



YSI incorporated



YSI Model 63

**Handheld pH,
Conductivity,
Salinity and
Temperature
System**

**Operations
Manual**

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1. Introduction

The YSI Model 63 Handheld pH, Conductivity, Salinity and Temperature System is a rugged, micro-processor based, digital meter with an attached pH, conductivity and temperature probe. The pH sensor can be easily replaced in the field.

The Model 63 has a non-detachable cable available in lengths of 10, 25, 50 or 100 feet (3, 7.6, 15.2 or 30.5 meters). The probe body has been manufactured with stainless steel to add rugged durability and sinking weight.

The YSI Model 63 has the following features:

- Capability to measure at depths of up to 100 feet (30.5 meters)
- Microprocessor control
- Field replaceable low maintenance pH sensor
- Push-button calibration
- Simultaneous display of pH, conductivity or salinity and temperature
- Automatic temperature compensation for conductivity readings
- Autoranging
- Data storage for 50 sets of readings with on screen recall
- Waterproof case (IP65)

The Model 63's micro-processor allows the system to be easily calibrated with the press of a few keys. Additionally, the micro-processor performs a self-diagnostic routine each time the instrument is turned on. The self-diagnostic routine provides useful information about the function of the instrument and probe.

A transport chamber, built into the instrument case, provides a convenient place to store the probe when transporting the system. The Model 63 case is waterproof (rated to IP65) allowing operation in the rain without damage to the instrument.

The Model 63 is powered by six AA-size alkaline batteries. A new set of alkaline batteries will provide approximately 100 hours of continuous operation. When batteries need to be replaced, the LCD will display a **“LO BAT”** message.

The YSI Model 63 is designed for use in environmental, aquaculture, and industrial applications where accurate pH, conductivity, salinity and temperature measurements are desired.

2. Preparing the Meter

2.1 Unpacking

When you unpack your new YSI Model 63 Handheld pH, conductivity, salinity and Temperature System for the first time, check the packing list to make sure you have received everything you should have. If there is anything missing or damaged, call the dealer from whom you purchased the system. If you do not know which of our authorized dealers sold the system to you, call YSI Customer Service at 800-765-4974 or 937-767-7241, and we'll be happy to help you.

2.2 Warranty Card

Please complete the Warranty Card and return it to YSI. This will record your purchase of this instrument in our computer system. Once your purchase is recorded, you will receive prompt, efficient service in the event any part of your YSI Model 63 should ever need repair.

2.3 Batteries

There are a few things you must do to prepare your YSI Model 63 for use. First, locate the six AA-size alkaline batteries and the battery cover kit which were included. Then locate the markings inside each of the two battery-chamber sleeves that illustrate the correct way to install the batteries. Install the batteries as shown.

NOTE: It is very important that the batteries be installed ONLY as illustrated. The instrument will not function and may be damaged if the batteries are installed incorrectly.

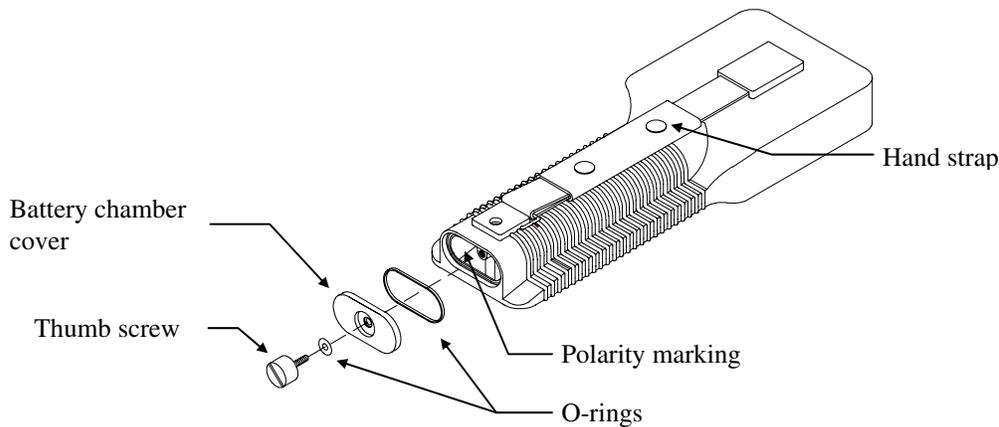


Figure 1

Attach the battery chamber cover to bottom of the instrument using the thumb screw as shown in Figure 1. Make sure that the o-rings are in place. The battery-chamber cover is marked with the words "OPEN" and "CLOSE."

Turn the instrument on by pressing and releasing the **ON/OFF** key on the front of the instrument. The liquid crystal display (LCD) should come on. Allow a few seconds for the instrument to complete its diagnostic routine. If the instrument does not operate, consult the chapter entitled *Troubleshooting*.

You may also want to take the instrument into a dark location and, with the instrument ON, hold down the **LIGHT** key. The instrument back-light should illuminate the LCD so that the display can be easily read.

2.4 Transport Chamber

The Model 63 has a convenient transport chamber built into the instrument's side. This chamber provides a storage area and protection for the probe while transporting the system in the field. Insert the round sponge (provided with the Model 63) into the bottom of the chamber. Put 6-8 drops of tap water into the sponge. The wet sponge creates a humid environment for the pH sensor to prevent it from drying out during transport in the field (up to one week). The transport chamber is NOT intended for long term storage of the pH sensor. See 6.3 *pH Sensor Storage*.

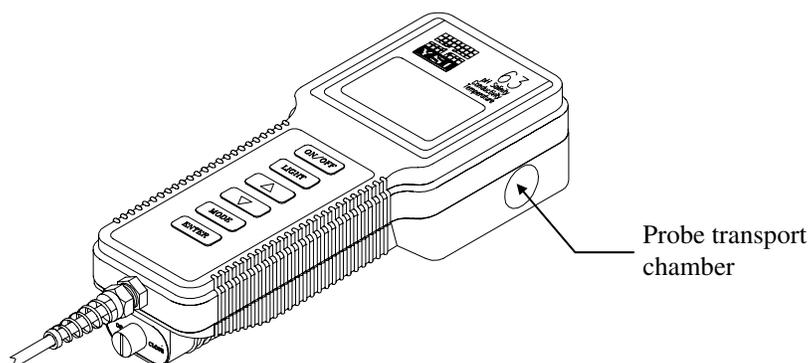


Figure 2

2.5 Hand Strap

The hand strap (see Figure 1 on previous page) is designed to allow comfortable operation of the Model 63 with minimum effort. If the hand strap is adjusted correctly, it is unlikely that the instrument will be easily dropped or bumped from your hand.

To adjust the hand strap on the back of the meter, unsnap the vinyl cover and pull the two Velcro strips apart. Place your hand between the meter and the strap and adjust the strap length so that your hand is snugly held in place. Press the two Velcro strips back together and snap the vinyl cover back into place.

2.6 The Meter Case

The meter case is sealed at the factory and is not intended to be opened, except by authorized service technicians. **Do not attempt to separate the two halves of the meter case as this may damage the instrument, break the water-resistant seal and may void the manufacturer's warranty.**

2.7 Calibration Vessels

To do a calibration you will need a plastic 100 mL graduated cylinder. A plastic container is provide with the Model 63. The graduated cylinder provides a convenient place to calibrate the pH sensor minimizing the amount of solution needed. The plastic container can be used as a conductivity calibration vessel or filled with distilled water and used as a rinse vessel while in the field. See section 4.2 *pH Calibration* and section 4.3 *Conductivity Calibration* for details.

3. Preparing the Probe

The YSI Model 63 is shipped without the pH sensor installed. The pH sensor must be installed before using the system (see section 3.1 *Installing the pH Sensor*, below). The sensor is shipped with a protective bottle filled with a mixture of pH 4 buffer and KCl solution. Do not remove the bottle until you are ready to use the instrument. Save the bottle for long term storage of the probe.

3.1 *Installing the pH Sensor*

A pH sensor is included with the Model 63. Install the pH sensor as follows:

1. Remove the sensor from its protective packing.
2. Insert the pH sensor into the probe body (be sure to align the tabs on the sensor with the slots in probe body) and twist 1/4 turn to lock in place. See *Figure 3*.

NOTE: Once installed, leave the pH sensor attached to the probe until replacement is needed.

3. Carefully remove the protective bottle (containing pH 4 buffer/KCl solution) from the sensor. Save the bottle and solution for long term (more than 1 week) storage of the sensor. Seal the storage bottle with the cap provided.
4. Rinse the sensor tip with distilled or deionized water.
5. **Calibrate the system before use.** See section 4.2 *pH Calibration*.

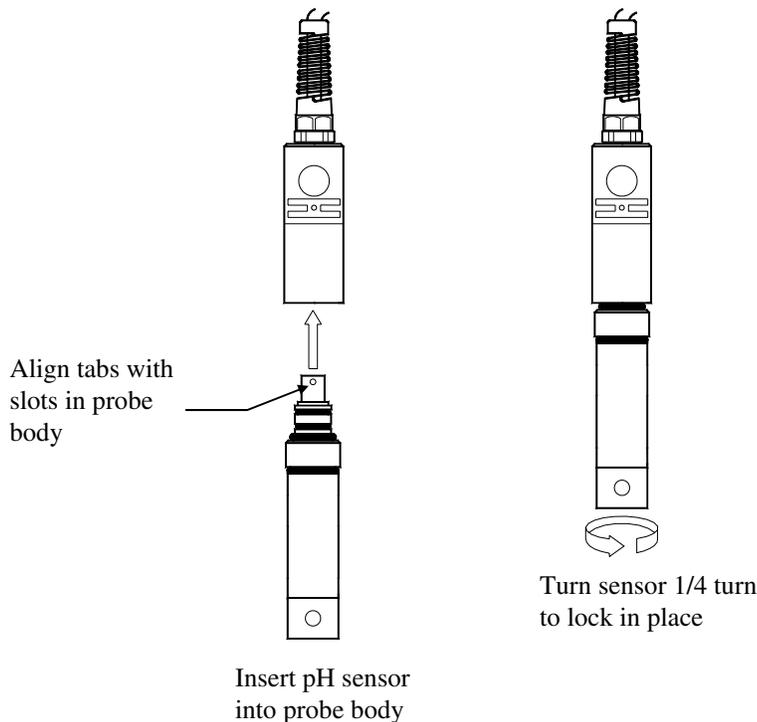


Figure 3

4. Operation

The following diagram is an overview of the operation of the Model 63. See the following sections for details of operation.

