OPERATION OF THE YSI 556 MULTI-PROBE WATER QUALITY SYSTEM

CONTENTS

CONTENTS (cont'd)

OPERATION OF THE YSI 556 MULTI-PROBE WATER QUALITY SYSTEM

The policies and procedures established in this document are intended solely for the guidance of OLEM employees of the U.S. Environmental Protection Agency (EPA). They are not intended and cannot be relied upon to create any rights, substantive or procedural, enforceable by any party in litigation with the United States. EPA reserves the right to act at variance with these policies and procedures, and to change them at any time without public notice. EPA strongly encourages all readers to verify the validity of the information contained in this document by consulting the most recent Code of Federal Regulations (CFR) and updated guidance documents.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

OPERATION OF THE YSI 556 MULTI-PROBE WATER QUALITY SYSTEM

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) outlines the steps required for the setup, calibration, check-out, operation, and routine use of the YSI 556 Multi-Probe System. The procedures and figures contained in this SOP are taken from the *MPS Multi Probe System Operations Manual* (2009). Some material is excerpted without change from this manual. This SOP will be used for educational and training purposes only.

A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The sampler needs to ensure that the methods used are adequate to satisfy the data quality objectives (DQOs) listed in the QAPP for a particular site.

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

2.0 METHOD SUMMARY

The YSI 556 MPS (Multi-Probe System) is designed for water quality applications primarily involved with environmental assessment. The 556 MPS is a portable handheld instrument for the simultaneous measurement of temperature, pH, dissolved oxygen (DO), salinity, conductivity, and optionally, oxidation reduction potential (ORP) in surface and groundwater. Specific applications include water quality measurements for:

- Groundwater
- Aquaculture
- Coastal Waterways
- Surface Water
- Drinking Water
- Waste Water

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

See *APPENDIX D: Storage* for detailed information on instrument storage.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 pH Measurement

Because of the ion-exchange nature of the glass membrane, it is possible for other ions to concurrently interact with ion-exchange centers of the glass and distort the linear dependence of the measured electrode potential on pH electrode function.

4.2 Dissolved Oxygen Measurement

- Oxygen dissolved in the sample is consumed during sensor operation and readings may be artificially low if sample media is not stirred.
- Erratic readings may result from loose, wrinkled, damaged, or fouled membranes; or from large bubbles in the electrolyte reservoir.
- Oxygen consuming bacteria growing on the membrane surface may produce erroneous readings.

- Oxidizing compounds, such as chlorine, sulfur dioxide, nitric oxide, and nitrous oxide may affect readings by behaving like oxygen at the sensor.

4.3 Conductivity Measurement

- Gaseous substances, such as carbon dioxide (CO_2) may be dissolved in the sample and form ionic species which influence the conductivity.
- Tiny air bubbles may adhere to the electrode surface and increase the resistance of the sample within the cell and lower the conductivity reading.
- Un-dissolved or slowly precipitating solids may build up a coating on the electrodes of the conductivity cell causing poor cell response and erroneous readings.
- The wall or the bottom of the sample vessel may cause interference with the field lines generated within the electrolyte and around the cell producing erroneous readings.
- The conductivity of solutions of ionic species is highly dependent on temperature, varying as much as 3 percent (%) for each change of one degree Celsius (°C).

4.4 Salinity Measurement

Salinity measurement is derived from temperature and conductivity, so the interferences attributed to conductivity also apply to salinity.

4.5 Oxidation Reduction Potential Measurement

Oxidation or passivation of the platinum electrode surface by organics, sulfides, and bromide may affect electrode response and variability.

5.0 EQUIPMENT/APPARATUS

- YSI 556 Meter
- Membrane Cap Kit
- pH/ORP Probe Kit
- Conductivity/Temperature Probe Kit
- YSI Maintenance Kit
- Rechargeable Battery Pack
- Charger Adapter Cable
- AC Power Supply
- PC Interface Cable
- Probe Sensor Guard
- Transport/Calibration Cup
- Conductivity Standard Solution
- pH Buffer Solutions (4.0, 7.0, 10.0)
- DO Electrolyte Solution

6.0 REAGENTS

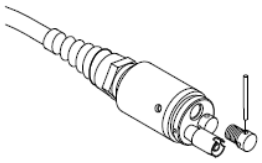
- Conductivity Solution
  - Iodine
  - Potassium Chloride
  - Water
- pH 4Solution
  - Potassium Hydrogen Phthalate
  - Formaldehyde
  - Water
- pH 7 Solution
  - Sodium Phosphate, Dibasic
  - Potassium Phosphate, Monobasic
  - Water
- pH 10 Solution
  - Potassium Borate, Tetra
  - Potassium Carbonate
  - Potassium Hydroxide
  - Sodium (di) EthylenediamineTetraacetate
  - Water
- Zobell Solution
  - Potassium Chloride
  - Potassium FerrocyanideTrihydrate
  - Potassium Ferricyanide
  - Water

7.0 PROCEDURES

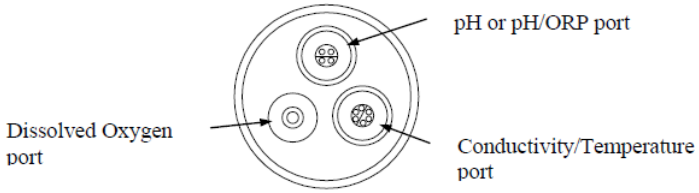
7.1 Assembly

7.1.1 Conductivity/Temperature, pH, pH/Oxidation Reduction Potential Sensor Installation

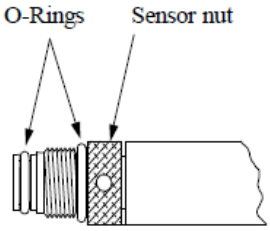
1. Unscrew and remove the probe sensor guard.
2. Using the sensor installation tool supplied in the YSI 5511 maintenance kit, unscrew and remove the sensor port plugs.



3. Locate the port with the connector that corresponds to the sensor that is to be installed.

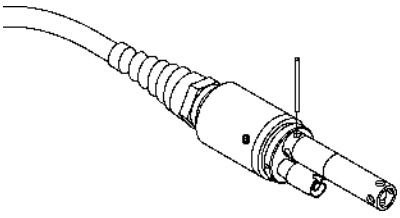


4. Apply a thin coat of o-ring lubricant to the o-rings on the connector side of the sensor.

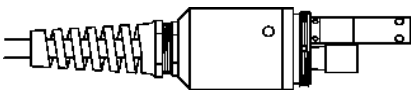


CAUTION: Make sure that there are NO contaminants between the o-ring and the sensor. Contaminants that are present under the o-ring may cause the o-ring to leak.

5. Be sure the probe module sensor port is free of moisture and insert the sensor into the correct port.
6. Gently rotate the sensor until the two connectors align.
7. With the connectors aligned, screw down the sensor nut using the sensor installation tool.



CAUTION: Do not cross thread the sensor nut. Tighten the nut until it is flush with the face of the probe module bulkhead. Do not over tighten.



8. Repeat steps 3-6 for any other sensors.
9. Replace the probe sensor guard.

7.1.2 Membrane Cap Selection

- 1 mil Teflon – Black Caps, standard performance for most applications
- 1 mil Polyethylene (PE) – Yellow Caps, significantly faster dissolved oxygen response
- 2 mil Polyethylene (PE) – Blue Caps, large reduction in flow dependence

IMPORTANT: No matter which type of membrane cap is selected, selection confirmation is required as described in *Section 7.3 Sensor Set Up.*

7.1.3 Membrane Cap Installation

NOTE: The YSI 5563 DO sensor, already installed in the probe module, was shipped dry. A shipping membrane was installed to protect the electrode. A new membrane cap must be installed before the first use. Unscrew and remove the probe sensor guard.

1. Unscrew, remove, and discard the old membrane cap.
2. Thoroughly rinse the sensor tip with distilled water.
3. Prepare the electrolyte according to the directions on the electrolyte solution bottle.
4. Hold the new membrane cap and fill it at least $^1/_2$ full with the electrolyte solution.
5. Screw the membrane cap onto the sensor moderately tight. A small amount of electrolyte should overflow.

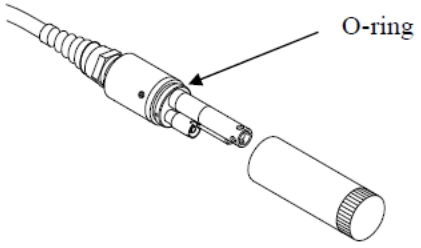
   Caution: Do not touch the membrane surface.

