STANDARD OPERATING PROCEDURE

Calibration, Field Measurement, Cleaning, and Storage of the YSI 6920 V2-2 Multiparameter Sonde

KEY WORDS

pH sensor, Conductivity sensor, Dissolved oxygen sensor, Temperature sensor, Turbidity sensor, Water quality

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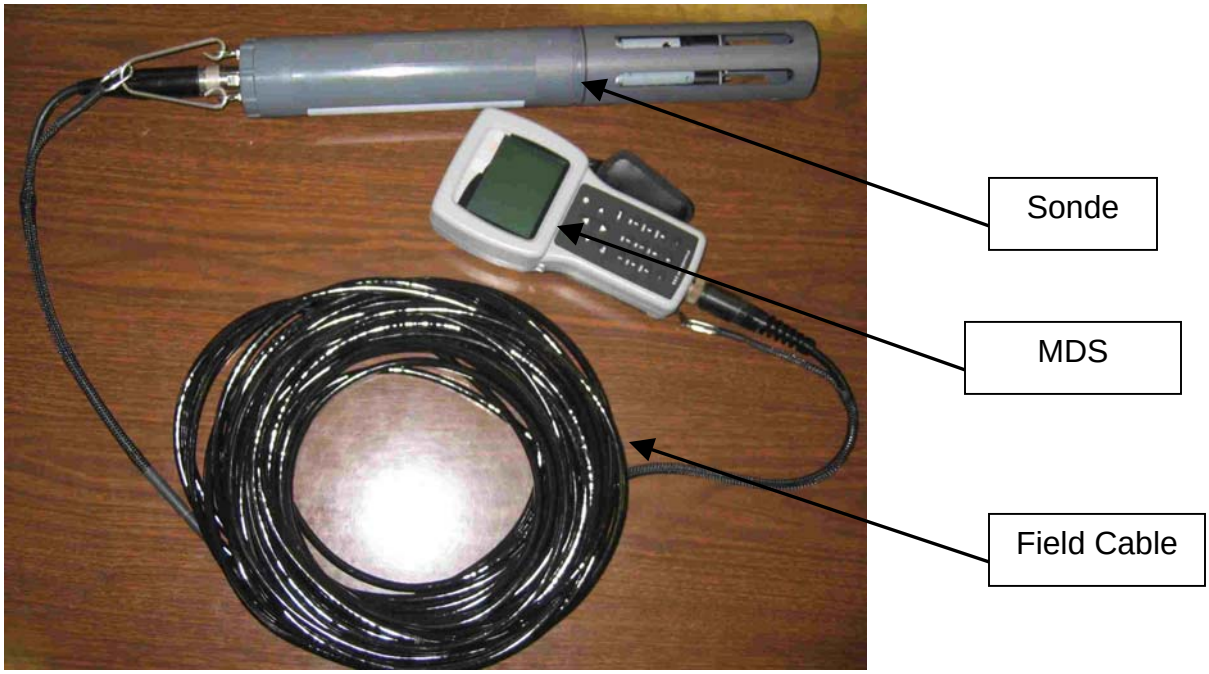
1.0 INTRODUCTION

1.1 Purpose

The Yellow Springs International (YSI) 6920 V2-2 Sonde is a multiparameter water quality monitoring instrument. While connecting to the YSI 650 Multiparameter Display System (MDS) with a field cable, water quality data measured by the Sonde can be viewed in real time. These *in situ* measurements provide important information for analyzing chemical, biological, or other environmental data. This document outlines appropriate techniques for using the YSI water quality monitoring system for short term use and the calibration, confidence check, field measurement, cleaning, and storage procedures.

1.2 Definitions

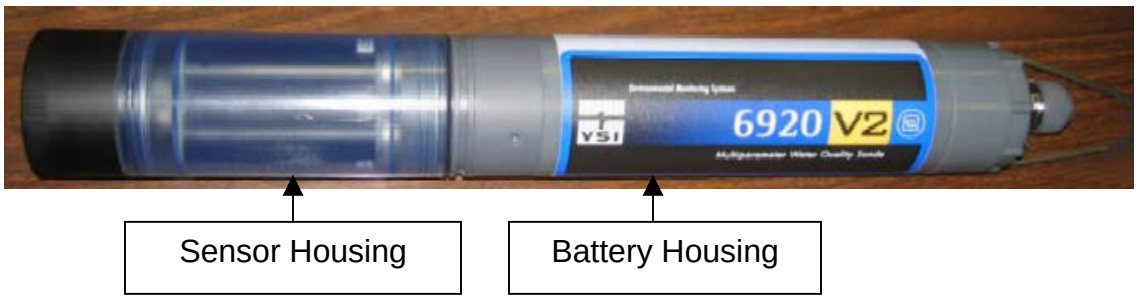
1.2.1 YSI Water Quality Monitoring System- Consists of three (3) components: Sonde, MDS, and a field cable to connect the Sonde to MDS.