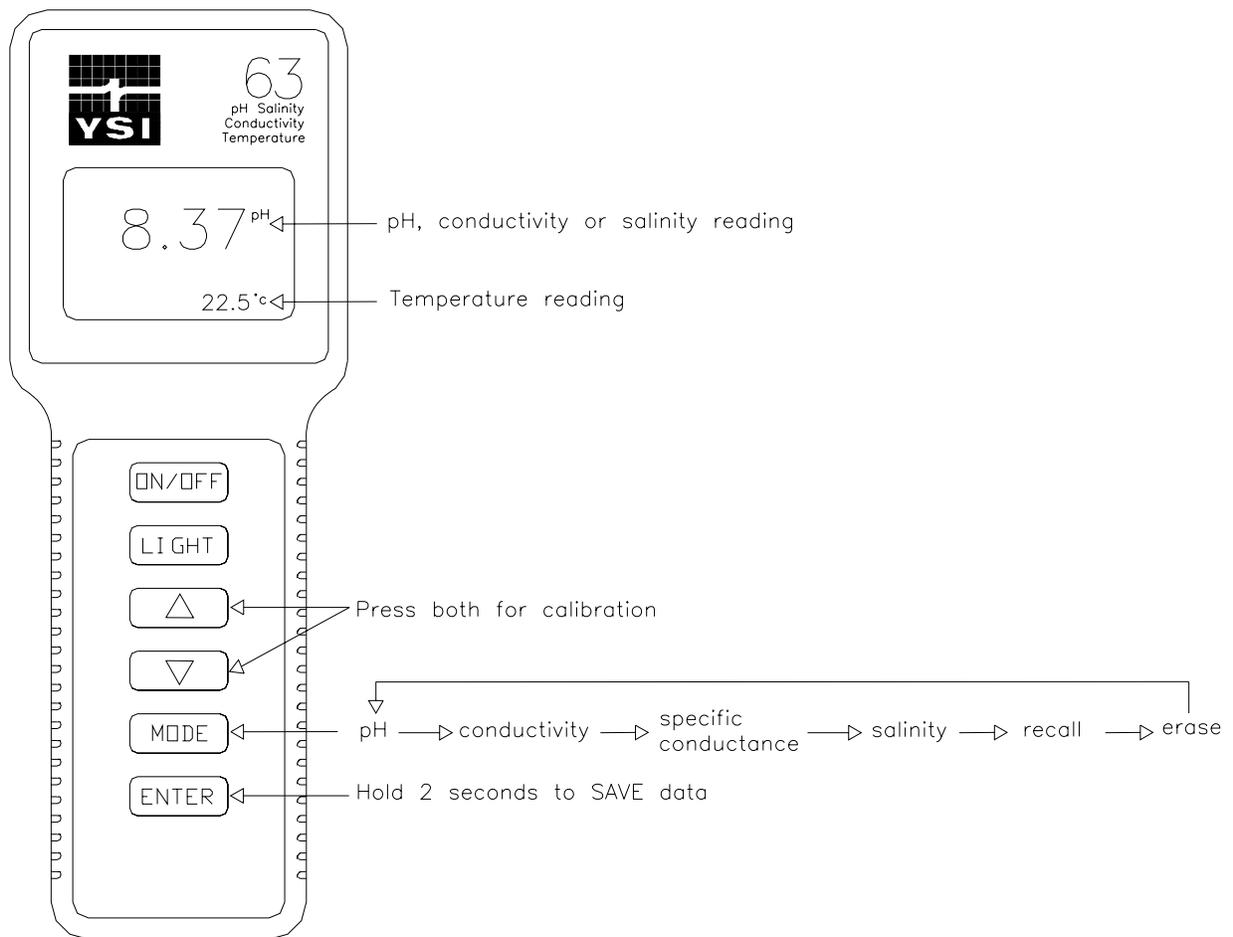


Figure 4

4.1 Turning The Instrument On

With the batteries installed correctly, press the **ON/OFF** key. The instrument will activate all segments of the display for a few seconds, which will be followed by a self test procedure which will last for several more seconds. The Model 63 will briefly display the cell constant of the conductivity probe when the self test is complete. During this power on self test sequence, the instrument's microprocessor is verifying that the system is working properly. If the instrument were to detect a problem, a **continuous** error message would be displayed. See the chapter entitled *Troubleshooting* for a list of error messages.



4.2 pH Calibration

The YSI Model 63 **MUST** be calibrated before making pH measurements. Calibration may be performed at 1, 2 or 3-points (at pH 7, 4 and 10, or at pH 6.86, 4.01 and 9.18). Perform a 1-point calibration (at pH 7 or at pH 6.86) **ONLY** if a previous 2 or 3-point calibration has been performed recently. In most cases, a 2-point pH calibration will be sufficient for accurate pH measurements, but if the general range of pH in the sample is not known, a 3-point calibration may be necessary. 3-point calibration assures accurate pH readings regardless of the pH value of the sample. See *9.1 pH* for more details.

WARNING: Calibration reagents may be hazardous to your health. Refer to *Appendix B - Health and Safety* for more information.

Before calibrating the YSI Model 63, complete the procedures discussed in the *Preparing the Meter* and *Preparing the Probe* chapters of this manual.

The user can choose from two sets of pH buffer values for 3-point calibration. The first set consists of the standard YSI pH buffer values of pH 7 (YSI 3822), pH 4 (YSI 3821) and pH 10 (YSI 3823). The second set available is the NIST pH 6.86, 4.01 and 9.18. **Note that the first calibration point must be either pH 7 or pH 6.86.** Calibration is performed as follows:

1. Turn the instrument on by pressing the **ON/OFF** key. Press the **MODE** key until pH is displayed.
2. Rinse the probe with deionized or distilled water, then carefully dry the probe (or rinse it with some of the pH buffer solution to be used for calibration).
3. Place 30 to 35 mL of the pH buffer you have chosen to calibrate the system with (pH 7 or 6.86) in the 100 mL graduated cylinder. The graduated cylinder minimizes the amount of solution needed. Immerse the probe making sure that both the pH and temperature sensors are covered by the solution (see *Figure 5* on the following page).

For best results:

- Calibrate as close as possible to the sample temperature.
- After storage in pH 4 buffer/KCl solution, place the pH sensor in pH 7 (6.86) buffer and allow to acclimate before calibrating (5 to 10 minutes).
- Always give the pH and temperature sensors enough time to equilibrate with the temperature of the buffer.

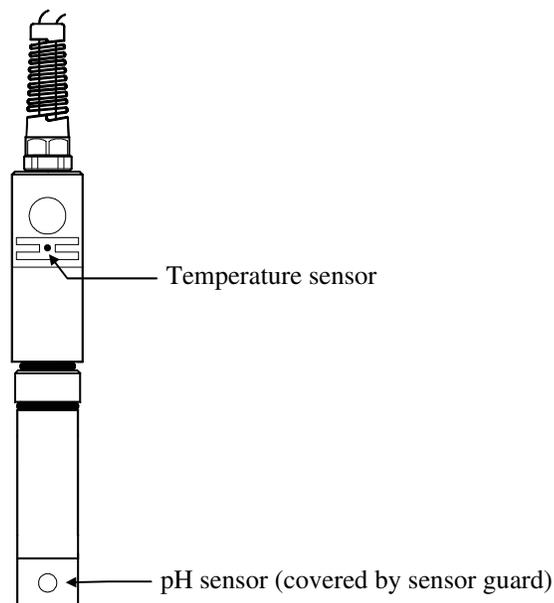
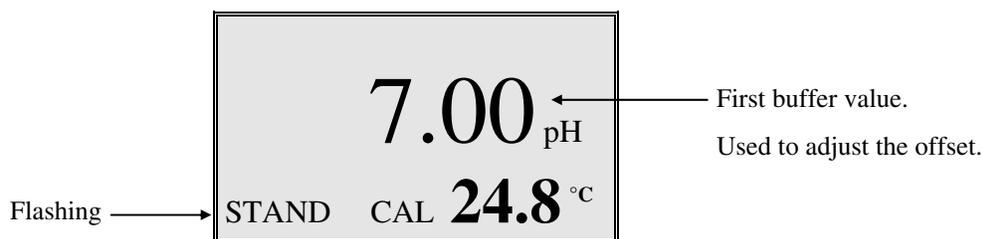


Figure 5

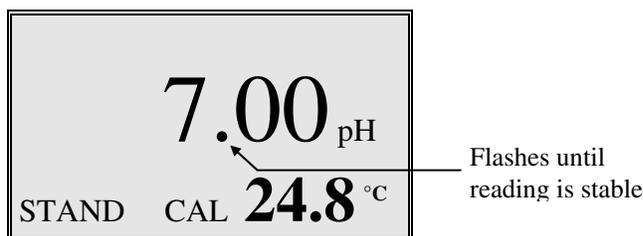
4. To enter the calibration menu, use two fingers to press and release both the **UP ARROW** and **DOWN ARROW** keys at the same time. The Model 63 display will show **CAL** at the bottom, **STAND** will be flashing and the pH reading will show **7.00** (the buffer to be used to adjust the offset).



NOTE: If you will be calibrating with pH buffers of 6.86, 4.01 and 9.18 (instead of 7, 4 and 10), press both the **UP ARROW** and **DOWN ARROW** keys again. The display will change to **6.86**.

NOTE: The Model 63 automatically accounts for the fact that the true pH of the buffers changes with temperature, therefore, the pH values displayed during calibration will vary with temperature. For example, pH 7 buffer at 20°C (rather than 25°C) has an actual pH of 7.02 and this number (rather than 7.00) will appear on the display when the probe is placed in the solution. See *Appendix C - pH Buffer Values*.