6. Screw the probe sensor guard on moderately tight.

7.1.4 Transport/Calibration Cup Installation

1. Remove probe sensor guard, if installed.
2. Ensure an o-ring is installed in the o-ring groove on the threaded end of the probe module body.
3. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not over tighten as this could cause damage to the threaded portions.

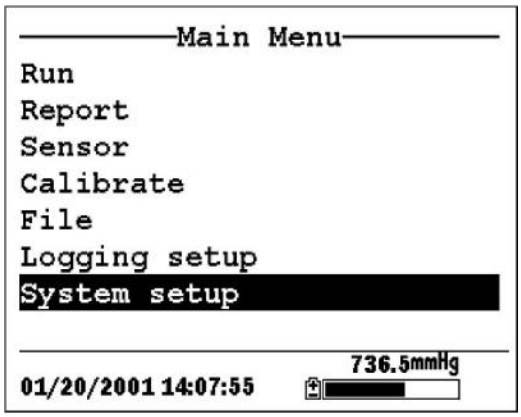


7.1.5 Instrument Cable Connection

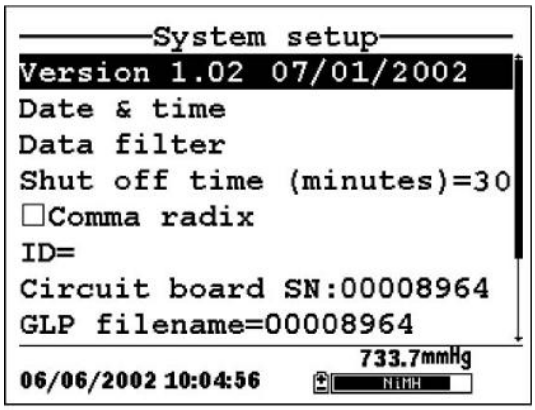
1. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI 556 instrument.
2. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place.
3. Remove the cable from the instrument by turning the cable connector counterclockwise until the cable disengages from the instrument.

7.2 Set System Date/Time

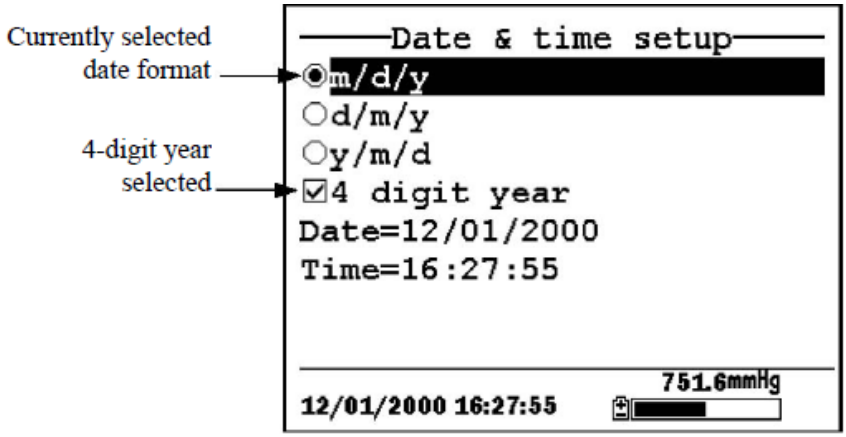
1. Press the **On/Off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.
3. Use the arrow keys to highlight the **System setup** selection.



4. Press the **Enter** key and the system setup screen is displayed.



5. Use the arrow keys to highlight the **Date & time** selection on the system setup screen.
6. Press **Enter** and the date and time setup screen is displayed.



7. Use the arrow keys to highlight desired date format.
8. Press **Enter**.
9. Use the arrow keys to highlight the 4-digit year selection.
10. Press **Enter** and a check mark is placed in the check box next to the 4-digit year selection.

    NOTE: If unchecked, a 2-digit year is used.

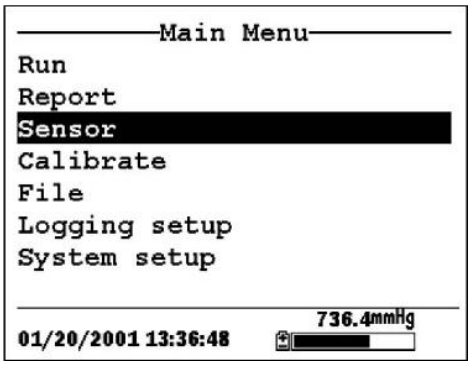
11. Use the arrow keys to highlight the **Date** selection.
12. Press **Enter** and a cursor is placed over the first number in the date.
13. Enter the proper number from the keypad for the highlighted date digit and the cursor moves automatically to the next date digit.
14. Repeat Step 10 until all date digits are correct.
15. Press **Enter** to input the specified date.
16. Use the arrow keys to highlight the **Time** selection.
17. Press **Enter** and a cursor appears over the first number in the time selection.
18. Enter the proper number from the keypad for the highlighted time digit and the cursor moves automatically to the next time digit.

    NOTE: Use military format when entering time.

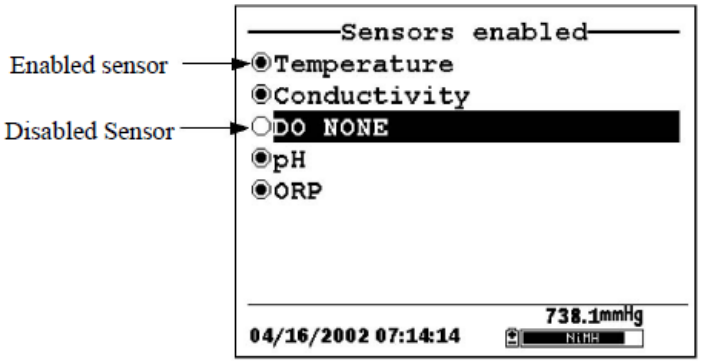
19. Repeat Step 15 until all time digits are correct.
20. Press **Enter** to input the correct time.
21. Press the **Escape** key repeatedly to return to the Main menu screen.

7.3 Sensor Set Up

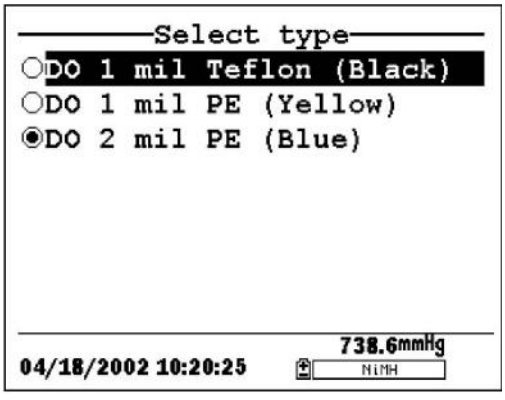
1. Press the **On/Off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.



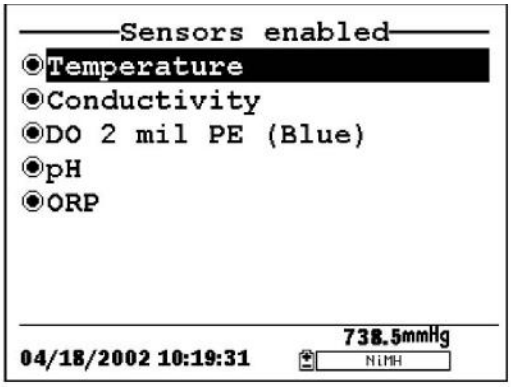
3. Use the arrow keys to highlight the **Sensor** selection.
4. Press the **Enter** key to display the sensors enabled screen.



5. Highlight the "DO None" entry as shown above and press **Enter** to display the membrane choice screen.



6. Highlight the desired membrane choice and press **Enter** to activate selection.
7. Press **Escape** to return to the Sensor menu that now shows your DO membrane selection.

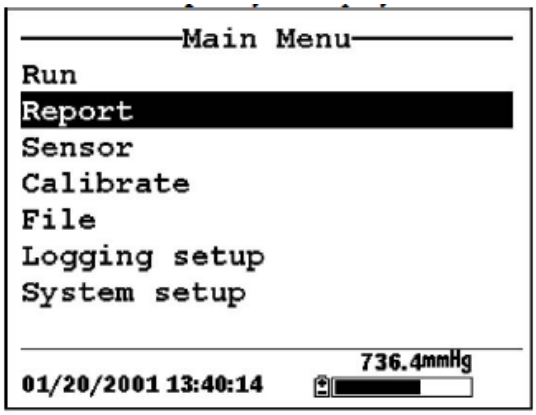


NOTE: The Temperature sensor cannot be disabled. Most other sensors require temperature compensation for accurate readings. In addition, the conductivity sensor must be activated in order to obtain accurate dissolved oxygen mg/L readings.

