you want.

*NOTE: You can escape setup mode at any time by pressing **mode**.*

1. Press **setup** and the meter displays a flashing *Clear* icon. Use this step only when you wish to clear all standards you have entered. To clear all existing standards, press **enter**. The meter clears all standards and returns to *Measuring* screen.
2. Press **setup** again to show electrode performance. If the meter has accepted two standards, it will display *OK*, and display the mV /decade change between the first and second standards.

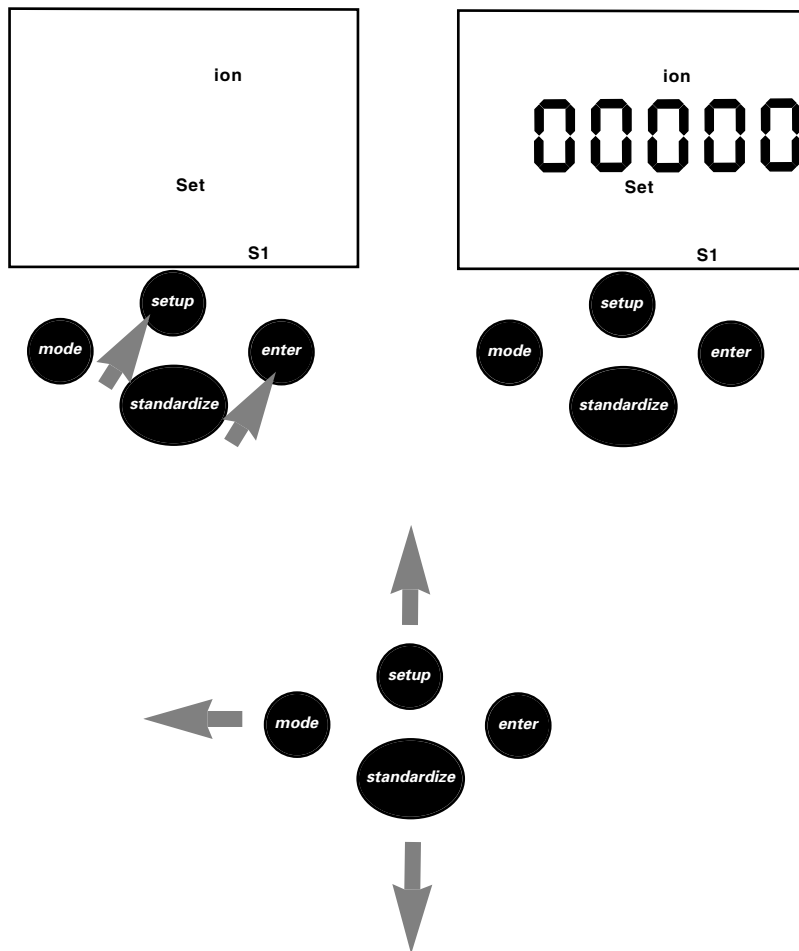


3. Press **setup** again to show mV/decade change from S2 and S3 (the second and third standards).

Note: These screens will only be displayed if standards are stored.

4. Press **setup** again and "Set" and "S1" will begin to flash. Press **enter** to set the value of the first standard.

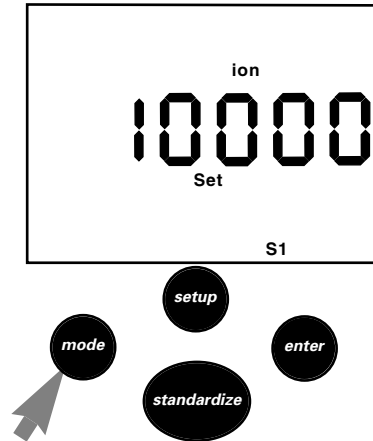
5. The current value set for the first standard will be displayed (00000 is displayed if no value is set). The first digit is flashing and is ready to be set.



To increase the number press **setup**.
To decrease the number press **standardize**.
To move to the next digit press **mode**.

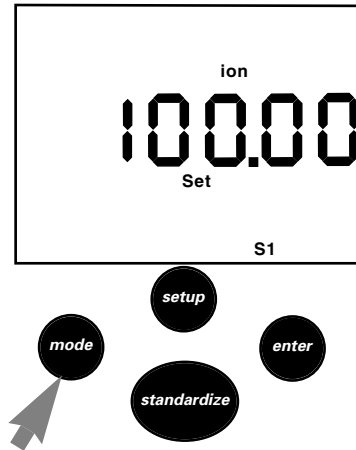
6. Press **setup** until the correct digit is displayed.