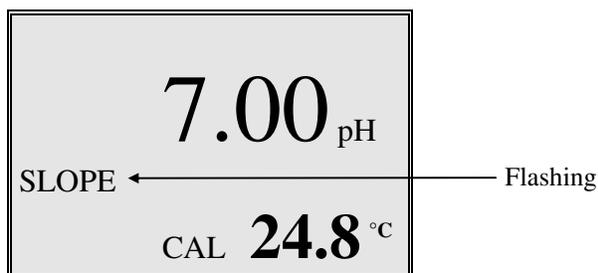
5. Press the **ENTER** key. The Model 63 display will show **CAL** at the bottom, **STAND** will stop flashing and the pH calibration value is shown with the middle decimal point flashing.



6. When the reading is stable (does not change by 0.01 pH in 10 seconds), the decimal point will stop flashing. Press and hold the **ENTER** key to save the calibration point. The Model 63 will flash **SAVE** on the display along with **OFS** to indicate that the offset value has been saved.



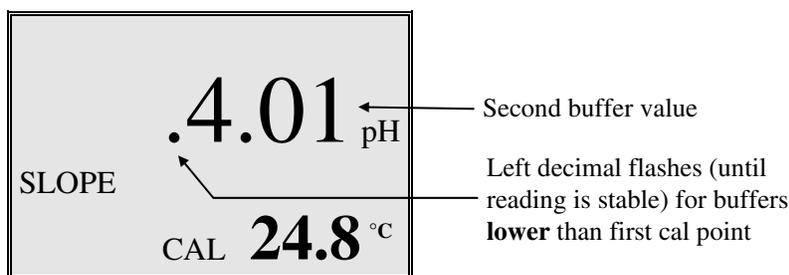
7. **SLOPE** will now appear on the display and be flashing. This indicates that the slope is ready to be set using a second pH buffer. The system is now calibrated at a single point. If you are only performing a single point calibration, press the **MODE** key to return to normal operation.



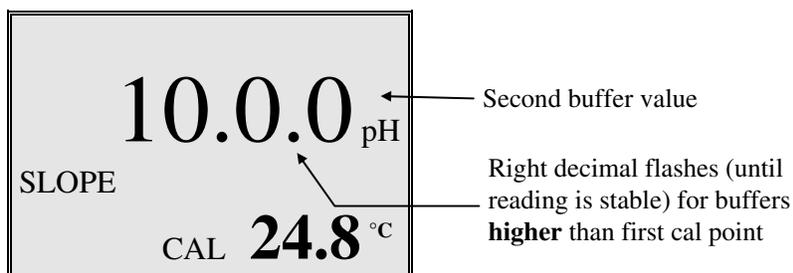
8. Rinse the probe with deionized or distilled water, then carefully dry the probe.

STOP HERE IF PERFORMING A 1-POINT CALIBRATION.

9. If you are performing a 2-point or 3-point calibration, fill a clean container with the second value pH buffer (pH 4 or 10, or pH 4.01 or 9.18) and immerse the probe into the solution. Make sure that the temperature sensor is immersed.
10. Press the **ENTER** key. The Model 63 should now show **CAL** at the bottom, **SLOPE** will stop flashing and the pH calibration value (automatically sensed by the instrument) is shown with one of the decimal points flashing.



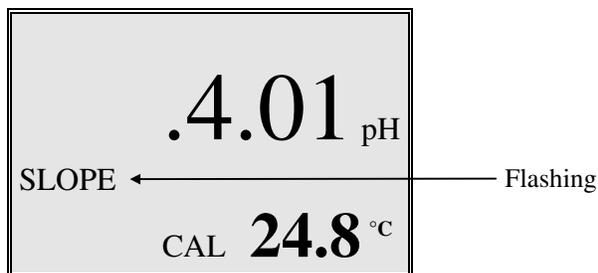
If the second pH buffer is less than the first buffer (which was used to adjust the offset; pH 7 or pH 6.86), the left decimal point will flash as shown above. If the second pH buffer is greater than the first, the right decimal point will flash as shown below.



11. When the reading is stable (does not change by 0.01 pH in 10 seconds), the decimal point will stop flashing. Press and hold the **ENTER** key to save the first SLOPE. The Model 63 will flash **SAVE** on the display along with **SLP** to indicate that the first slope value has been saved.



12. **SLOPE** will start flashing again indicating that the slope is ready to be set using a third pH buffer.



13. The system is now calibrated at two points. If you are only performing a two point calibration, press the **MODE** key to return to normal operation.

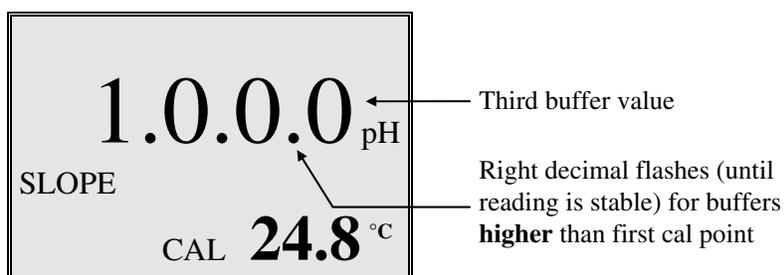
14. Rinse the probe with deionized or distilled water, then carefully dry the probe.

STOP HERE IF PERFORMING A 2-POINT CALIBRATION.

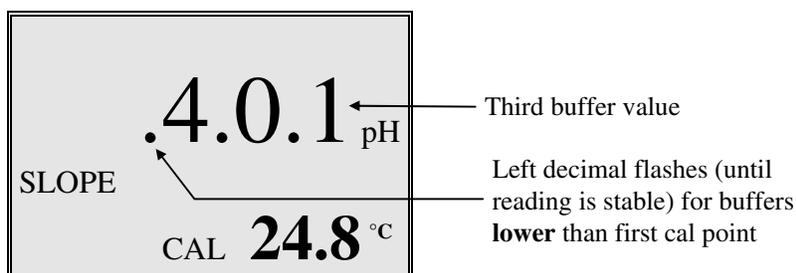
15. If you are performing a 3-point calibration, fill a clean container with the third value pH buffer (pH 4 or 10, or pH 4.01 or 9.18) and immerse the probe into the solution. Make sure that the temperature sensor is immersed.

NOTE: The third buffer must not be the same as the second buffer. For example; if the second buffer was less than pH 7, the third buffer must be greater than pH 7.

16. Press the **ENTER** key. The Model 63 display will now show **CAL** at the bottom, **SLOPE** will stop flashing and the pH calibration value (automatically sensed by the instrument) is shown with one of the decimal points flashing. If the third pH buffer is less than the first buffer (which was used to adjust the offset; usually pH 7), the left decimal point will flash. If the third pH buffer is greater than the first, the right decimal point will flash.



or



17. When the reading is stable (does not change by 0.01 pH in 10 seconds), the decimal point will stop flashing. Press and hold the **ENTER** key to save the second SLOPE. The Model 63 will flash **SAVE** on the display along with **SLP** to indicate that the second slope value has been saved.



The system is now calibrated at three points and will return to normal operation.

18. Rinse the probe with deionized or distilled water.

4.3 Conductivity Calibration

IMPORTANT: System calibration is rarely required because of the factory calibration of the YSI Model 63. However, from time to time it is wise to check the system calibration and make adjustments when necessary.

Prior to calibration of the YSI Model 63, it is important to remember the following:

1. Always use clean, properly stored, NIST traceable calibration solutions (see *12 Accessories and Replacement Parts*). When filling a calibration container prior to performing the calibration procedures, make certain that the level of calibrant buffers is high enough in the container to cover the entire probe. Gently agitate the probe to remove any bubbles in the conductivity cell.
2. Rinse the probe with distilled water (and wipe dry) between changes of calibration solutions.
3. During calibration, allow the probe time to stabilize with regard to temperature (approximately 60 seconds) before proceeding with the calibration process. The readings after calibration are only as good as the calibration itself.
4. Perform conductivity calibration at a temperature as close to 25°C as possible. This will minimize any temperature compensation error.

Follow these steps to perform an accurate calibration of the YSI Model 63:

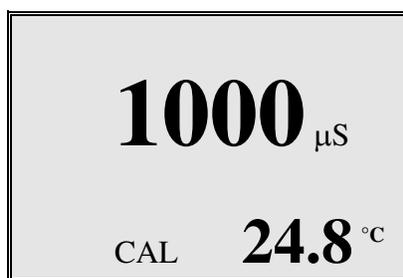
1. Turn the instrument on and allow it to complete its self test procedure.
2. Select a calibration solution which is most similar to the sample you will be measuring.
 - For sea water choose a 50 mS/cm conductivity standard (YSI Catalog# 3169)
 - For fresh water choose a 1 mS/cm conductivity standard (YSI Catalog# 3167)
 - For brackish water choose a 10 mS/cm conductivity standard (YSI Catalog # 3168)
3. Place at least 7 inches of solution in the plastic container or a clean glass beaker.

NOTE: Do NOT use the 100 mL graduated cylinder. The diameter of the cylinder is too small for accurate conductivity measurements.

4. Use the **MODE** key to advance the instrument to display conductivity.
5. Insert the probe into the solution deep enough to completely cover the probe. Both conductivity ports must be submerged (see *Figure 6* on the following page).
6. Allow at least 60 seconds for the temperature reading to become stable.
7. Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.
8. Press and release the **UP ARROW** and **DOWN ARROW** keys at the same time.

The **CAL** symbol will appear at the bottom left of the display to indicate that the instrument is now in Calibration mode.





9. Use the **UP ARROW** or **DOWN ARROW** key to adjust the reading on the display until it matches the value of the calibration solution you are using.
10. Once the display reads the exact value of the calibration solution being used (the instrument will make the appropriate compensation for temperature variation from 25°C), press the **ENTER** key. The word “**SAVE**” will flash across the display for a second indicating that the calibration has been accepted.

The YSI Model 63 is designed to retain its last conductivity calibration permanently. Therefore, there is no need to calibrate the instrument after battery changes or power down.

4.4 Making Measurements

After the system has been set-up and pH has been calibrated as described in *4.2 pH Calibration*, it is ready to make measurements. Simply insert the probe into the sample, shake gently to remove any trapped air bubbles and wait for the readings to stabilize (approximately 60 seconds). The first pH reading after storage in buffers may take longer to stabilize (5 to 10 minutes), therefore, the probe should be stored in the transport chamber when making field measurements. It is important that the probe be inserted into the sample far enough so that the pH, temperature and conductivity sensors are covered by the liquid (see *Figure 6*).