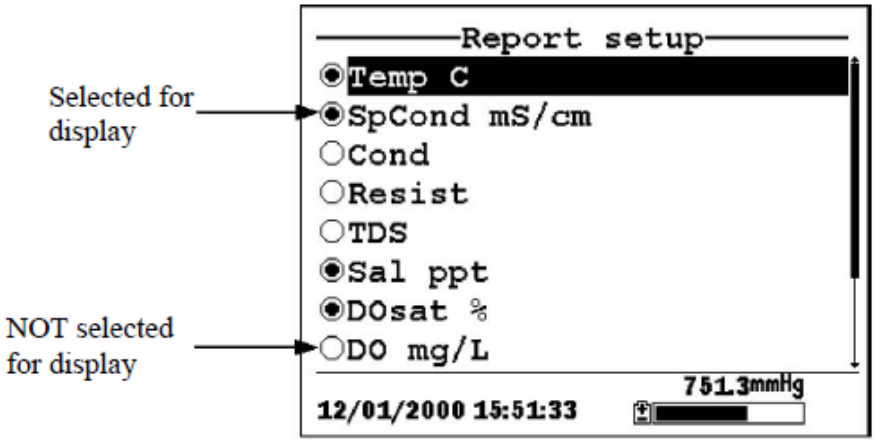
8. Use the arrow keys to highlight the sensor you want to change and press the **Enter** key to enable or disable it.
9. Repeat step 5 for each sensor you want to change.
10. Press the **Escape** key to return to the main menu screen.

7.4 Report Set Up

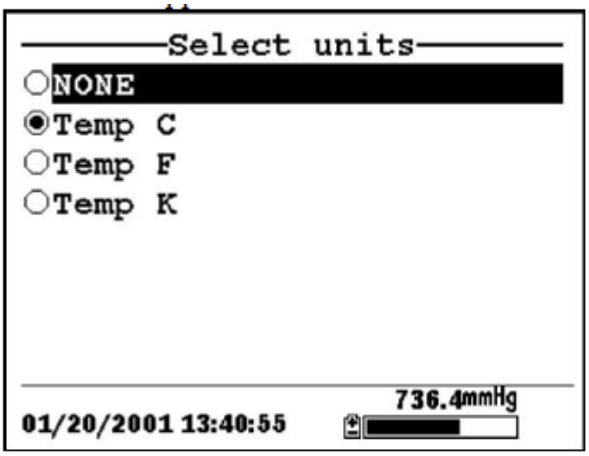
1. Press the **On/Off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.



3. Use the arrow keys to highlight the **Report** selection.
4. Press the **Enter** key to display the report setup screen.



5. Use the arrow keys to highlight the parameter you want to change and press the **Enter** key.
6. If you selected Temperature, Specific Conductivity, Conductivity, Resistance or Total Dissolved Solids, the Units screen will appear.



7. Use the arrow keys to select the units desired and press the **Enter** key to return to the Report setup screen.
8. Repeat steps 5 and 6 for each parameter you want to change.

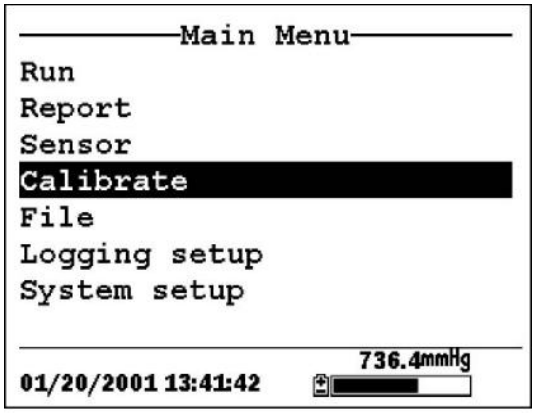
   NOTE: Specific Conductance is notated on the Run screen with a small 'c' after the units of measure.

9. Press the **Escape** key to return to the Main menu screen.

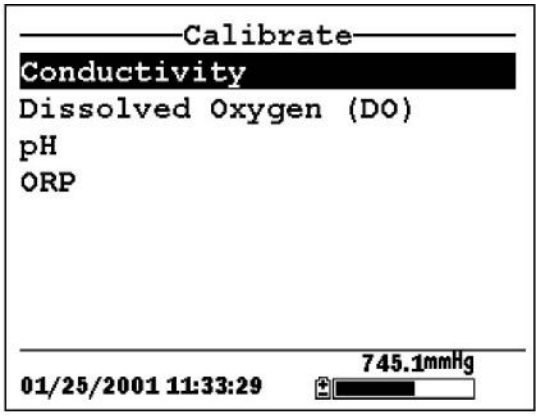
7.5 Calibration

7.5.1 Access Calibrate Menu

1. Press the **On/Off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.
3. Use the arrow keys to highlight the **Calibrate** selection.



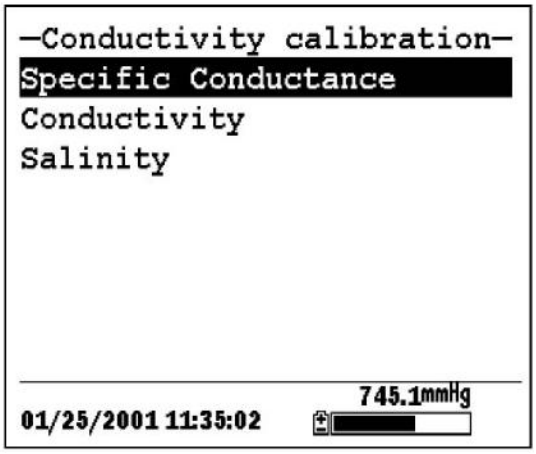
4. Press the **Enter** key and the Calibrate screen will be displayed.



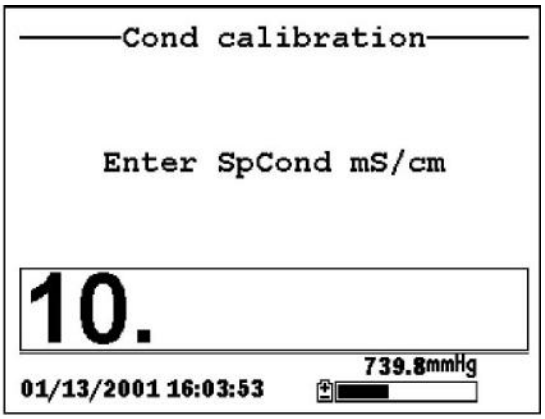
7.5.2 Conductivity Calibration

This procedure calibrates specific conductance, conductivity and salinity. Calibrating any one option automatically calibrates the other two.

1. Use the arrow keys to highlight the **Conductivity** selection.
2. Press **Enter** and the Conductivity Calibration Screen is displayed.



3. Use the arrow keys to highlight the Specific Conductance selection.
4. Press **Enter** and the Conductivity Calibration Entry Screen is displayed.



5. Place conductivity standard into a clean, dry or pre-rinsed transport/calibration cup.

    - For fresh water use a 1 mS/cm conductivity standard.
    - For brackish water use a 10 mS/cm conductivity standard.
    - For seawater use a 50 mS/cm conductivity standard.

    WARNING: Calibration reagents may be hazardous to your health. See *Section 11.2 Conductivity Solution* for more information.

    NOTE: Before proceeding, ensure the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that to be discarded. Avoid cross-contamination of solutions. Make certain that there are no salt deposits around the oxygen and pH/ORP sensors, particularly if employing standards of low conductivity.

6. Carefully immerse the sensor end of the probe module into the solution.

7. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

   NOTE: The sensor must be completely immersed past its vent hole.

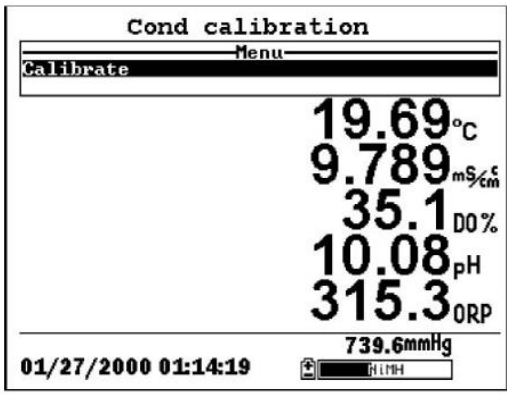
8. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not over tighten as this could cause damage to the threaded portions.