7. Press the **mode** key to move to the second digit.

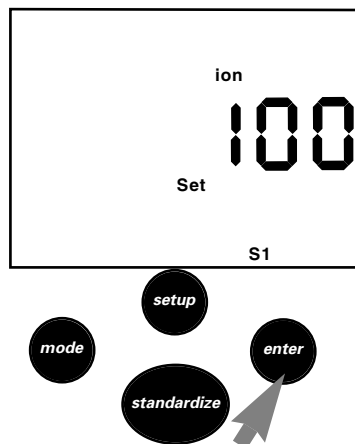


8. Repeat steps for all digits. After the last digit, press **mode** until the decimal place is in the proper location.

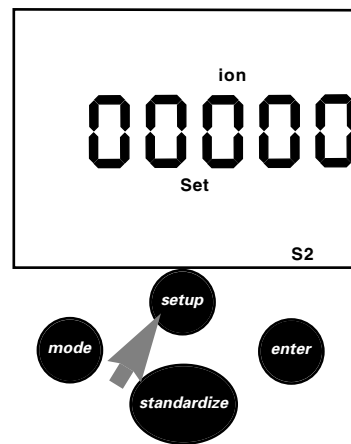
Note: To clear standard value setting press **mode** until "clear" is displayed and press **enter**.



9. Press **enter** to accept the value. If the value needs to be changed, press **enter** key again.



10. Press **setup** and repeat steps 4 - 9 for S2 and S3.



Understanding pH Theory

Defining pH

The measurement of pH plays an important role in identifying and controlling acidity and alkalinity levels for industry and research. pH is a measure of the acidity or alkalinity of a solution and can be represented by this equation:

$$\text{pH} = -\log [\text{H}^+]$$

with $[\text{H}^+]$ representing the concentration of hydrogen ions in the solution. pH is sometimes referred to as the power of the hydrogen ion in a solution.

By using a pH meter, you can determine exact pH levels of solutions. For example, rather than say that lemon juice is quite acidic, you can say that lemon juice has a pH of 2.4. An exact pH value can be used to control or measure acidity levels for manufacturing processes or for basic research.

pH values generally range from 0 to 14, with a pH value of 7 being the neutral point, or the value of pure water. pH values greater than 7 represent increasing alkalinity, whereas pH values below 7 represent increasing acidity (Figure 1).

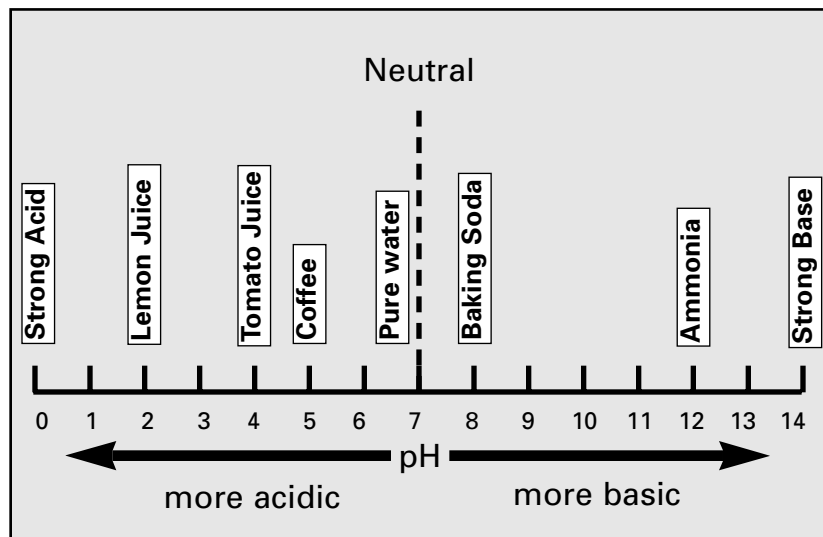


Figure 1.
pH Scale showing the relative acidity or basicity of some common substances.

Understanding Temperature Compensation

NOTE: Temperature compensation only takes effect when an ATC probe is attached.

There are two ways that temperature compensation affects pH measurement:

1. Buffer pH values change with temperature.

Each buffer changes depending on the temperature of the solution. These values are typically found on the label of the buffer. The tables below are representative of most buffers.

When standardization is performed in pH mode, the pH value is adjusted to the current value for the current temperature.

For example, if your pH 7 buffer is at 20°C the meter will standardize your buffer at 7.02 instead of 7.00 which is the value at 25°C.