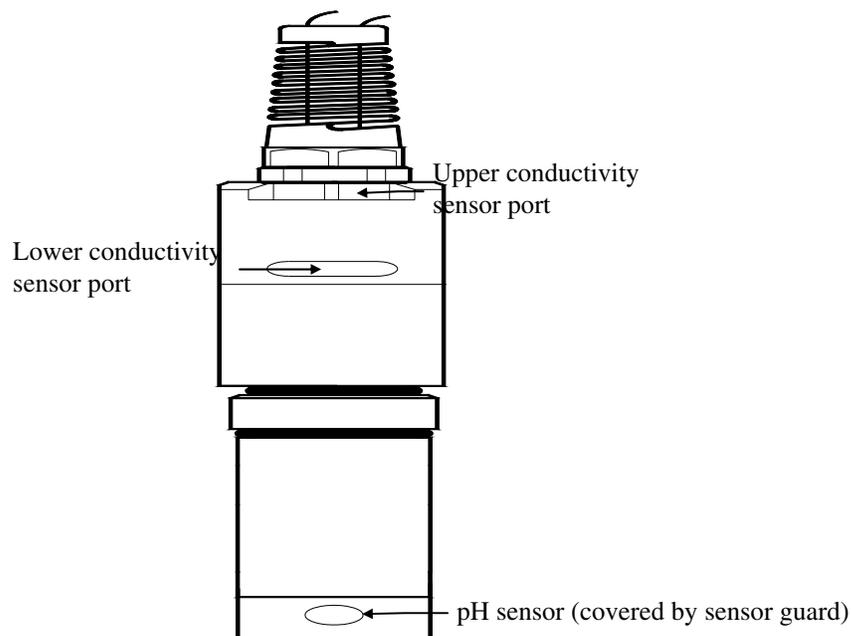
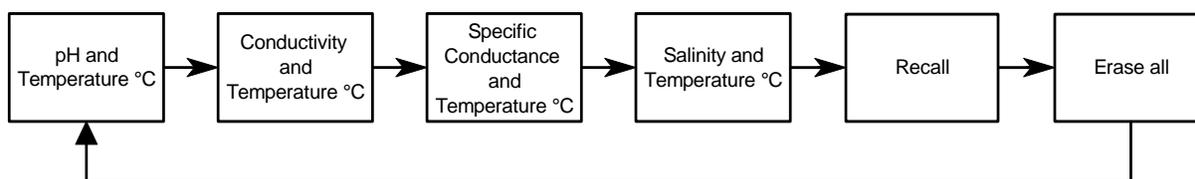


Figure 6

The Model 63 has six modes:

- **pH** -- Displays pH and temperature (°C).
- **Conductivity** -- A measurement of the conductive material in the liquid sample without regard to temperature. Also displays temperature (°C).
- **Specific Conductance** -- Also known as temperature compensated conductivity which automatically adjusts the reading to a calculated value which would have been read if the sample had been at 25° C (or some other reference temperature which you choose). See section 5 *Advanced Conductivity Setup*. Also displays temperature (°C).
- **Salinity**-- A calculation done by the instrument electronics, based upon the conductivity and temperature readings. Also displays temperature (°C).
- **Recall** -- Allows previously stored data to be displayed.
- **Erase all** -- Allows ALL previously stored data to be deleted.

To change between the Model 63 modes, simply press and release the **MODE** key. The Model 63 will cycle through the modes as follows:

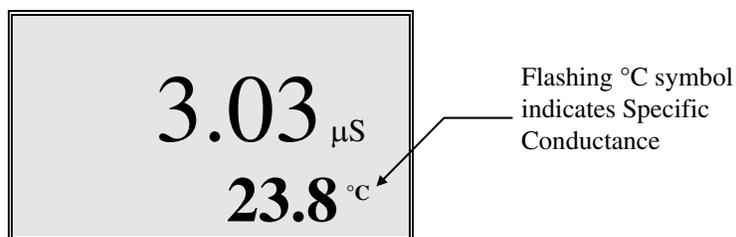


NOTE: When the Model 63 is turned off, it will “remember” which mode you used last and will return to that mode the next time it is turned on. If turned off while in recall or erase mode, it will default to pH mode when turned on.

To determine the current mode of the Model 63, carefully observe the small legends at the far right side of the LCD. If the instrument is reading **pH**, the large numbers on the display will be followed by **pH** as shown below.



If the instrument is reading **Conductivity**, (not temperature compensated) the large numbers on the display will be followed by either a **µS** or an **mS**. Additionally, the small portion of the display will show the ° C **NOT** flashing.



If the instrument is reading **Specific Conductance**, the large numbers on the display will be followed by either a **μS** or an **mS**. Additionally, the small portion of the display will show the **°C** flashing on and off.

If the instrument is reading **Salinity**, the large numbers on the display will be followed by a **ppt**.



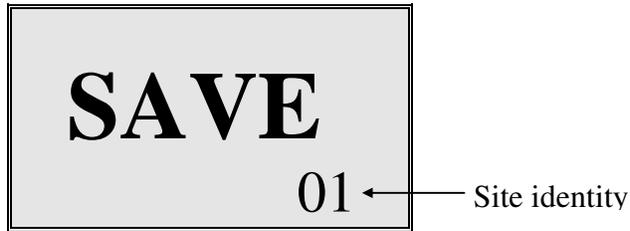
4.5 Autoranging & Range Searching

The YSI Model 63 is an autoranging instrument. This means that regardless of the conductivity or salinity of the solution (within the specifications of the instrument) all you need to do to get the most accurate reading is to put the probe in the sample. This feature makes the Model 63 as simple as possible to operate.

When you first place the Model 63 probe into a sample or calibration solution, and again when you first remove the probe the instrument will go into a range search mode that may take as long as 5 seconds. During some range searches the instrument display will flash **rANG** to indicate its movement from one range to another. The length of the range search depends on the number of ranges which must be searched in order to find the correct range for the sample. During the range search, the instrument will appear to freeze on a given reading for a few seconds then, once the range is located, will pinpoint the exact reading on the display. The display may also switch to **00.0** for a second or two during a range search before it selects the proper range.

4.6 Saving Data

The Model 63 is equipped with non-volatile memory that is capable of storing up to 50 different sets of readings. Non-volatile means that you do not need to worry that your data will be lost due to a power failure or interruption, such as when the batteries are removed. Each set consists of pH, conductivity, specific conductance, salinity and temperature. The Model 63 will also assign a site identity number to each set of readings to allow easy review of the data. This feature is useful in situations where transcribing data is difficult or not available.



While pH, conductivity, specific conductance or salinity is displayed on the screen, press the **ENTER** key and hold it for approximately 2 seconds. The meter will flash **SAVE** on the display along with the current site identity (1 through 50) being used.

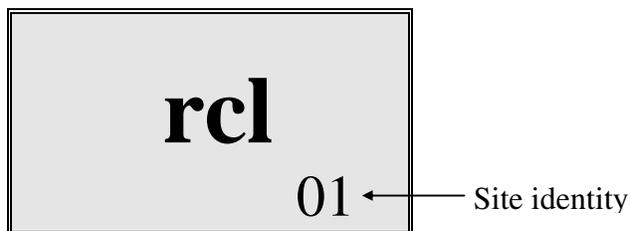
When all 50 sites are full, the display will flash **FULL** on the screen. This message will remain on the screen (even after power down) until a key is pushed.



Once you have acknowledged the memory is full, any subsequent saved data will begin overwriting existing data starting with site #1. No additional warning will be displayed.

4.7 Recalling Stored Data

1. To put the Model 63 into the **RECALL** mode, press the **MODE** key until “**rcl**” is displayed on the screen along with the site ID number in the lower right corner.



2. Press the **ENTER** key to review the last set of data that was saved. The Model 63 will display the pH and temperature. Another press of the **ENTER** key will display the conductivity and the temperature.
3. Depress the **ENTER** key again and again to review the specific conductance and salinity readings. All readings are displayed with the temperature.
4. Press the **UP ARROW** key to move up through the saved sets of data.
5. Press the **DOWN ARROW** key to move down through the saved sets of data.
6. When the correct Site ID# is displayed, press the **ENTER** key to display the data.

7. When you have finished recalling data, press **MODE** two times to return to normal operation.

NOTE: The Model 63 will recall data as a list. When the **UP ARROW** is pressed the Model 63 will display the Site ID# for the previously recorded data. For example: If you are reviewing Site ID# 5 and the **UP ARROW** is pressed, the Model 63 will display Site ID#4. If you are reviewing Site ID# 5 and Site ID# 5 was the last set of data stored, the **DOWN ARROW** key will display Site ID# 1.

Here is an example of the Model 63 memory.

Site ID #1
Site ID #2
Site ID #3 ←If the **UP ARROW** key was pressed the Model 63 would display Site ID #2
Site ID #4
Site ID #5

4.8 Erasing Stored Data

1. To erase the data that is stored in the Model 63's memory, press the **MODE** key until the Model 63 displays **ErAS** on the screen.
2. Press and hold the **DOWN ARROW** and **ENTER** keys simultaneously for approximately 5 seconds.



ErAS

3. Successful erasure is indicated by the Model 63 displaying **DONE** on the display for 1 to 2 seconds.



dOnE

The instrument will automatically change to pH mode after completion and the next saved data will be stored in site ID# 1.

IMPORTANT: Data in all 50 site ID's will be erased completely and will be lost forever. Do not use the erase function until all recorded data has been transcribed to an archive outside the Model 63.

4.9 Display Backlight

At times it may be necessary to take measurements with the Model 63 in dark or poorly lit areas. To help in this situation, the Model 63 comes equipped with a backlight which will illuminate the display so that it can be easily read. To activate the backlight, press and hold the **LIGHT** key. The display will remain lit as long as the key is pressed. When you release it, the light goes out to preserve battery life.

5. Advanced Conductivity Setup

The default settings of the YSI Model 63 are appropriate for the vast majority of measurement applications. However, some measurement applications require very specific measurement criteria. For that reason, we have made the YSI Model 63 flexible to accommodate these “advanced users.”