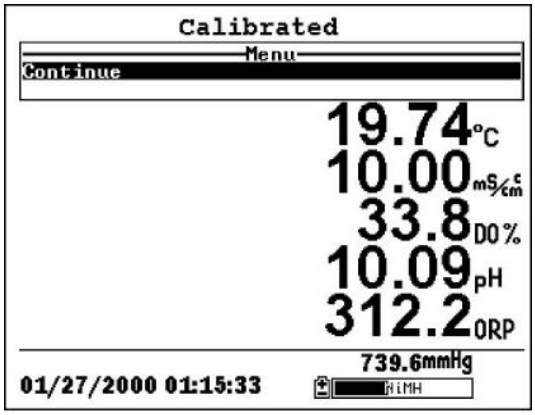
9. Use the keypad to enter the calibration value of the standard selected.

   NOTE: Be sure to enter the value in **mS/cm at 25ºC**.

10. Press **Enter** and the Conductivity Calibration Screen is displayed.



11. Allow at least one minute for temperature equilibration before proceeding.
12. Observe the reading under Specific Conductance.
13. When the reading shows no significant change for approximately 30 seconds, press **Enter**.
14. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.



15. Press **Enter** to return to the Conductivity Calibrate Selection Screen.
16. Press **Escape** to return to the calibrate menu.
17. Rinse the probe module and sensors in tap or purified water and dry.

.

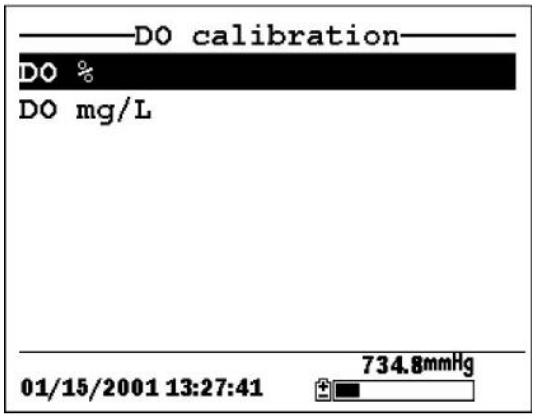
7.5.3 Dissolved Oxygen Calibration

Calibrating either % or milligrams per Liter (mg/L) automatically calibrates the other.

1. Press **Escape** then **Enter,** the Calibrate screen is displayed.

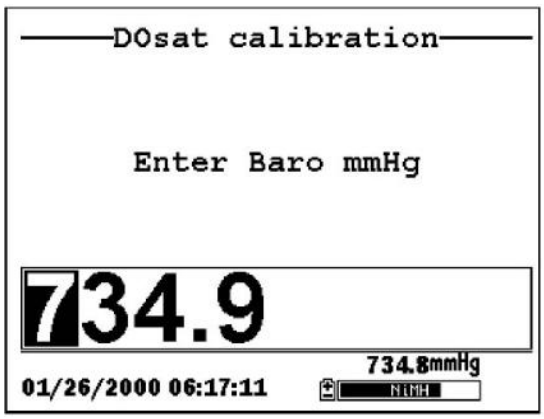
NOTE: The instrument must be on for at least 10 - 15 minutes to polarize the DO sensor before calibrating.

2. Use the arrow keys to highlight the **Dissolved Oxygen** selection.
3. Press **Enter** and the dissolved oxygen calibration screen is displayed.



7.5.3.1 Dissolved Oxygen Calibration (% Saturation)

1. Use the arrow keys to highlight the DO% selection.
2. Press **Enter** and the DO Barometric Pressure Entry Screen is displayed.



3. Place approximately 3 millimeter (mm; 1/8 inch) of water in the bottom of the transport/calibration cup.
4. Place the probe module into the transport/calibration cup.

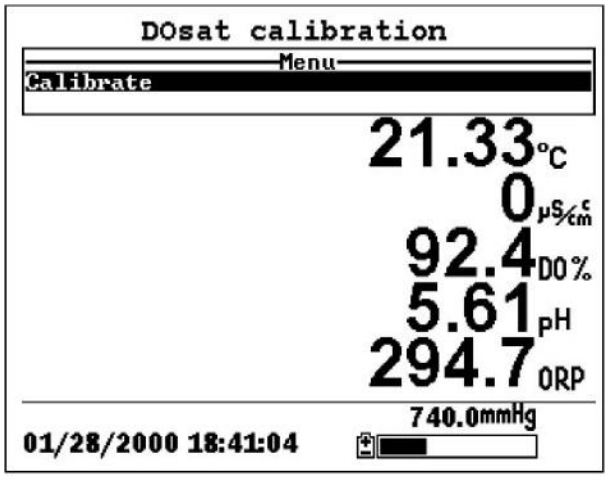
   NOTE: Make sure that the DO and temperature sensors are **NOT** immersed in the water.

5. Engage only 1 or 2 threads of the transport/calibration cup to ensure the DO sensor is vented to the atmosphere.
6. Use the keypad to enter the current local barometric pressure.

   NOTE: If the unit has the optional barometer, no entry is required.

   NOTE: Barometer readings that appear in meteorological reports are generally referenced to sea level and must be corrected to actual pressure altitude before use.

7. Press **Enter** and the DO% saturation calibration screen is displayed.

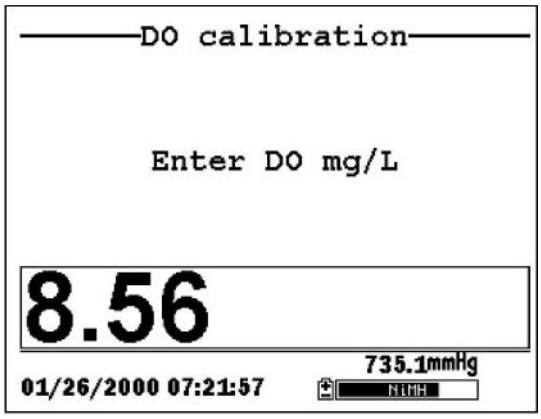


8. Allow approximately ten minutes for the air in the transport/calibration cup to become water saturated and for the temperature to equilibrate before proceeding.
9. Observe the reading under DO %.
10. When the reading shows no significant change for approximately 30 seconds, press **Enter** and the screen will indicate that the calibration has been accepted and prompt to press **Enter** again to Continue.
11. Press **Enter** to return to the DO calibration screen.
12. Press **Escape** to return to the calibrate menu.
13. Rinse the probe module and sensors in tap or purified water and dry.

7.5.3.2 Dissolved Oxygen Calibration (mg/L)

DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen.

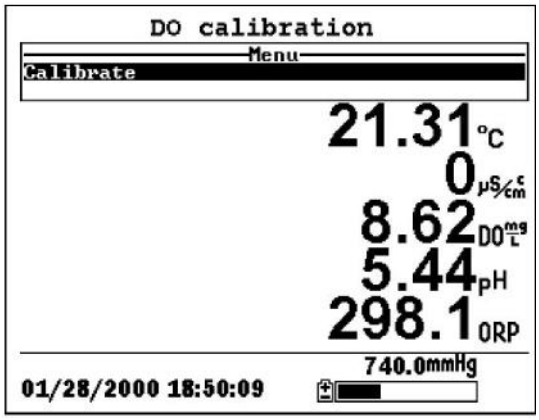
1. Press **Escape, Escape,** highlight DO selection and **Enter**.
2. Use the arrow keys to highlight the **DO mg/L** selection.
3. Press **Enter** and the DO mg/L Entry Screen is displayed.



4. Place the probe module in water with a known DO concentration.

   NOTE: Be sure to completely immerse all the sensors.

5. Use the keypad to enter the known DO concentration of the water.
6. Press **Enter** and the Dissolved Oxygen mg/L Calibration Screen is displayed.

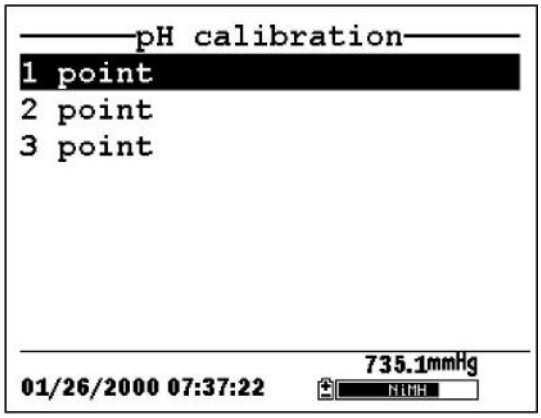


7. Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.
8. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
9. Observe the DO mg/L reading, when the reading is stable, press **Enter**.
10. The screen will indicate that the calibration has been accepted and prompt to press **Enter** again to Continue.
11. Press **Enter** and return to the DO calibration screen.
12. Press **Escape** to return to the calibrate menu.