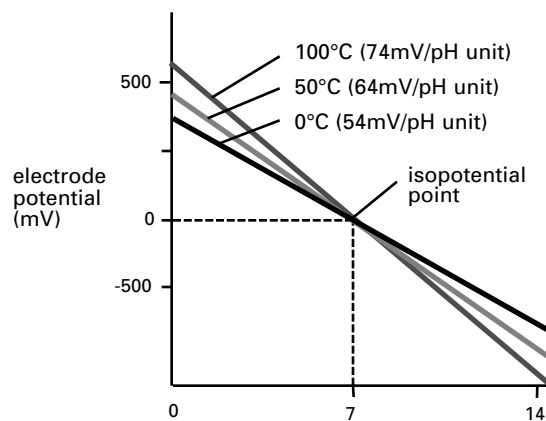
U.S. Standard Buffer

	pH 4.00	pH 7.00	pH 10.00
0°C	4.005	7.13	10.34
5°	4.003	7.10	10.26
10°	4.001	7.07	10.19
15°	4.002	7.05	10.12
20°	4.003	7.02	10.06
25°	4.008	7.00	10.00
30°	4.010	6.99	9.94
35°	4.020	6.98	9.90
40°	4.03	6.97	9.85
50°	4.061	6.97	9.78

2. The electrode efficiency changes with temperature.

The standard mV change per pH unit is approximately 59.17 at 25°C. However, as shown in the below graph, this mV per pH unit value changes as temperature changes.

The meter compensates for this change by changing the pH reading as temperature changes.

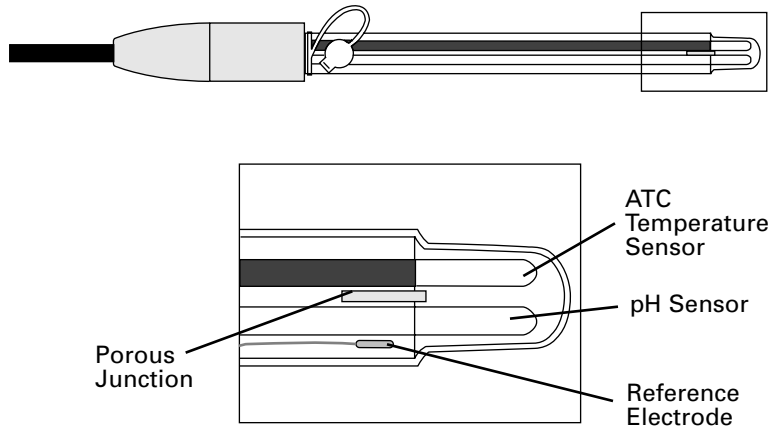


Typical pH electrode response as a function of temperature

Measuring pH

To measure pH with a conventional glass pH electrode, the meter uses a pH-sensing glass bulb that is sensitive to hydrogen ions. The potential developed at the glass membrane is directly related to the pH of the solution.

The glass electrode is paired with a reference electrode which completes the electrical measuring circuit and provides a stable reference point. These two electrodes are joined to create a combination electrode. The combination glass electrode is connected to the pH meter which reads the voltage, converts it to pH units, and displays the result.



Measuring Ion Concentration

The UP-25 not only has the capability of measuring pH and mV but also measures ion concentration. In ion mode you can measure the concentration of specific ions using an ion selective electrode (ISE). The concept is the same as in pH mode where the activity of hydrogen ions is measured with a pH electrode.

In pH mode the mV values of pH buffers are plotted against the pH buffer value to generate a standardization curve. The same can be done for other ions since ion selective electrodes follow a Nernstian electrode slope. By plotting log concentration versus mV value of the standards a standardization curve can be generated. This standardization data is then used to take the mV reading, of unknown samples, and determine concentration of those samples.

A typical slope for a monovalent ISE is 59 mV/decade and 27 mV/decade for a divalent ISE. However at lower concentrations (typically less than 10 ppm) the response of the electrode starts to deviate from the Nernstian curve. This is due primarily to the low activity of the ion as well as the solubility of the membrane. It is very important to standardize at several points if measurements are typically in this range.

Choosing ion standardization points

You must standardize at a minimum of two points for the UP-25 meter to begin taking measurements. You should choose standards that bracket the concentration range of your samples. We would recommend using standards that are ten-fold apart. So if the expected concentration of your samples were between 15 and 50 ppm, we would recommend that you standardize at 10 ppm and 100 ppm. You can standardize up to three points. So if your sample range is from 15 ppm to 1500 ppm you should standardize at 10 ppm, 100 ppm and 1000 ppm. This meter can only take measurements from 0 to 99900 ppm. All standards values need to be below 99900.

Preparing your standards

Typically standard solutions are purchased at a higher concentration than is needed for standardization. Then dilutions are made, using volumetric pipettes and flasks, to the required concentrations. Generally ionic strength adjuster (ISA) is added to the standards and samples to speed up electrode response time, eliminate background noise, and adjust the pH to the desired range. Typically 1 mL of ISA should be added for every 50 mL of standard and sample.