If, for example, you are using the YSI Model 63 for a process control application which requires that the conductivity readings be compensated to 20°C instead of 25°C -- this is the chapter to read. Or, if your application for the YSI Model 63 involves the measurement of a very specific saline solution, the default temperature coefficient may need to be changed to get the very best measurement of that specific salt.

IMPORTANT: There is never a need to enter Advanced Setup Mode unless your special measurement application calls for a change in reference temperature and or temperature coefficient. Therefore, unless you are certain that your application requires a change to one or both of these criteria, do not modify the default reference temperature (25°C) or the default temperature coefficient (1.91%).

NOTE: Changing the reference temperature or temperature coefficient does not affect salinity readings which are always referenced to seawater at 15°C. See 9.3 *Salinity* for details.

5.1 Changing The Temperature Coefficient

Follow these steps to modify the temperature coefficient of the Model 63.

1. Turn the instrument on and wait for it to complete its self test procedure.
2. Use the **MODE** key to advance the instrument to display conductivity.
3. Press and release both the **DOWN ARROW** and the **MODE** keys at the same time.

The **CAL** symbol will appear at the bottom left of the display. The large portion of the display will show **1.91 %** (or a value set previously using Advanced Setup).

4. Use the **UP ARROW** or **DOWN ARROW** key to change the value to the desired new temperature coefficient.
5. Press the **ENTER** key. The word “**SAVE**” will flash across the display for a second to indicate that your change has been accepted.
6. Press the **MODE** key to return to normal operation; the **CAL** symbol will disappear from the display.

5.2 Changing The Reference Temperature

Follow these steps to modify the reference temperature of the Model 63.

1. Turn the instrument on and wait for it to complete its self test procedure.
2. Use the **MODE** key to advance the instrument to display conductivity.
3. Press and release both the **DOWN ARROW** and the **MODE** keys at the same time.

The **CAL** symbol will appear at the bottom left of the display. The large portion of the display will show **1.91 %** (or a value set previously using Advanced Setup).

4. Press and release the **MODE** key; the large portion of the display will show **25.0C** (or a value set previously using Advanced Setup).
5. Use the **UP ARROW** or **DOWN ARROW** key to change the value to the desired new reference temperature (any value between 15°C and 25°C is acceptable).
6. Press the **ENTER** key. The word “**SAVE**” will flash across the display for a second to indicate that your change has been accepted.
7. The instrument will automatically return to normal operation mode.

5.3 Changing Conductivity From Autoranging To Manual Ranging

If your application is easier to perform using a manual range which you select, the YSI Model 63 allows you to turn off the default autoranging feature. While you are making conductivity or temperature compensated conductivity measurements, simply press and release the **UP ARROW** key. Each additional press of the **UP ARROW** key will cycle the Model 63 to a different manual range until you return again to autoranging. Five pushes of the **UP ARROW** key will cycle the Model 63 through the four manual ranges and return the instrument to autoranging.

NOTE: You may see an error message in some manual ranges if the manual range selected is not adequate for the sample you are measuring. If this happens, simply press and release the **UP ARROW** key again until a range is selected which is suitable for your sample. If you get lost and don't know if you're in a manual range or autoranging, simply turn the instrument off and back on. Also note that the conductivity units will flash while you are in manual range. The instrument will always default to autoranging when first turned on.

The four conductivity ranges of the YSI Model 63 are:

Range 1	Range 2	Range 3	Range 4
0 to 499.9 μ S/cm	0 to 4999 μ S/cm	0 to 49.99 mS/cm	0 to 200.0 mS/cm

6. Maintenance

6.1 *pH Sensor Precautions*

1. When making measurements or performing the calibration procedure, make certain that the level of sample or pH buffer is high enough to cover both the pH and temperature sensors.
2. Rinse the probe with deionized water between changes of calibration buffer solutions.
3. During pH calibration, allow the sensors time to stabilize with regard to temperature (approximately 60 seconds) before proceeding with the calibration protocol. The pH readings after calibration are only as good as the calibration itself.
4. Clean and store the probe according to the instructions found below.

6.2 *pH Sensor Cleaning*

Cleaning is required whenever deposits or contaminants appear on the glass pH sensor. Unscrew and remove the small guard that protects the pH sensor. Use tap water and a clean cloth or lens cleaning tissue to remove all foreign material from the glass sensor.

If good pH response is not restored by the above procedure, perform the following additional procedure:

1. Soak the probe for 10 to 15 minutes in clean water containing a few drops of commercial dishwashing liquid.
2. GENTLY clean the glass bulb by rubbing with a cotton swab soaked in the cleaning solution.
3. Rinse the probe in clean water, wipe with a cotton swab saturated with clean water, and then rerinse with clean water.

If good pH response is still not restored by the above procedure, perform the following additional procedure:

1. Soak the pH sensor for 5 minutes in one molar (1 M) hydrochloric acid (HCl).
2. GENTLY clean the glass bulb by rubbing with a cotton swab soaked in the acid.
3. Rinse the probe in clean water, wipe with a cotton swab saturated with clean water, and then rerinse with clean water.
4. Reinstall the small guard that protects the pH sensor.

If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following additional cleaning step:

1. Soak the probe for approximately 1 hour in a 1 to 1 dilution of commercially-available chlorine bleach.
2. Rinse the probe with clean water and then soak for 1 hour in clean water to remove residual bleach from the junction.

6.3 pH Sensor Storage

For short term storage between measurements in the field (up to one week), place the probe in the transport chamber in the side of the instrument case. Make sure that the sponge inside the chamber is wet (tap water).

For long term storage (over one week), place the probe in the storage bottle (provided) containing a mixture of 50% pH 4 buffer and 50% 1.5M KCl. This will assure the fastest possible pH response. If this mixture is not available, storage in tap water is the next best choice. **Do NOT store the probe dry or in distilled or deionized water.**

NOTE: After storage in the pH 4/KCl solution described above, place the probe in the transport chamber in the side of the instrument case or soak the probe in pH 7 buffer for 5 to 10 minutes allowing it to acclimate before calibrating.

If the probe has been inadvertently left in air and the reference electrode junction has dried out, good function can usually be restored by soaking the probe in the pH 4/KCl solution described above.

6.4 Conductivity Sensor Cleaning

The single most important requirement for accurate and reproducible results in conductivity measurement is a clean cell. A dirty cell will change the conductivity of a solution by contaminating it.

NOTE: Always rinse the conductivity cell with clean water after each use.

To clean the conductivity cell:

1. Dip the cell in cleaning solution and agitate for two to three minutes. Any one of the foaming acid tile cleaners, such as Dow Chemical Bathroom Cleaner, will clean the cell adequately. When a stronger cleaning preparation is required, use a solution of 1:1 isopropyl alcohol and one molar (1 M) hydrochloric acid (HCl). Remove the cell from the cleaning solution.
2. Use the nylon brush (supplied) to dislodge any contaminants from inside the electrode chamber.
3. Repeat steps one and two until the cell is completely clean. Rinse the cell thoroughly in deionized, or clean tap water.

7. Discussion of Measurement Errors

7.1 pH Errors

There are two basic types of pH errors. The first type are errors related to limitations of instrument design and tolerances of components. The second type are errors due to basic sensor accuracy tolerances, mainly background signal, linearity, and variations in temperature coefficient. It is unlikely that the actual error in any measurement will be the maximum possible error.

Errors

- Component and circuitry error: ± 0.03 pH
- pH error caused by sensor accuracy and temperature compensation:
 - ± 0.1 pH for measurements at 10°C from calibration temperature
 - ± 0.2 pH for measurements at 20°C from calibration temperature

7.2 Conductivity Errors

System accuracy for conductivity measurements is equal to the sum of the errors contributed by the environment and the various components of the measurement setup. These include:

- Instrument accuracy
- Cell-constant error
- Solution temperature offset
- Cell contamination (including air bubbles)
- Electrical noise
- Galvanic effects

Only the first three are of major concern for typical measurements, although the user should also be careful to see that cells are clean and maintained in good condition at all times.

Instrument Accuracy = $\pm .5\%$ maximum

The accuracy specified for the range being used is the worst case instrument error.

Cell-Constant Error = $\pm .5\%$ maximum

Although YSI cells are warranted to be accurate to within one percent, you should still determine the exact cell constant of your particular cell. Contamination or physical damage to the cell can alter the cell constant. Performing a calibration will eliminate any error which might arise because of cell constant change.

YSI cells are calibrated to within one percent of the stated cell constant at a single point. We consider these products to be usefully linear over most instrument ranges. The cell constant can be calibrated to $\pm 0.35\%$ accuracy with YSI conductivity calibrator solutions.

Temperature Error = $\pm 1\%$ maximum

The solution temperature error is the product of the temperature coefficient and the temperature offset from 25°C, expressed as a percentage of the reading that would have been obtained at 25°C. The error is not necessarily a linear function of temperature. The statement of error is derived from a 25°C temperature offset and a 3%/°C temperature coefficient.

Total Error

Considering only the above three factors, system accuracy under worst case conditions will be $\pm 2\%$, although the actual error will be considerably less if recommended and properly calibrated cells and instrument ranges are used. Additional errors, which can essentially be eliminated with proper handling, are described below.

Cell Contamination

This error is usually due to contamination of the solution being measured, which occurs when solution is carried-over from the last solution measured. Thus, the instrument might be correctly reporting the conductivity seen, but the reading does not accurately represent the value of the bulk solution. Errors will be most serious when low conductivity solutions are contaminated by carry-over from high conductivity solutions, and can then be of an order of magnitude or more.

Follow the cleaning instructions carefully before attempting low conductivity measurements with a cell of unknown history or one that has been previously used in higher value solutions.

An entirely different form of contamination sometimes occurs due to a buildup of foreign material directly on cell electrodes. While rare, such deposits have, on occasion, markedly reduced the effectiveness of the electrodes. The result is an erroneously low conductance reading.

Electrical-Noise Errors

Electrical noise can be a problem in any measurement range, but will contribute the most error and be the most difficult to eliminate when operating in the lowest ranges. The noise may be either line-conducted or radiated or both, and may require, grounding, shielding, or both.