13. Rinse the probe module and sensors in tap or purified water and dry.

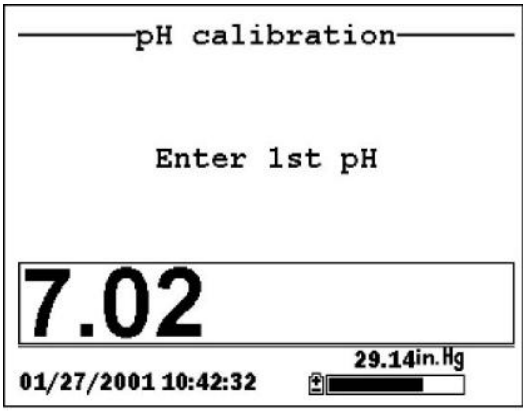
7.5.4 pH Calibration

1. Press **Escape**, **Escape** to reach the calibrate screen.
2. Use the arrow keys to highlight the **pH** selection.
3. Press **Enter** and the pH calibration screen is displayed.



- Select the **1-point** option only if adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt to select only one pH buffer.
- Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic.
- Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 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. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.

4. Use the arrow keys to highlight the 2-point selection.
5. Press **Enter**. The pH Entry Screen is displayed.



6. Place pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

   WARNING: Calibration reagents may be hazardous to your health. See *Section 11.3 pH Solutions* for more information.

   NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.

   NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer to be discarded. Be certain that you avoid cross contamination of buffer solutions.

7. Carefully immerse the sensor end of the probe into the solution.
8. Gently rotate and move the probe module up and down to remove any bubbles from the pH sensor.

   NOTE: The sensor must be completely immersed.

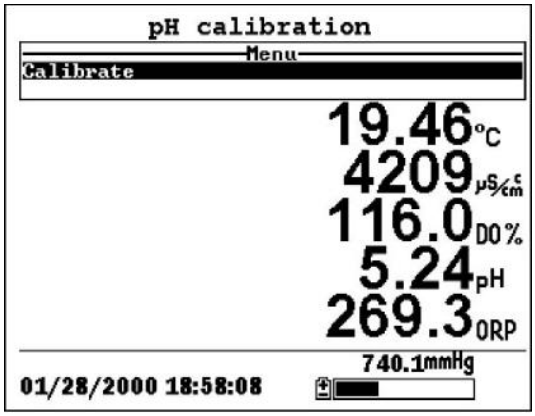
9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not over tighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

    NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

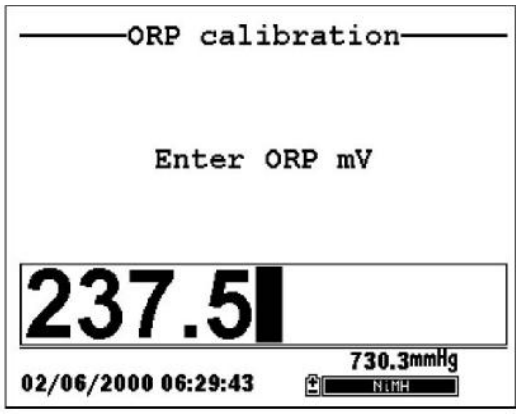
11. Press **Enter** and the pH calibration screen is displayed.



12. Allow at least one minute for temperature equilibration before proceeding.
13. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
14. Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**.
15. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
16. Press **Enter** and return to the specified pH Calibration Screen.
17. Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.
18. Repeat steps 6 through 16 above using a second pH buffer.
19. Press **Enter**. This returns you to the pH Calibration Screen.
20. Press **Escape** to return to the calibrate menu.
21. Rinse the probe module and sensors in tap or purified water and dry.

7.5.5 Oxidation Reduction Potential Calibration

1. Press **Escape**, **Escape** to display the calibrate screen.
2. Use the arrow keys to highlight the **ORP** selection.
3. Press **Enter** and the ORP calibration screen is displayed.



4. Place Zobell solution into a clean, dry or pre-rinsed transport/calibration cup.

   WARNING: Calibration reagents may be hazardous to your health. See *Section 11.4 Zobell Solution* for more information.

   NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain to avoid cross contamination with other solutions.

5. Carefully immerse the sensor end of the probe module into the solution.
6. Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

   NOTE: The sensor must be completely immersed.

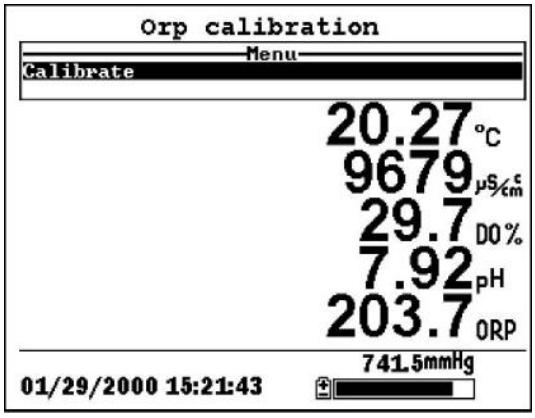
7. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not over tighten as this could cause damage to the threaded portions.

8. Use the keypad to enter the correct value of the calibration solution you are using at the current temperature. Refer to the following Table of Zobell Solution Values.

Temperature °C	Zobell Solution Value, mV
-5	270.0
0	263.5
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0
40	211.5
45	205.0
50	198.5

9. Press **Enter** and the ORP calibration screen is displayed.

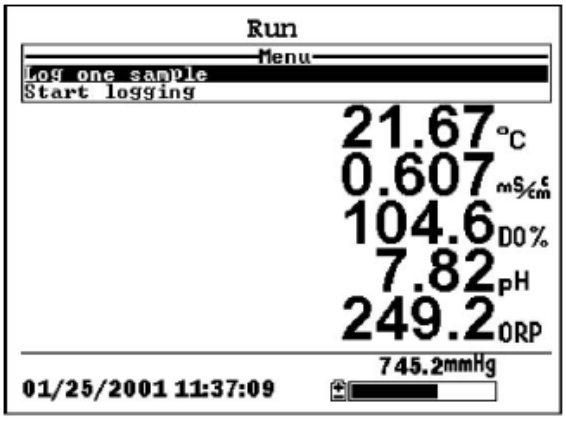


10. Allow at least one minute for temperature equilibration before proceeding.
11. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
12. Observe the reading under ORP and when the reading shows no significant change for approximately 30 seconds, press **Enter**.
13. The screen will indicate that the calibration has been accepted and prompt to press **Enter** again to Continue.
14. Press **Enter** to return to the Calibrate Screen.
15. Rinse the probe module and sensors in tap or purified water and dry.

7.6 Run

7.6.1 Real-Time Data

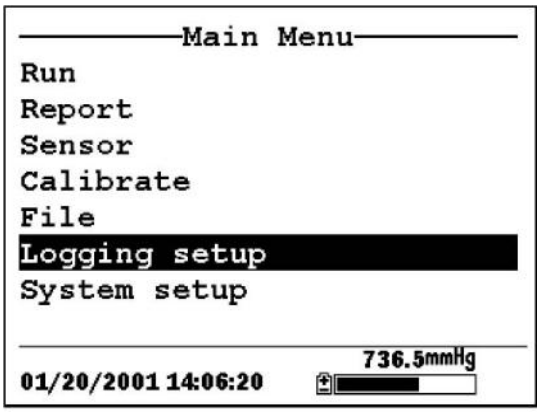
1. Press the **On/Off** key or select **Run** from the main menu to display the run screen.



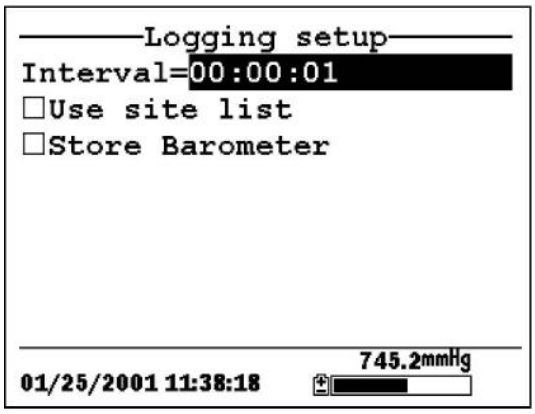
2. Make sure the probe sensor guard is installed.
3. Place the probe module in the sample and completely immerse all the sensors.
4. Rapidly agitate the probe module to provide fresh sample to the DO sensor.
5. Watch the readings on the display until they are stable.
6. Real time data are displayed.