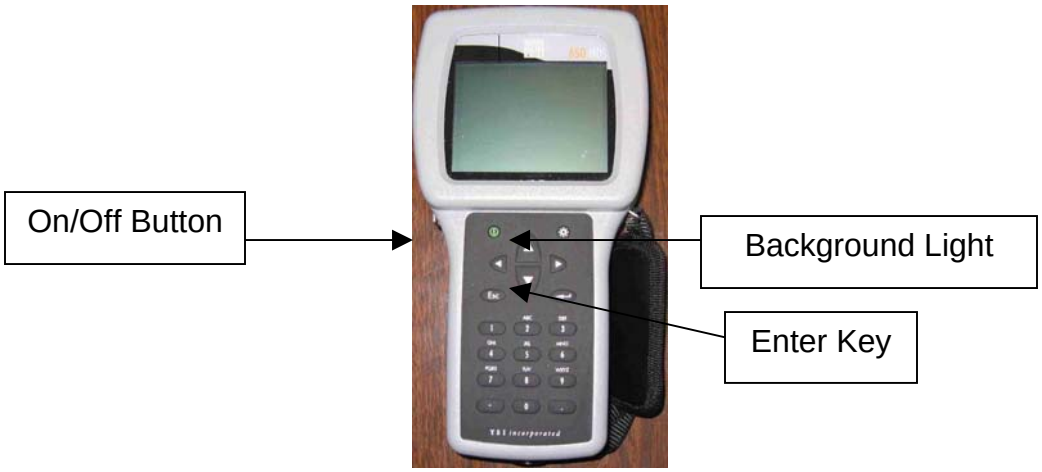
1.2.2 Sonde- The YSI 6920 V2-2 Sonde has two compartments: Battery and sensor housings. The battery housing holds eight (8) AA batteries. The

sensor housing has five ports: two for optical sensors and three for other sensors. Installed sensors include:

- Optical ROX® dissolved oxygen sensor (YSI 6150)
- Optical turbidity sensor (YSI 6136)
- Conductivity/temperature sensor (YSI 6560)
- pH sensor (YSI 6561)



1.2.3 MDS- The YSI 650 MDS used to set up and calibrate the Sonde. The MDS displays monitoring readings, logs real-time data, and uploads data to a computer.



1.2.4 Dummy Plugs- The plugs to protect the ports without sensors.

1.2.5 Chinese Finger Strain Relief Lanyard- The cross-woven rope on the outside of the each of the end of the field cable prevents stress on the cable connections when connected to the Sonde and MDS.

1.2.6 Calibration Solutions- Standard solutions used to calibrate conductivity, pH, and turbidity.

1.2.7 Confidence Solution- The solution used to quickly check the sensors for accuracy.

1.2.8 Calibration/Storage Cup- The Execelon® -R-4000 cup used for calibration or storage. One cup is always attached to the Sonde to protect sensors during storage and transport.

1.2.9 Sonde Guard- The guard used to protect sensors from potential damage during field measurement or deployment.

2.0 MATERIALS

2.1 Sonde (YSI 6920 V2-2)

2.2 Conductivity/temperature sensor (YSI 6560)

2.3 pH sensor (YSI 6561)

2.4 Optical turbidity sensor (YSI 6136)

2.5 Optical ROX® dissolved oxygen sensor (YSI 6150)

2.6 MDS (YSI 650 MDS)

2.7 Field cable to connect the Sonde to the MDS

2.8 4 extra “C” batteries for the displayer

2.9 8 extra “AA” Batteries for the Sonde (Not necessary unless used for long-term deployment.)