Galvanic and Miscellaneous Effects

In addition to the error sources described above, there is another class of contributors that can be ignored for all but the most meticulous of laboratory measurements. These errors are always small and are generally completely masked by the error budget for cell-constant calibration, instrument accuracy, etc. Examples range from parasitic reactances associated with the solution container and its proximity to external objects to the minor galvanic effects resulting from oxide formation or deposition on electrodes. Only trial and error in the actual measurement environment can be suggested as an approach to reduce such errors. If the reading does not change as the setup is adjusted, errors due to such factors can be considered too small to see.

8. Troubleshooting

Error Messages

The instrument performs a Power On Self Test each time it is turned on. The following error messages are provided to facilitate troubleshooting. They appear on the LCD when an error is detected.

Symptom	Possible Cause	Action
1. Instrument will not turn on	<ul style="list-style-type: none"> • Low battery voltage • Batteries installed wrong • Meter requires service 	<ul style="list-style-type: none"> • Replace batteries (pg 2) • Check battery polarity (pg 2) • Return system for service (pg 29)
2. Instrument "locks up"	<ul style="list-style-type: none"> • Instrument has received a shock • Batteries are low or damaged • System requires service 	<ul style="list-style-type: none"> • Remove battery lid, wait 15 seconds for reset, replace lid. (pg 2) • Replace batteries (pg 2) • Return system for service (pg 29)
3. Conductivity will not calibrate	<ul style="list-style-type: none"> • Conductivity standards out of spec. • Conductivity cell is contaminated 	<ul style="list-style-type: none"> • Recalibrate with known good standards (pg 11) • Clean conductivity cell (pg 20)
4. pH will not calibrate due to unstable readings (decimal point keeps flashing)	<ul style="list-style-type: none"> • pH sensor is fouled • pH sensor is bad • System requires service 	<ul style="list-style-type: none"> • Clean pH sensor (pg 20) • Replace pH sensor (pg 4, 33) • Return system for service (pg 29)
5. pH readings are inaccurate	<ul style="list-style-type: none"> • Calibration is required • pH calibration buffers out of spec • Calibration procedure not correct • Sample temperature is over 20°C from calibration temperature • pH sensor is fouled or damaged • pH Sensor is bad • System requires service 	<ul style="list-style-type: none"> • Recalibrate with known good standards (pg 6) • Calibrate within $\pm 20^{\circ}\text{C}$ of sample temp ($\pm 10^{\circ}\text{C}$ for best results) • Clean pH sensor (pg 20) • Replace pH sensor (pg 4, 33) • Return system for service (pg 29)
6. Conductivity readings are inaccurate	<ul style="list-style-type: none"> • Cell is contaminated • Calibration is required • Temperature coefficient is set incorrectly • Reference temperature is set incorrectly • Readings are or are not temperature compensated. 	<ul style="list-style-type: none"> • Clean conductivity cell (pg 21) • See <i>Conductivity Calibration</i> (pg 11) • See <i>Changing The Temperature Coefficient</i> (pg 18) • See <i>Changing The Reference Temperature</i> (pg 19) • See <i>Making Measurements</i> (pg 12)
7. LCD displays "LO BAT"	<ul style="list-style-type: none"> • Batteries are low or damaged • System requires service 	<ul style="list-style-type: none"> • Replace batteries (pg 2) • Return system for service (pg 29)
8. Main Display reads "nOnE"	<ul style="list-style-type: none"> • During recall, no data is currently stored in memory. 	<ul style="list-style-type: none"> • Store data before attempting to recall (pg 14)
9. pH Display reads "OVER"	<ul style="list-style-type: none"> • When calibrating: pH level is over range allowed for the buffer value selected. • When measuring, pH level is > 14 	<ul style="list-style-type: none"> • Recalibrate with known good standards (pg 6) • Clean pH sensor (pg 20) • Replace pH sensor (pg 4, 33) • Return system for service (pg 29)

Symptom	Possible Cause	Action
10. Conductivity/Salinity Display reads "OVER"	<ul style="list-style-type: none"> When calibrating: User cell constant cal K is >5.25 When measuring: Conductivity reading is >200 mS Salinity reading is >80 ppt 	<ul style="list-style-type: none"> Recalibrate with known good standards (pg 11) Clean conductivity cell (pg 21) Return system for service (pg 29)
11. pH Display reads "undr"	<ul style="list-style-type: none"> When calibrating, pH level is under range allowed for the buffer value selected. When measuring, pH level is < 0 	<ul style="list-style-type: none"> Recalibrate with known good standards (pg 6) Clean pH sensor (pg 20) Replace pH sensor (pg 4, 33) Return system for service (pg 29)
12. Conductivity Display reads "undr"	<ul style="list-style-type: none"> User cell constant cal K is <4.9 	<ul style="list-style-type: none"> Recalibrate with known good standards (pg 11) Clean conductivity cell (pg 21) Return system for service (pg 29)
13. Main Display reads "OVER" (Secondary display reads "ovr")	<ul style="list-style-type: none"> Temperature reading is >75°C 	<ul style="list-style-type: none"> Measure samples at a temperature within the range of the system.
14. Main Display reads "undr" (Secondary display reads "udr")	<ul style="list-style-type: none"> Temperature reading is <-5°C 	<ul style="list-style-type: none"> Measure samples at a temperature within the range of the system.
15. Main display reads "PErr"	<ul style="list-style-type: none"> User cell constant cal K is 0.0 Incorrect sequence of keystrokes. 	<ul style="list-style-type: none"> See "Advanced Setup" chapter (pg 18) Refer to manual section for step by step instruction for the function you are attempting.
16. Main display reads "LErr"	<ul style="list-style-type: none"> In temperature compensated conductivity mode, temperature exceeds the values computed using user defined temperature coefficient and/or reference temperature. In cell constant cal mode, temperature exceeds the values computed using user defined temperature coefficient and/or reference temperature. 	<ul style="list-style-type: none"> Adjust user defined temperature coefficient or reference temperature. (pg 18)
17. Main display reads "Err" (Secondary display reads "ra")	<ul style="list-style-type: none"> System has failed its RAM test check procedure. 	<ul style="list-style-type: none"> Turn instrument OFF and back ON again. Return the system for service (pg 29)
18. Main display reads "Err" (Secondary display reads "ro")	<ul style="list-style-type: none"> System has failed its ROM test check procedure. 	<ul style="list-style-type: none"> Turn instrument OFF and back ON again. Return the system for service (pg 29)
19. Main display reads "FAIL" (Secondary display reads "eep")	<ul style="list-style-type: none"> EEPROM has failed to respond in time. 	<ul style="list-style-type: none"> Return the system for service (pg 29)
20. Readings on main display don't change	<ul style="list-style-type: none"> Meter is in recall mode. 	<ul style="list-style-type: none"> Press MODE key to return to Normal Operation (pg 5, 12)

9. Principles of Operation

9.1 pH

The YSI Model 63 employs a field replaceable pH sensor for the determination of hydrogen ion concentration. The sensor is a combination electrode consisting of a proton selective glass reservoir filled with buffer at approximately pH 7 and a Ag/AgCl reference electrode which utilizes gelled electrolyte. A silver wire coated with AgCl is immersed in the buffer reservoir. Protons (H⁺ ions) on both sides of the glass (media and buffer reservoir) selectively interact with the glass, setting up a potential gradient across the glass membrane. Since the hydrogen ion concentration in the internal buffer solution is invariant, this potential difference, determined relative to the Ag/AgCl reference electrode, is proportional to the pH of the media.

Our testing of the Model 63 pH sensor indicates that it should provide long life, good response time and accurate readings in most environmental waters, including fresh water of low ionic strength. No special sensor is required (nor offered) for water of low conductivity.

pH Calibration And Effect Of Temperature

The software of the YSI Model 63 calculates pH from the established linear relationship between pH and the millivolt output as defined by a variation of the Nernst equation:

$$E = E_0 + \frac{2.3RT}{nF} * \text{pH}$$

where E = millivolts output
E₀ = a constant associated with the reference electrode
T = temperature of measurement in degrees Kelvin
R, n, and F are invariant constants

Thus, in simplified $y = mx + b$ form, it is (mv output) = (slope)x(pH) + (intercept). In order to quantify this simple relationship, the instrument must be calibrated properly using buffers of known pH values. In this procedure, the millivolt values for two standard buffer solutions are experimentally established and used by the YSI Model 63 software to calculate the slope and intercept of the plot of millivolts vs. pH. Once this calibration procedure has been carried out, the millivolt output of the probe in any media can readily be converted by the YSI Model 63 software into a pH value, *as long as the calibration and the reading are carried out at the same temperature*. This last qualifier is almost never met in actual environmental measurements, thus, a mechanism must be in place to compensate for temperature or, in other words, to accurately convert the slope and intercept of the plot of pH vs. millivolts established at T_c (temperature of calibration) into a slope and intercept at T_m (temperature of measurement). Fortunately, the Nernst equation provides a basis for this conversion.

According to the Nernst equation as shown above, the slope of the plot of pH vs. millivolts is *directly proportional* to the absolute temperature in degrees Kelvin. Thus, if the slope of the plot is experimentally determined to be 59 mv/pH unit at 298 K (25 C), then the slope of the plot at 313 K (40 C) must be (313/298) * 59 = 62 mv/pH unit. At 283 K (10 C), the slope is calculated to be 56 mv/pH unit ((283/298) * 59). Determination of the slope of pH vs. mv plots at temperatures different from T_c is thus relatively simple. In order to establish the intercept of the new plot, the point where plots of pH vs. mv at different temperatures intersect (the isopotential point) must be known. Using standard pH determination protocol, the YSI Model 63 software assigns the isopotential point as the mv reading at pH 7 and then calculates the intercept using

this assumption. Once the slope and intercept to the plot of pH vs. mv are assigned at the new temperature, the calculation of pH under the new temperature conditions is straightforward, and is automatically carried out by the software.

Number of pH Calibration Points

When calibrating the YSI Model 63, you have the choice of 1-point 2-point, or 3-point calibration. **Perform a 2 or 3 point calibration at least once per day for accurate results.**

Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously (at least once per day), you can adjust the calibration by carrying out a 1-point calibration at pH 7 (or pH 6.86). This calibration procedure adjusts only the pH offset and leaves the previously-determined slope unaltered.