7.6.2 Logging Data

1. Press the **On/Off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.



3. Use the arrow keys to highlight the **Logging setup** selection.
4. Press the **Enter** key and the logging setup screen is displayed.



NOTE: If you do not specify an interval, the instrument will use a default interval setting of 1 second.

5. Use the keypad to enter an interval between 1 second and 15 minutes.

   NOTE: The interval field has hour, minute and second entry fields. Any entry over 1 hour will change automatically to a 15-minute setting.

6. **P**ress the **Enter** key and the data stream interval is set.
7. Press the **Escape** key repeatedly to return to the main menu screen.

8.0 CALCULATIONS

The 556 MPS is a direct readout instrument that requires no external calculations.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

9.1 General Quality Assurance/Quality Control Procedures

- Instrument will be checked for operability and performance monthly. Results and observations are recorded in a bound instrument maintenance logbook.
- All sample data, pre-operational, and operational checks must be documented in the instrument run or analysis log.
- The instrument must be operated in accordance with this SOP and manufacturer's recommendations.
- An instrument log must be maintained to document specific corrective actions taken to alleviate any instrumental problems, or for recording any service that has been performed.
- Results must be saved electronically.
- Records must be maintained, documenting the training of the operators that use instrumentation and equipment for the collection of environmental information.

9.2 Calibration

Instrument sensors are calibrated before each use. See *Section 7.5 Calibration* for details.

10.0 DATA VALIDATION

The operator will ensure that the 556 Multi-Probe was operated in accordance with this SOP, within instrument specifications, and all operational checks have been completed and are within the criteria specified in the site-specific UFP-QAPP. The U.S. EPA Environmental Response Team (ERT) contractor's Task Leader is responsible for completing the UFP-QAPP verification checklist for each project.

11.0 HEALTH AND SAFETY

11.1 General Precautions

Based on Occupational Safety and Health Administration (OSHA) requirements, a site-specific health and safety plan (HASP) must be prepared for response operations under the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard, 29 CFR 1910.120. Field personnel working for EPA's ERT should consult the Emergency Responder Health and Safety Manual currently located at https://response.epa.gov/_HealthSafetyManual/manual-index.htm for the development of the HASP, required personal protective equipment (PPE) and respiratory protection.

11.2 Conductivity Solution

Harmful if ingested or inhaled. Skin or eye contact may cause irritation. Has a corrosive effect on the gastro-intestinal tract, causing abdominal pain, vomiting, and diarrhea. Hyper-sensitivity may cause conjunctivitis, bronchitis, or skin rashes. Evidence of reproductive effects.

WARNING: INHALATION MAY BE FATAL

CAUTION: AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. SOLUTIOIN MAY EVOLVE TOXIC FUMES IN FIRE.

11.3 pH Solutions

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.

CAUTION: AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.

11.4 Zobell Solution

May be harmful by inhalation, ingestion or skin absorption. Causes eye and skin irritation. Material is irritating to mucous membranes and upper respiratory tract. Ingestion of large quantities can cause weakness, gastrointestinal irritation and circulatory disturbances. The chemical, physical, and toxicological properties have not been thoroughly investigated.

CAUTION: AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.

12.0 REFERENCES

YSI Environmental, 2009, *MPS Multi Probe System Operations Manual.*

American Public Health Association, American Water Works Association, Water Environment Federation, ed. 1999, *Standard Methods for the Examination of Water and Wastewater.*

13.0 APPENDICES

A – Specifications
B – Maintenance
C – Troubleshooting
D – Storage
E – Theory of Operation

APPENDIX A
Specifications
SOP: ERT-PROC-2209-20
October 2020

(Source: YSI Environmental.2009. *MPS Multi Probe System Operations Manual*)

SENSOR SPECIFICATIONS

	Sensor Type	Range	Accuracy	Resolution
Dissolved Oxygen (% Saturation)	Steady state polarographic	0 to 500% air saturation	0 to 200% air sat.; ±2% of the reading or ±2% air sat., whichever is greater; 200 to 500% air sat., ±6% of the	0.1% air saturation
Dissolved Oxygen (mg/L)	Steady state polarographic	0 to 50 mg/L	0 to 20mg/L; ±2% of the reading or ±0.2mg/L whichever is greater; 20 to 50 mg/L, ±6% of the reading	0.01 mg/L
Temperature	YSI Temp Precision thermistor	-5° to 45°C	±0.15°C	0.1°C
Conductivity	4-electrode cell with autoranging	0 to 200 mS/cm	±0.5% of reading or +0.001 mS/cm; whichever is greater (4-meter cable) ±1.0% of reading or ±0.001 mS/cm; whichever is greater (20-meter cable)	0.001 mS/cm to 0.1 mS/cm (range dependent)
Salinity	Calculated from conductivity and temperature	0 to 70 ppt	±1.0% of reading or ±0.1ppt, whichever is greater	0.01 ppt
pH Optional	Glass combination electrode	0 to 14 units	±0.2 units	0.01 units
Amplified pH Optional	Combination electrode with ribbon junction and glass	0 to 14 units	±0.2 units	0.01 units
ORP Optional	Platinum button	-1999 to +1999 mV	±20 mV	0.1 mV
Amplified pH/ORP Combo Optional (pH the same as above)	Combination electrode with ribbon junction and platinum button	-999 to 999 mV	±20 mV	0.1 mV
Barometer Optional		500 to 800 mm Hg	±3 mm Hg within ±10°C temperature range from calibration point	0.1 mm Hg
Total Dissolved Solids (TDS)	Calculated from conductivity (variable constant, default 0.65)	0 to 100 g/L		4 digits
Resistivity	Calculated from conductivity reading	Measured in KOhm cm, user dependent	±0.5% of reading	

INSTRUMENT SPECIFICATIONS

Size: 11.9 cm width x 22.9 cm length (4.7 in. x 9 in.)

Weight with Batteries: 2.1 lbs. (916 grams)

Power: 4 alkaline C-cells
Optional rechargeable pack

Cables: 4-m, 10-m, 20-m lengths (13.1 ft., 32.8 ft. and 65.6 ft.)

Communication Port: RS-232 Serial

Data Logger: 49,000 data sets, date and time stamp, manual or logging, with user-selectable intervals

Warranty: 3 year for the instrument, 1 year for probes and cables

Options: Flow Cell
Hard-sided carry case

APPENDIX B
Maintenance
SOP: ERT-PROC-2209-20
October 2020

(Source: YSI Environmental.2009. *MPS Multi Probe System Operations Manual*)

11. Maintenance

11.1 Sensor Care and Maintenance

Once the sensors have been properly installed, remember that periodic cleaning and DO membrane changes are required.

11.1.1 DO Sensor

For best results, we recommend that the KCl solution and the membrane cap be changed at least once every 30 days.

1. It is important to recognize that oxygen dissolved in the sample is consumed during sensor operation. It is therefore essential that the sample be continuously stirred at the sensor tip. If stagnation occurs, your readings will be artificially low. Stirring may be accomplished by mechanically moving the sample around the sensor tip, or by rapidly moving the sensor through the sample. The rate of stirring should be at least 1 foot per second.

2. Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes, or from large (more than 1/8" diameter) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, you should replace the membrane and the electrolyte solution. The average replacement interval is two to four weeks.

3. If the membrane is coated with oxygen consuming (e.g. bacteria) or oxygen producing organisms (e.g. algae), erroneous readings may occur.

4. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the sensor. If you suspect erroneous readings, it may be necessary to determine if these gases are the cause.

5. Avoid any environment that contains substances that may attack the probe module and sensor materials. Some of these substances are concentrated acids, caustics, and strong solvents. The sensor materials that come in contact

with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the PVC cable covering.

6. It is possible for the silver anode, which is the entire silver body of the sensor, to become contaminated. This will prevent successful calibration. To restore the anode, refer to Section *11.1.1 DO Sensor, Silver Anode Cleaning.*

7. For correct sensor operation, the gold cathode must always be bright. If it is tarnished (which can result from contact with certain gases), or plated with silver (which can result from extended use with a loose or wrinkled membrane), the gold surface must be restored. To restore the cathode, refer to Section *11.1.1 DO Sensor, Gold Cathode Cleaning.*

8. To keep the electrolyte from drying out, store the sensor in the transport/calibration cup with at least 1/8" of water.