2.10 Screw drivers (Phillips and slotted)

2.11 Kimwipes®

2.12 Lens cleaning paper

2.13 Purified water (deionized (DI) water or distilled water)

2.14 Silicone grease

2.15 Calibration solutions

2.15.1 10 mS/cm standard for conductivity

2.15.2 pH 7 and pH 10 standards for pH

2.15.3 0 and 123 NTU standards for turbidity

2.15.4 DI water for dissolved oxygen (DO)

2.16 Confidence solution (YSI 5580)

2.17 Calibration and confidence solution check logsheet (Appendix 1)

2.18 Carrying case for Sonde

3.0 PROCEDURES

3.1 Calibrating the YSI 6920 V2-2 Sonde

Calibration of the Sonde sensors should follow this order: Conductivity, pH, turbidity, and dissolved oxygen (DO). Note that the temperature sensor will not need to be calibrated. If the Sonde has been calibrated within the last 15 days, refer to Section 3.6 for more information on how to check with the confidence or standard solutions in lieu of recalibrating the Sonde. All solutions used for calibration should be at ambient temperature to ensure quality of calibration.

3.1.1 Record calibration date, time, and Sonde serial number or the Sonde/MDS number on the YSI Sonde Calibration and Confidence Solution Check Logsheet (Appendix 1).

3.1.2 Connect the MDS to the Sonde and turn it on.

3.1.3 Select **Sonde Menu, Report** and press **Enter** on the MDS.

3.1.4 Select **Date, Time, Temperature, Specific conductivity, pH, pH mV, turbidity, ODOsat%,** and **ODOmg/L.**

3.1.5 Triple rinse a set of seven (7) Sonde calibration/storage cups with DI water. Then rinse with the appropriate standard solutions. Dispose of used solutions in the sink and flush with copious amounts of tap water. Note: Calibration cups are marked for the appropriate calibration solution.

3.1.6 Fill the calibration cups about half full (to the marked line on the cup) with the appropriate calibration standard solution. For calibration, new bottles of standard solutions must be used.

3.1.7 For the sensors, rinse with DI water.

3.1.8 After rinsing with DI water, rinse the sensor with a small amount of the calibration solution or dry with Kimwipes®. Previously opened standard solutions can be used for pre-rinsing calibration cups or sensors.

3.1.9 Each time the Sonde is calibrated with standard solutions or checked with the confidence/standard solutions, all data must be entered on the logsheet (Appendix 1).

3.1.10 After completion of calibration, dispose of used solutions in the sink and flush with copious amounts of tap water. Clean the calibration cups and the Sonde with DI water.

3.1.11 Fill the bottom of a calibration cup with a small amount (0.5 inch) of DI water and screw it on the Sonde hand tight so no water will leak. The sensors must not be allowed to dry out.

3.2 Calibration of the Conductivity Sensor (YSI 6560)

The YSI conductivity sensor is very linear within its entire 0-100 mS/cm range. It is recommended that the YSI 10 mS/cm conductivity standard be used for the calibration.

3.2.1 Use a thermometer to measure the temperature of the conductivity solution and record the reading to the logsheet.

3.2.2 Screw on the calibration cup that contains conductivity standard solution. Invert and tap the side of the calibration cup to dislodge bubbles stuck inside the side hole. The hole in the side of the sensor must be submerged, without any bubbles trapped in the side hole. Bubbles will prevent accurate measurements.

3.2.3 Use the arrow keys to highlight **Sonde Menu**, then press **Enter** on the MDS.

3.2.4 Select **Calibrate** selection and press **Enter**.

3.2.5 Select **Conductivity** and press **Enter.**

3.2.6 Select **SpCond** and press **Enter**.

3.2.7 Enter the specific conductivity value (@ 25 ^{o}C) of the calibration solution. **Note**: The MDS can be set to display either μS/cm or mS/cm. Use the standard unit of mS/cm for calibration and measurement.

3.2.8 After typing the proper specific conductivity value, press **Enter**. The screen will display real-time readings that will help determine when the conductivity and temperature readings have stabilized (stable for 30 seconds). Allow at least one minute for the temperature to equilibrate.

3.2.9 Record the pre-calibration specific conductivity reading to the logsheet.

3.2.10 Select **Calibrate** on the upper right hand screen and press **Enter** to confirm the calibration. Record the post-calibration specific conductivity value into the logsheet.