Select the **2-point** option to calibrate the pH probe using only two calibration standards. In this procedure, the pH sensor is calibrated using a pH 7 (or pH 6.86) buffer and *one additional* buffer. A two point calibration procedure (as opposed to a 3-point procedure) can save time if the pH of the sample is known to be either basic or acidic. For example, if the pH of a sample is known to vary between 5.5 and 7, a two point calibration with pH 7 and pH 4 buffers is appropriate. Three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.

Select the **3-point** option to calibrate the pH probe using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 (or pH 6.86) buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated.

9.2 Conductivity

The conductivity cell utilizes four pure nickel electrodes for the measurement of solution conductance. Two of the electrodes are current driven, and two are used to measure the voltage drop. The measured voltage drop is then converted into a conductance value in milli-Siemens (millimhos). To convert this value to a conductivity (specific conductance) value in milli-Siemens per cm (mS/cm), the conductance is multiplied by the cell constant which has units of reciprocal cm (cm^{-1}). The cell constant for the Model 63 conductivity cell is $5.0/\text{cm} \pm 4\%$. For most applications, the cell constant is automatically determined (or confirmed) with each deployment of the system when the calibration procedure is followed. Solutions with conductivity's of 1.00, 10.0, 50.0, and 100.0 mS/cm, which have been prepared in accordance with recommendation 56-1981 of the Organisation Internationale de Métrologie Légale (OIML) are available from YSI. The instrument output is in $\mu\text{S}/\text{cm}$ or mS/cm for both conductivity and specific conductance. The multiplication of cell constant times conductance is carried out automatically by the software.

Temperature Effect On Conductivity

The conductivity of solutions of ionic species is highly dependent on temperature, varying as much as 3% for each change of one degree Celsius (temperature coefficient = 3%/C). In addition, the temperature coefficient itself varies with the nature of the ionic species present.

Because the exact composition of a natural media is usually not known, it is best to report a conductivity at a particular temperature, e.g. 20.2 mS/cm at 14 C. However, in many cases, it is also useful to compensate for the temperature dependence in order to determine at a glance if gross changes are occurring in the ionic content of the medium over time. For this reason, the Model 63 software also allows the user to output conductivity data in either raw or temperature compensated form. If "Conductivity" is selected, values of conductivity which are **NOT** compensated for temperature are output to the display. If "Specific Conductance" is selected, the Model 63 uses the temperature and raw conductivity values associated with each determination to generate a specific conductance value compensated to a user selected reference temperature (see *Advanced Setup*) between 15 C and 25 C. Additionally the user can select any temperature coefficient from 0% to 4% (see *Advanced Setup*). Using the Model 63 default reference temperature and temperature coefficient (25 C and 1.91%), the calculation is carried out as in the equation below:

$$\text{Specific Conductance (25°C)} = \frac{\text{Conductivity}}{1 + \text{TC} * (\text{T} - 25)}$$

As noted above, unless the solution being measured consists of pure KCl in water, this temperature compensated value will be somewhat inaccurate, but the equation with a value of TC = 0.0191 will provide a close approximation for solutions of many common salts such as NaCl and NH₄Cl and for seawater.

9.3 Salinity

Salinity is determined automatically from the Model 63 conductivity and temperature readings according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (ed. 1995). The use of the Practical Salinity Scale 1978 results in values which are unitless, since the measurements are carried out in reference to the conductivity of standard seawater at 15°C. However, the unitless salinity values are very close to those determined by the previously-used method where the mass of dissolved salts in a given mass of water (parts per thousand) was reported. Hence, the designation "ppt" is reported by the instrument to provide a more conventional output.

For further information on conductivity and the above standard information, refer to the ASTM document, *Standard Methods of Test for Electrical Conductivity of Water and Industrial Wastewater*, ASTM Designation D1125-82, and OIML *Recommendation Number 56*. ASTM symbols for conductivity, cell constant, and path length differ from those preferred in the general literature and also from those used in this manual.

9.4 Temperature

The YSI Model 63 system utilizes a thermistor which changes predictably in resistance with temperature variation. The algorithm for conversion of resistance to temperature is built-in to the Model 63 software, and accurate temperature readings, in degrees Celsius, are provided automatically. No calibration or maintenance of the temperature sensor is required.

10. Warranty and Repair

YSI Model 63 Meters are warranted for two years from date of purchase by the end user against defects in materials and workmanship. YSI Model 63 probes, cables and sensors are warranted for one year from date of purchase by the end user against defects in material and workmanship. Breakage of pH sensors is NOT covered under warranty. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

YSI Authorized Service Centers

Please visit www.ysi.com or contact YSI Technical Support for the nearest authorized service center.

YSI Incorporated • Technical Support • Phone: +1 937 767-7241 • 800 897-4151 • Fax: 937 767-1058 • Email: environmental@ysi.com

10.1 Cleaning Instructions

NOTE: Before they can be serviced, equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, or with waste water. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification has been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at YSI, the following steps must be taken to insure the safety of our service personnel.

- 1.** In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4 cup bleach to 1 gallon tap water are suitable for most disinfecting. Instruments used with waste water may be disinfected with .5% Lysol if this is more convenient to the user.
- 2.** The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.
- 3.** If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.
- 4.** Any product being returned to the YSI Repair Center, should be packed securely to prevent damage.
- 5.** Cleaning must be completed and certified on any product before returning it to YSI.

10.2 Packing Instructions

1. Clean and decontaminate items to insure the safety of the handler.
2. Complete and include the Cleaning Certificate.
3. Place the product in a plastic bag to keep out dirt and packing material.
4. Use a large carton, preferably the original, and surround the product completely with packing material.
5. Insure for the replacement value of the product.

Cleaning Certificate	
Organization _____	
Department _____	
Address _____	
City _____	State _____ Zip _____
Country _____	Phone _____
Model No. of Device _____ Lot Number _____	
Contaminant (if known) _____	

Cleaning Agent(s) used _____	
Radioactive Decontamination Certified?	
(Answer only if there has been radioactive exposure)	
___ Yes ___ No	
Cleaning Certified By _____	
	Name Date

11. Required Notice

The Federal Communications Commission defines this product as a computing device and requires the following notice:

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. There is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- re-orient the receiving antenna
- relocate the computer with respect to the receiver
- move the computer away from the receiver
- plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 0004-000-00345-4.

12. Accessories and Replacement Parts

The following parts and accessories are available from YSI or any Franchise Dealer authorized by YSI.

YSI Order Number	Description
3161	Conductivity Calibration Solution 1,000 μ /cm (1 Quart)
3163	Conductivity Calibration Solution 10,000 μ /cm (1 Quart)
3165	Conductivity Calibration Solution 100,000 μ /cm (1 Quart)
3167	Conductivity Calibration Solution 1,000 μ /cm (8 pints)
3168	Conductivity Calibration Solution 10,000 μ /cm (8 pints)
3169	Conductivity Calibration Solution 50,000 μ /cm (8 pints)
3821	pH Buffer Solution, 4
3822	pH Buffer Solution, 7
3823	pH Buffer Solution, 10
5050	Carrying Case
031133	pH sensor
113165	Conductivity Probe/Cable Assembly (10 feet)
113166	Conductivity Probe/Cable Assembly (25 feet)
113157	Conductivity Probe/Cable Assembly (50 feet)
113158	Conductivity Probe/Cable Assembly (100 feet)
031163	Front Case Cover
055242	Rear Case Cover
055210	Battery Cover Kit
055204	Case Gasket and Screw
031129	Main Board Assembly
038213	Electrode Cleaning Brush, Conductivity
031189	Graduated Cylinder, 100 mL
060992	Container, Plastic (uses 060991 cap)
060991	Cap, Plastic Container (for 060992 container)

13. Appendix A - Specifications

Materials: ABS, Stainless Steel, and other materials

Dimensions:

Height:	9.5 inches	(24.13 cm)
Thickness:	2.2 inches	(5.6 cm)
Width:	3.5 inches max.	(8.89 cm)
Weight:	1.7 pounds (w/ 10' cable)	(.77 kg)
Display:	2.3"W x 1.5"L	(5.8 cm W x 3.8 cm L)

Power: 6 AA-size Alkaline Batteries (included)

Approximately 100 hours operation from each new set of batteries

Automatic shutoff after 10 hours without a key press

Water Tightness: Meets or exceeds IP65 standards

Probe Operating Environment

Medium: fresh, sea, or polluted water and most other liquid solutions.

Temperature: -5 to +75 °C

Depth: 0 to 10, 0 to 25, 0 to 50, or 0 to 100 feet (depending on cable length)

Meter Ambient Operating/Storage Temperature: -5 to +45 °C

System Performance Specifications

Measurement	Range	Resolution	Accuracy
pH	0 to 14	0.01 unit	± 0.1 pH unit within ±10°C of calibration temperature or ± 0.2 pH unit within ±20°C of calibration temperature
Conductivity	0 to 499.9 µS/cm 0 to 4999 µS/cm 0 to 49.99 mS/cm 0 to 200.0 mS/cm	0.1 µS/cm 1.0 µS/cm 0.01 mS/cm 0.1 mS/cm	± 0.5% FS
Salinity	0 to 80 ppt	0.1 ppt	± 2%, or ± 0.1 ppt
Temperature	-5 to +75 °C	0.1 °C	± 0.1°C ±1 LSD

Adjustable Conductivity Reference Temperature: 15°C to 25°C

Adjustable Temperature Compensation Factor for Conductivity: 0% to 4%

pH Response Time: 3 sec for 95% of the change at 25°C

Temperature Response Time: 20 sec for 95% of the change

Temperature Compensation: Automatic

Range: User selected or Autoranging for Conductivity

Data Storage: 50 points with ID number.

14. Appendix B - Health and Safety

YSI pH 4, 7 & 10 Buffer Solutions: 3821, 3822, 3823

pH 4 Ingredients:

- ☞ Potassium Hydrogen Phthalate
- ☞ Formaldehyde
- ☞ Water

pH 7 Ingredients:

- ☞ Sodium Phosphate, Dibasic
- ☞ Potassium Phosphate, Monobasic
- ☞ Water

pH 10 Ingredients:

- ☞ Potassium Borate, Tetra
- ☞ Potassium Carbonate
- ☞ Potassium Hydroxide
- ☞ Sodium (di) Ethylenediamine Tetraacetate
- ☞ Water

CAUTION - Avoid inhalation, skin contact, eye contact or ingestion. May affect mucous membranes.