Silver Anode Cleaning

After extended use, a thick layer of AgCl builds up on the silver anode reducing the sensitivity of the sensor. The anode must be cleaned to remove this layer and restore proper performance. The cleaning can be chemical or mechanical:

Chemical Cleaning: Remove the membrane cap and soak the entire anode section in a 14% ammonium hydroxide solution for 2 to 3 minutes, followed by a thorough rinsing with distilled or deionized water. The anode should then be thoroughly wiped with a wet paper towel to remove the residual layer from the anode.

Mechanical Cleaning: Sand off the dark layer from the silver anode with 400 grit wet/dry sandpaper. Wrap the sandpaper around the anode and twist the sensor. Rinse the anode with clean water after sanding, followed by wiping thoroughly with a wet paper towel.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation.*

Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are still unable to calibrate, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service.*

Gold Cathode Cleaning

For correct sensor operation, the gold cathode must be textured properly. It can become tarnished or plated with silver after extended use. The gold cathode can be cleaned by using the adhesive backed sanding disc and tool provided in the YSI 5238 Probe Reconditioning Kit.

Using the sanding paper provided in the YSI 5238 Probe Reconditioning Kit, wet sand the gold with a twisting motion about 3 times or until all silver deposits are removed and the gold appears to have a matte finish. Rinse the cathode with clean water after sanding, followed by wiping thoroughly with a wet paper towel. If the cathode remains tarnished, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation*.

11.1.2 DO Sensor Replacement

1. Remove the probe sensor guard.

⚠ **CAUTION:** Thoroughly dry the sensor so that no water enters the probe module sensor port when the sensor is removed.

2. Insert the long end of the hex key wrench into the small hole in the side of the probe module bulkhead. Turn the wrench counterclockwise and remove the screw. (You do not have to remove the screw all the way to release the sensor.)

3. Pull the old DO sensor module straight out of the probe module body.

   NOTE: The DO sensor is not threaded, it is keyed, so it cannot be removed by twisting.

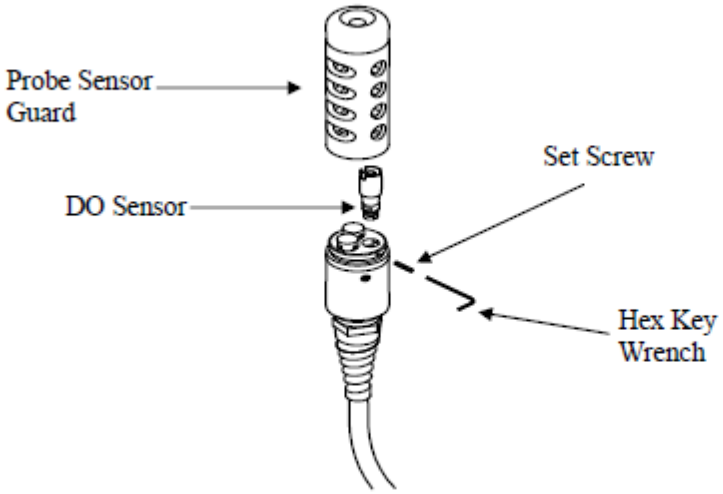


Figure 11.1 DO Sensor Replacement

4. Insert the new DO sensor module. Make sure that the inside of the probe module sensor port and the o-ring on the sensor are clean, with no contaminants, such as grease, dirt, or hair. The DO sensor is keyed, or has a flat side, so that it cannot be aligned improperly.

   NOTE: Make sure the DO sensor bottoms out before the set screw is inserted.

5. Insert the set screw into the small hole in the side of the probe module bulkhead, and turn clockwise to rethread.

⚠ **CAUTION**: Make sure that you do not cross-thread the set screw. Use the hex key wrench to tighten the screw in properly, making sure that the screw does not stick out of the side of the probe module bulkhead. The probe sensor guard will not thread on properly and damage may result if the screw is allowed to stick out.

NOTE: The YSI 5563 DO sensor is shipped dry. A shipping membrane was installed to protect the electrode. A new membrane cap must be installed before the first use. Refer to Section 3.4.1 Sensor Installation.

11.1.3 YSI 5564 pH and 5565 Combination pH/ORP Sensor Cleaning

Cleaning is required whenever deposits or contaminants appear on the glass and/or platinum surfaces of these sensors or when the response of the sensor becomes slow.

1. Remove the sensor from the probe module.
2. Initially, simply use clean water and a soft clean cloth, lens cleaning tissue, or cotton swab to remove all foreign material from the glass bulb (YSI 5564 and YSI 5565) and platinum button (YSI 5565). Then use a moistened cotton swab to carefully remove any material that may be blocking the reference electrode junction of the sensor.

⚠ **CAUTION:** When using a cotton swab with the YSI 5564 or YSI 5565, be careful NOT to wedge the swab tip between the guard and the glass sensor. If necessary, remove cotton from the swab tip, so that the cotton can reach all parts of the sensor tip without stress.

NOTE: If good pH and/or ORP response is not restored by the above procedure, perform the following additional procedure:

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

NOTE: If good pH and/or ORP response is still not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 30-60 minutes in one molar (1 M) hydrochloric acid (HCl). This reagent can be purchased from most distributors. Be sure to follow the safety instructions included with the acid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the acid.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water. To be certain that all traces of the acid are removed from the sensor crevices, soak the sensor in clean water for about an hour with occasional stirring.

NOTE: 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 sensor for approximately 1 hour in a 1 to 1 dilution of commercially available chlorine bleach.

2. Rinse the sensor with clean water and then soak for at least 1 hour in clean water with occasional stirring to remove residual bleach from the junction. (If possible, soak the sensor for period of time longer than 1 hour in order to be certain that all traces of chlorine bleach are removed.) Then re-rinse the sensor with clean water and retest.

11.1.4 Temperature/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. The small cleaning brush included in the YSI 5511 Maintenance Kit is ideal for this purpose.

To clean the conductivity cell:

1. Dip the brush in clean water and insert it into each hole 1520 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

NOTE: In the event that deposits have formed on the electrodes, perform the following additional procedure:

1. Use a mild detergent solution in combination with the brush. Dip the brush in the solution and insert it into each hole 1520 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

NOTE: After cleaning, check the response and accuracy of the conductivity cell with a calibration standard.

NOTE: If this procedure is unsuccessful, or if sensor performance is impaired, it may be necessary to return the sensor to a YSI authorized service center for service, Refer to *Appendix E Customer Service*.

The temperature portion of the sensor requires no maintenance.

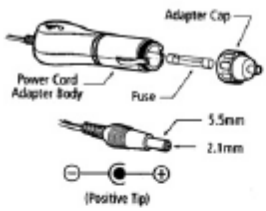
APPENDIX C
Troubleshooting
SOP: ERT-PROC-2209-20
October 2020

(Source: YSI Environmental.2009. *MPS Multi Probe System Operations Manual*)

13. Troubleshooting

The following sections describe problems you may encounter when using the YSI 556 MPS and provides suggestions to overcome the symptom.

PROBLEM	POSSIBLE SOLUTION
Display Problems	
No display is visible after pressing the on/off key.	If C cells are used, make certain that they are installed properly with regard to polarity and that good batteries are used. If a rechargeable battery pack is used, place the pack in the instrument and charge for 30 minutes.
Instrument software appears to be locked up as evidenced by no response to keypad entries or display not changing.	First, attempt to reset the instrument by simply turning off and then on again. If this fails, remove battery power from the instrument for 30 seconds and then reapply power. When using C cells, remove the battery lid and one of the batteries; when using the rechargeable battery pack, remove the pack completely from the instrument. After 30 seconds replace the battery or battery pack and check for instrument function.
The 556 display flashes and the instrument speaker makes a continuous clicking sound.	The battery voltage is low. Change to new C cells or recharge the 6117 battery pack.
Water Damage to Instrument	
Leakage detected in battery compartment when using C cells.	Dispose of batteries properly. Dry the battery compartment using compressed air if possible. If corrosion is present on battery terminals, contact YSI Customer Service.
Water has contacted rechargeable battery pack.	Remove battery pack immediately. Send battery pack to YSI Product Service for evaluation. **CAUTION**: DO NOT REUSE BATTERY PACK UNTIL YSI PRODUCT SERVICE HAS EVALUATED IT.
Leakage suspected into the main cavity of the instrument case.	Remove the batteries immediately. Return the instrument to YSI Product Service.