Standardizing

After setting the value of the standards (see Using Setup in Ion Mode) it will be necessary to standardize the electrode. Place the electrode in the lowest concentration standard to be standardized. Typically the recommended storage solution for ion selective electrodes is the lowest concentration standard regularly measured so it should not take too much time for the electrode to stabilize. You can press "Mode" until mV is displayed to view the stability of the result. Follow the steps in the "Standardizing for Ion Measurement" section to complete standardization taking care to wait for a stable result before pressing the **Standardize** key.

Taking measurements

After standardization is complete, you are ready to take measurements. Add ISA to your sample(s). As soon as you put the electrode in the sample, measurements begin. The reading is stable when both the "S" icon appears and when the result is no longer changing. The meter displays three significant figures.

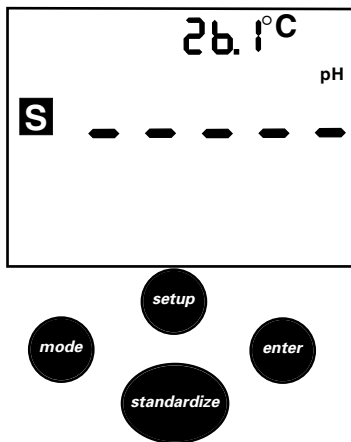
Errors

The most common errors in ion measurement are:

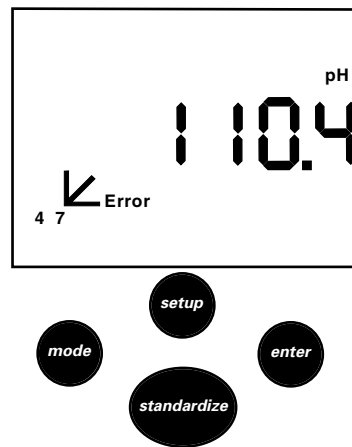
- Dilution errors
- Entering standards before the reading is stable
- Impurities in water and/or dirty glassware
- Improper care/storage of ISE

Troubleshooting

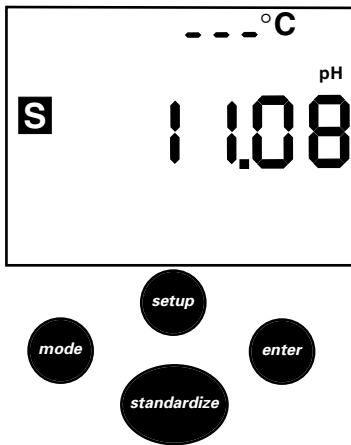
1. If the signal from the electrode is *out of range*, the display will show " - - - ". This may happen when the electrode is not in a solution.



2. The meter will display *Electrode Error* when it detects an error in electrode response. During pH standardization, the message indicates that the electrode is less than 90% or more than 105% of the correct response in pH mode. The *Electrode Error* message can indicate either a bad electrode or bad buffer(s).



3. If the meter detects an error in the temperature probe, the display shows " - - - ". If you do not use a temperature probe, the meter uses the default temperature of 25°C .