Inhalation may cause severe irritation and be harmful. Skin contact may cause irritation; prolonged or repeated exposure may cause Dermatitis. Eye contact may cause irritation or conjunctivitis. Ingestion may cause nausea, vomiting and diarrhea.

FIRST AID:

INHALATION - Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

15. Appendix C - pH Buffer Values

YSI pH 4, 7 and 10 Buffer Solutions: 3821, 3822, 3823

The following table lists the values of YSI pH buffer solutions at various temperatures.

Temperature	pH 4	pH 7	pH 10
0°C	4.01	7.13	10.34
5°C	4.00	7.10	10.26
10°C	4.00	7.07	10.19
15°C	4.00	7.05	10.12
20°C	4.00	7.02	10.06
25°C	4.01	7.00	10.00
30°C	4.01	6.99	9.94
35°C	4.02	6.98	9.90
40°C	4.03	6.97	9.85
50°C	4.06	6.97	9.78
60°C	4.09	6.98	9.70

NIST pH 4.01, 6.86 and 9.18 Buffers: SRM 185g, SRM 186-Ie/IIe, SRM 187c

The following table lists the values of NIST pH buffer solutions at various temperatures.

Temperature	pH 4.01	pH 6.86	pH 9.18
0°C	4.005	6.984	9.463
5°C	4.003	6.950	9.395
10°C	4.001	6.924	9.333
15°C	4.002	6.899	9.277
20°C	4.003	6.879	9.226
25°C	4.005	6.863	9.180
30°C	4.010	6.852	9.139
35°C	4.020	6.844	9.102
37°C	4.025	6.842	N/A
40°C	4.033	6.840	9.070
45°C	4.047	6.837	9.042
50°C	4.061	6.836	9.018

16. Appendix D - Temperature Correction Data

Conductivity Temperature Correction Data for Typical Solutions

A. Potassium Chloride ** (KCl)

Concentration: 1 mole/liter			Concentration: 1×10^{-1} mole/liter		
°C	mS/cm	%/°C (to 25°C)	°C	mS/cm	%/°C (to 25°C)
0	65.10	1.67	0	7.13	1.78
5	73.89	1.70	5	8.22	1.80
10	82.97	1.72	10	9.34	1.83
15	92.33	1.75	15	10.48	1.85
20	101.97	1.77	20	11.65	1.88
25	111.90	1.80	25	12.86	1.90
			30	14.10	1.93
			35	15.38	1.96
			37.5	16.04	1.98
			40	16.70	1.99
			45	18.05	2.02
			50	19.43	2.04

Concentration: 1×10^{-2} mole/liter			Concentration: 1×10^{-3} mole/liter		
°C	mS/cm	%/°C (to 25°C)	°C	mS/cm	%/°C (to 25°C)
0	0.773	1.81	0	0.080	1.84
5	0.892	1.84	5	0.092	1.88
10	1.015	1.87	10	0.105	1.92
15	1.143	1.90	15	0.119	1.96
20	1.275	1.93	20	0.133	1.99
25	1.412	1.96	25	0.147	2.02
30	1.553	1.99	30	0.162	2.05
35	1.697	2.02	35	0.178	2.07
37.5	1.771	2.03	37.5	0.186	2.08
40	1.845	2.05	40	0.194	2.09
45	1.997	2.07	45	0.210	2.11
50	2.151	2.09	50	0.226	2.13

** Charts developed by interpolating data from *International Critical Tables*, Vol. 6, pp. 229-253, McGraw-Hill Book Co., NY.

B. Sodium Chloride* (NaCl)

Saturated solutions at all temperatures			Concentration: 0.5 mole/liter		
°C	mS/cm	%/°C (to 25°C)	°C	mS/cm	%/°C (to 25°C)
0	134.50	1.86	0	25.90	1.78
5	155.55	1.91	5	29.64	1.82
10	177.90	1.95	10	33.61	1.86
15	201.40	1.99	15	37.79	1.90
20	225.92	2.02	20	42.14	1.93
25	251.30	2.05	25	46.65	1.96
30	277.40	2.08	30	51.28	1.99
			35	56.01	2.01
			37.5	58.40	2.02
			40	60.81	2.02
			45	65.65	2.04
			50	70.50	2.05

Concentration: 1×10^{-1} mole/liter			Concentration: 1×10^{-2} mole/liter		
°C	mS/cm	%/°C (to 25°C)	°C	mS/cm	%/°C (to 25°C)
0	5.77	1.83	0	0.632	1.87
5	6.65	1.88	5	0.731	1.92
10	7.58	1.92	10	0.836	1.97
15	8.57	1.96	15	0.948	2.01
20	9.60	1.99	20	1.064	2.05
25	10.66	2.02	25	1.186	2.09
30	11.75	2.04	30	1.312	2.12
35	12.86	2.06	35	1.442	2.16
37.5	13.42	2.07	37.5	1.508	2.17
40	13.99	2.08	40	1.575	2.19
45	15.14	2.10	45	1.711	2.21
50	16.30	2.12	50	1.850	2.24

Concentration: 1×10^{-3} mole/liter		
°C	mS/cm	%/°C (to 25°C)
0	0.066	1.88
5	0.076	1.93
10	0.087	1.98
15	0.099	2.02
20	0.111	2.07
25	0.124	2.11
30	0.137	2.15
35	0.151	2.19
37.5	0.158	2.20
40	0.165	2.22
45	0.180	2.25
50	0.195	2.29

* Charts developed by interpolating data from the *CRC Handbook of Chemistry and Physics*, 42nd ed., p. 2606, The Chemical Rubber Company, Cleveland.

C. Lithium Chloride* (LiCl)

Concentration: 1 mole/liter			Concentration: 1×10^{-1} mole/liter		
°C	mS/cm	%/°C (to 25°C)	°C	mS/cm	%/°C (to 25°C)
0	39.85	1.82	0	5.07	1.87
5	46.01	1.85	5	5.98	1.85
10	52.42	1.89	10	6.87	1.85
15	59.07	1.92	15	7.75	1.85
20	65.97	1.95	20	8.62	1.85
25	73.10	1.98	25	9.50	1.86
30	80.47	2.02	30	10.40	1.88
35	88.08	2.05	35	11.31	1.91
37.5	91.97	2.07	37.5	11.78	1.92
40	95.92	2.08	40	12.26	1.94
45	103.99	2.11	45	13.26	1.98
50	112.30	2.15	50	14.30	2.02

Concentration: 1×10^{-2} mole/liter			Concentration: 1×10^{-3} mole/liter		
°C	mS/cm	%/°C (to 25°C)	°C	mS/cm	%/°C (to 25°C)
0	0.567	1.88	0	0.059	1.93
5	0.659	1.92	5	0.068	2.03
10	0.755	1.96	10	0.078	2.12
15	0.856	2.00	15	0.089	2.19
20	0.961	2.04	20	0.101	2.25
25	1.070	2.08	25	0.114	2.28
30	1.183	2.12	30	0.127	2.31
35	1.301	2.16	35	0.140	2.32
37.5	1.362	2.18	37.5	0.147	2.32
40	1.423	2.20	40	0.154	2.31
45	1.549	2.24	45	0.166	2.29
50	1.680	2.28	50	0.178	2.25

D. Potassium Nitrate** (KNO₃)

Concentration: 1×10^{-1} mole/liter			Concentration: 1×10^{-2} mole/liter		
°C	mS/cm	%/°C (to 25°C)	°C	mS/cm	%/°C (to 25°C)
0	6.68	1.78	0	0.756	1.77
5	7.71	1.79	5	0.868	1.80
10	8.75	1.81	10	0.984	1.83
15	9.81	1.83	15	1.105	1.86
20	10.90	1.85	20	1.229	1.88
25	12.01	1.87	25	1.357	1.90
30	13.15	1.90	30	1.488	1.93
35	14.32	1.92	35	1.622	1.95
37.5	14.92	1.94	37.5	1.690	1.96
40	15.52	1.95	40	1.759	1.97
45	16.75	1.97	45	1.898	1.99
50	18.00	2.00	50	2.040	2.01

* Charts developed by interpolating data from the *CRC Handbook of Chemistry and Physics*, 42nd ed., p. 2606, The Chemical Rubber Company, Cleveland.

** Charts developed by interpolating data from *International Critical Tables*, Vol. 6, pp. 229-253, McGraw-Hill Book Co., NY.

E. Ammonium Chloride* (NH₄Cl)

Concentration: 1 mole/liter			Concentration: 1 x 10 ⁻¹ mole/liter		
°C	mS/cm	%/°C (to 25°C)	°C	mS/cm	%/°C (to 25°C)
0	64.10	1.60	0	6.96	1.82
5	74.36	1.53	5	7.98	1.88
10	83.77	1.45	10	9.09	1.93
15	92.35	1.37	15	10.27	1.97
20	100.10	1.29	20	11.50	2.00
25	107.00	1.21	25	12.78	2.03
			30	14.09	2.06
			35	15.43	2.07
			37.5	16.10	2.08
			40	16.78	2.08
			45	18.12	2.09
			50	19.45	2.09

Concentration: 1 x 10 ⁻² mole/liter			Concentration: 1 x 10 ⁻³ mole/liter		
°C	mS/cm	%/°C (to 25°C)	°C	mS/cm	%/°C (to 25°C)
0	0.764	1.84	0	0.078	1.88
5	0.889	1.86	5	0.092	1.90
10	1.015	1.88	10	0.105	1.91
15	1.144	1.91	15	0.119	1.93
20	1.277	1.94	20	0.133	1.95
25	1.414	1.97	25	0.148	1.98
30	1.557	2.02	30	0.162	2.01
35	1.706	2.06	35	0.178	2.04
37.5	1.782	2.08	37.5	0.186	2.06
40	1.860	2.10	40	0.194	2.07
45	2.020	2.14	45	0.210	2.11
50	2.186	2.18	50	0.227	2.15

* Charts developed by interpolating data from the *CRC Handbook of Chemistry and Physics*, 42nd ed., p. 2606, The Chemical Rubber Company, Cleveland.

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