PROBLEM	POSSIBLE SOLUTIONS
Optional Cigarette Lighten Charger	
Power cord fuse blown. 	1. Unscrew adapter's cap, remove tip and pull out fuse. 2. Replace fuse with a new 2-amp fast-blow fuse from an electronics store such as Radio Shack. 3. Reassemble the adapter and securely screw the cap back onto the adapter body.
File Problems	
Upload of files from YSI 556 MPS to PC fails	1. Make sure that cable is connected properly to both 556 and PC. 2. Make certain that the proper Comm port is selected in EcoWatch for Windows.
Barometer data is not stored with sensor data file.	Make sure **Store barometer** is active in the 556 **Logging setup** menu.
Site Descriptions in the **Site List** are "grayed-out" and not available for appending files with additional data.	There is a parameter mismatch between the current 556 setup and that initially used. Change the current logging and sensor setup to match the setup that was initially used to create the file.
Sensor Problems	
Dissolved Oxygen reading is unstable or inaccurate. Out of Range message appears during calibration.	Sensor not properly calibrated. Follow DO cal procedures.
	Membrane not properly installed or may be punctured. Replace membrane cap.
	DO sensor electrodes require cleaning. Follow DO cleaning procedure. Use 5511 Maintenance kit.
	Water in sensor connector. Dry connector; reinstall sensor.
	Algae or other contaminant clinging to DO sensor. Rinse DO sensor with clean water.
	Barometric pressure entry is incorrect. Repeat DO cal procedure.
	Calibrated at extreme temperature. Recalibrate at (or near) sample temperature.
	DO sensor has been damaged. Replace sensor.
	Internal failure. Return probe module for service.

PROBLEM	POSSIBLE SOLUTIONS
Sensor Problems	
pH or ORP readings are unstable or inaccurate. Out of Range message appears during calibration.	Sensor requires cleaning. Follow sensor cleaning procedure.
	Sensor requires calibration. Follow cal procedures.
	pH sensor reference junction has dried out from improper storage. Soak sensor in tap water or buffer 4 until readings become stable.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace sensor.
	Calibration solutions out of spec or contaminated with other solution. Use new calibration solutions
	ORP fails Zobell check. Take into account temperature dependence of Zobell solution readings.
	Internal failure. Return probe module for service.
Conductivity unstable or inaccurate. Out of Range message appears during calibration	Conductivity improperly calibrated. Follow calibration procedure.
	Conductivity sensor requires cleaning. Follow cleaning procedure.
	Conductivity sensor damaged. Replace sensor.
	Calibration solution out of spec or contaminated. Use new calibration solution.
	Internal failure. Return probe module for service.
	Calibration solution or sample does not cover entire sensor. Immerse sensor fully.
Temperature, unstable or inaccurate	Water in connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace the 5560 sensor.
Installed sensor has no reading	The sensor has been disabled. Enable sensor.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace sensor.
	Report output improperly set up. Set up report output.
	Internal failure. Return probe module for service.

If these guidelines and tips fail to correct your problem or if any other symptoms occur, contact YSI Customer Service for Advice. Refer to *Appendix E Customer Service*.

APPENDIX D
Storage
SOP: ERT-PROC-2209-20
October 2020

(Source: YSI Environmental.2009. *MPS Multi Probe System Operations Manual*)

12. Storage

Proper storage between periods of usage will not only extend the life of the sensors, but will also ensure that the unit will be ready to use as quickly as possible in your next application.

12.1 General Recommendations for Short Term Storage

No matter what sensors are installed in the instrument, it is important to keep them moist without actually immersing them in liquid. Immersing them could cause some of them to drift or result in a shorter lifetime.

YSI recommends that short term storage of all multi-parameter instruments be done by placing approximately 1/2 inch of tap water in the transport/calibration cup that was supplied with the instrument, and by placing the probe module with all of the sensors installed into the cup. The use of a moist sponge instead of a 1/2 inch of tap water is also acceptable, as long as its presence does not compromise the attachment of the cup to the probe module. The transport/calibration cup should be sealed to prevent evaporation.

NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

NOTE: If the storage water (tap water) is accidentally lost during field use, environmental water can be used.

12.2 General Recommendations for Long Term Storage

12.2.1 Probe Module Storage

1. Remove the pH or pH/ORP sensor from the probe module and store according to the individual sensor storage instructions found in Section *12.2.2 Sensor Storage*.

2. Seal the empty port with the provided port plug.

   NOTE: Leave the conductivity/temperature sensor and

dissolved oxygen sensor, with membrane cap still on, in the probe module.

3. Place 1/2" of water, deionized, distilled or tap, in the transport/calibration cup.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

4. Insert the probe module into the cup.

NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

12.2.2 Sensor Storage

Temperature/Conductivity Sensor

No special precautions are required. Sensor can be stored dry or wet, as long as solutions in contact with the thermistor and conductivity electrodes are not corrosive (for example, chlorine bleach). However, it is recommended that the sensor be cleaned with the provided brush prior to long term storage. Refer to Section *11.1.4 Temperature/Conductivity Sensor Cleaning*.

pH and Combination pH/ORP Sensor

The key to sensor storage is to make certain that the reference electrode junction does not dry out. Junctions which have been allowed to dry out due to improper storage procedures can usually be rehydrated by soaking the sensor for several hours (overnight is recommended) in a solution which is 2 molar in potassium chloride. If potassium chloride solution is not available, soaking the sensor in tap water or commercial pH buffers may restore sensor function. However in some cases the sensor may have been irreparably damaged by the dehydration and will require replacement.

⚠ **CAUTION:** Do not store the sensor in distilled or deionized water as the glass sensor may be damaged by exposure to this medium.

1. Remove the pH or pH/ORP sensor from the probe module.
2. Seal the empty port with the provided port plug.
3. Place the sensor in the storage vessel (plastic boot or bottle) which was on the sensor at delivery. The vessel should contain a solution which is 2 molar in potassium chloride.

NOTE: Make certain that the vessel is sealed to prevent evaporation of the storage solution.

APPENDIX E
Theory of Operation
SOP: ERT-PROC-2209-20
October 2020

Theory of Operation

Temperature

The 556 MPS utilizes thermistor sensor technology in which circuit resistance changes predictably with temperature variation. Embedded software, utilizing the Steinhart-Hart equation, converts measured resistance values to accurate temperature readings in degrees Celsius.

pH

The pH 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 containing a gelled electrolyte. A silver wire coated with AgCl is immersed in the buffer reservoir and protons (H+ ions) on both sides of the glass selectively interact with the glass, setting up a potential gradient across the glass membrane. Because 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. The measured potential difference is calibrated to known pH for reporting.

Dissolved Oxygen (DO)

The DO sensor consists of a silver body as the anode with a circular gold cathode embedded in the end. The sensor is filled with a solution of electrolyte containing a small amount of surfactant to improve wetting action. A thin semi-permeable membrane, stretched over the sensor, isolates the electrodes from the environment, while allowing gases to enter. When a polarizing voltage is applied to the sensor electrodes, oxygen that has passed through the membrane reacts at the cathode causing a current to flow. The membrane passes oxygen at a rate proportional to the pressure difference across it. Because oxygen is rapidly consumed at the cathode, the oxygen pressure inside the membrane is presumed zero and the force causing oxygen to diffuse through the membrane is proportional to the partial pressure of oxygen outside the membrane. Oxygen diffusion through the membrane varies as oxygen partial pressure changes, which causes a proportional change in probe current. The measured changes in probe current are calibrated to dissolved oxygen content for reporting as %DO or mg/L DO.

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 voltage drop which is proportional to conductance. The measured voltage drop is then converted and reported as a conductance value in milli-Siemens (millimhos). To convert the conductance value to a conductivity or specific conductance 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 YSI conductivity cell is 5.0/cm + 4%.

Salinity

Salinity is derived from the conductivity and temperature readings according to algorithms found in Standard Methods for the Examination of Water and Wastewater (ed.1999). The use of the Practical Salinity Scale 1978 results in values which are unit-less, because the measurements are carried out in reference to the conductivity of standard seawater at 15°C. However, the unit-less 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, as parts per thousand, was reported. For this reason, the designation "ppt" is reported by the instrument to provide a more conventional output.

Oxidation Reduction Potential (ORP)

The Oxidation Reduction Potential (ORP) of the media is determined by measuring the difference in potential between an electrode which is relatively chemically inert and a reference electrode. A combination pH/ORP probe is utilized to make the ORP measurement. The ORP sensor consists of a platinum button found on the tip of the p9robe and a Ag/AgCl reference electrode containing a gelled electrolyte. The potential associated with platinum button is read versus the Ag/AgCl reference electrode and reported as ORP values in millivolts.