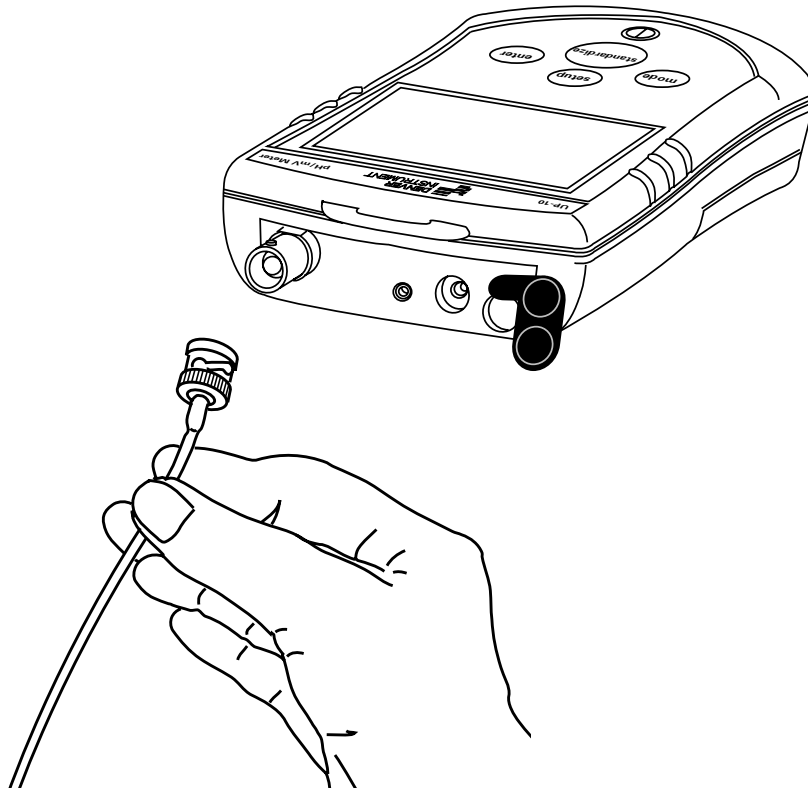


4. To test the pH electrode, place it in a good pH 7 buffer. Press **mode** to use the mV mode (UP-10 and UP-25 only), and note the millivolt reading. Make sure the meter is in mV mode and not relative mV mode. Repeat for either a pH 4 or pH 10 buffer. The electrode signal must be within the limits shown below (when temperature is near 25°C).

Electrode Test

pH 7	0 ± 30 mV
pH 4	159 to 186 mV more than pH 7
pH10	159 to 186 mV less than pH 7

5. To test the meter for correct operation, install the BNC (input) shorting cap. Press **mode** to select the mV mode (UP-10 and UP-25 only), and note the mV reading. Make sure the meter is in mV mode and not relative mV mode. If the meter reads 0 ± 0.3 mV, it is measuring correctly. Note that a long term drift of 0.1mV/month since last calibration is specified.



Accessories

You can order the following accessories for your pH meter:

Replacement UltraBasic pH electrode	301423.1
Plastic-body pH/ATC Electrode	300728.1
High-performance glass-body pH/ATC Electrode	300729.1
ATC Temperature Probe	300733.1
Free-standing Electrode Arm with Base	300401.1
Transformer, 115 V NA	102077.1

Other electrodes, such as ion selective electrodes and redox electrodes are also available. Call your sales representative.

Meter Specifications

pH	Range	0.000 to 14.00 pH
	Resolution	0.01 pH
	Accuracy	0.01 pH
	Standardization	1, 2 or 3 buffers
Auto buffer recognition		16 buffers 2, 4, 7, 10, 12 1, 3, 6, 8, 10, 13 1.68, 4.01, 6.86, 9.18, 12.46
mV (UP-10 & UP-25 only)	Range	-1800.0 to 1800.0 mV
	Resolution	0.1 mV
	Accuracy	0.2 mV or 0.05%, whichever is greater
Ion (UP-25 only)	Range	0.000 to 99900
	Resolution	3 sig figs
	Accuracy	0.34%
	Standardization	2 or 3 standards
Temperature	Range	-5.0 to 105.0°C
	Resolution	0.1°C
	Accuracy	0.4°C

Auto pH Temperature Compensation with ATC probe
Automatic pH electrode slope correction for 90-105%

Warranty Instructions

1. Please return the prepaid, pre-addressed Purchase Registration Card to Denver Instrument Company promptly upon your purchase of the Denver Instrument product. The return of the card is not a condition precedent to warranty coverage.
2. If you have any questions about a Denver Instrument product, please contact the nearest Denver Instrument office as listed below.
3. If it becomes necessary to return your Denver Instrument product for service, you must obtain a "Return Authorization Number". Please pack the product securely in its original approved packing carton or an other suitable container. Include your Return Authorization Number on the shipping label. Shipping charges must be fully prepaid.

Return to authorized distributor or :

North and South America:

Denver Instrument Company Service Center
6542 Fig Street
Arvada, Colorado 80004
Tel: 800.321.1135
Tel: 303.431.7255
Fax: 303.423.4831

U.K. and Ireland:

Denver Instrument Company
Denver House, Sovereign Way
Trafalgar Business Park
Downham Market
Norfolk PE38 9SW England
Tel: 44 136 63862 42
Fax: 44 136 63862 04

Europe, Asia and Australia:

Denver Instrument GmbH
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37079 Gottingen Germany
Tel: 49 551 20977 31
Fax: 49 551 20977 39

Disclaimers

You have purchased a quality precision meter that requires handling with care.

*Read entire contents of this **Operation Manual** prior to operating your new Denver Instrument meter.*

Important Notes:

IP-67 rating is valid only when AC cover is completely installed and securely in place.

The operator shall be responsible for any modifications to Denver Instrument Company equipment and for any connections of cables or equipment not supplied by Denver Instrument and must check and if necessary, correct these modifications and connections.

Changes or modifications not expressly approved by the manufacturer could void the product's warranty.



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