3.2.11 Escape to **Main Menu**, select and press **Advanced, Cal Constants,** and record the conductivity constant value into the logsheet. If the cell-constant value is out of the pre-defined range (as specified on the logsheet), replace the calibration solution with solution from a new bottle, re-calibrate, and recheck the cell constant. If the constant value still remains out of range, the sensor must be serviced or replaced.

3.2.12 Rinse the Sonde and sensors with DI water, and dry with Kimwipes® or pre-rinse with the next standard solution.

3.3 Calibration of the pH Sensor (YSI 6561)

A 2-point calibration in most cases will suffice. Choose buffer solutions that are closest to the expected field sample pH. The pH of the sample taken in the field should lie between the chosen calibration solutions. Always start with pH 7 as the first buffer for calibration. Most surface waters in California are between pH 7 and pH 10. For a two-point calibration use pH 7 and pH 10 solutions to calibrate unless the surface water is more acidic (<pH 7).

3.3.1 Screw on the calibration cup that contains the pH 7 solution. Make sure that temperature and pH sensors are submerged.

3.3.2 Select **Calibrate** and then **ISE1 pH**.

3.3.3 Scroll and select **2-point** calibration.

3.3.4 Type in the first pH standard solution value. Note: The actual pH value of the standard solution varies with temperature. A table on the side of the calibration solution bottle provides the appropriate value for a given temperature. Enter the appropriate value from this table as the calibration value. For example, the pH of “YSI pH 7 Buffer” is 7.00 at 25 ^{o}C, but 7.02 at 20 ^{o}C.

3.3.5 After typing the proper pH value, press **Enter**. The screen will display real-time readings that will help determine when the pH and temperature readings have stabilized (stable for 30 seconds). Allow at least one minute for the temperature to equilibrate.

3.3.6 Record the pre-calibration pH reading to the logsheet.

3.3.7 Press **Enter** to confirm the calibration. Record the post-calibration pH value to the logsheet.

3.3.8 Record the mV reading into the calibration logsheet.

3.3.9 Rinse the sensors with DI water, and dry or pre-rinse with an appropriate standard solution.

3.3.10 Screw on the second pH calibration cup. Make sure the temperature and pH sensors are submerged.

3.3.11 Type in the second pH value (the actual pH value from the bottle label) and press **Enter**.

3.3.12 Wait for the meter to stabilize, record the pre-calibration pH reading to the logsheet. Allow at least one minute for the temperature to equilibrate.

3.3.13 Press **Enter** and record the post-calibration pH value into the logsheet.

3.3.14 Record the mV reading into the logsheet.

3.3.15 Subtract the two mV readings. The absolute value should be greater than 160 mV. If this value falls below 160 mV, the sensor must be serviced or replaced.

3.3.16 Rinse the Sonde and sensors with DI water, and dry with Kimwipes or pre-rinse with an appropriate standard solution.

3.4 Calibration of the Optical Turbidity Sensor (YSI 6136)

It is recommended to perform a 2-point calibration for turbidity. For general purpose measurements, the appropriate choice of standards is 0 and 123 NTU (for YSI 6136). Calibrate turbidity only in the provided calibration cup, as light will affect measurements in other containers.

3.4.1 Screw on the cup containing the first turbidity standard (0 NTU) cup.

3.4.2 Select and press **Calibrate, Optic-T Turbidity-6136**, and then **2-point** calibration.

3.4.3 Type in the first turbidity standard (0 NTU) and Press **Enter**.

3.4.4 Select and press **Clean optics** to clean the turbidity optic sensor.

3.4.5 After typing the proper turbidity value and cleaning, the screen will display real-time readings that will help determine when the turbidity reading has stabilized (stable for 30 seconds).

3.4.6 Record the pre-calibration turbidity reading on the logsheet.

3.4.7 When readings stabilize, press **Enter** to confirm the calibration. Record the post-calibration turbidity value into the logsheet.

3.4.8 Press **Enter** to continue.

3.4.9 Rinse the Sonde and sensors, and dry with Kimwipes® or pre-rinse with an appropriate standard solution.

3.4.10 Screw on the cup containing the second turbidity standard.

3.4.11 Type in the value “123 NTU” of the second turbidity standard. (The Sonde is equipped with the 6136 sensor and 123 NTU is it’s standard value). Press **Enter.**

3.4.12 Select and press **Clean optics** to clean the turbidity optic sensor.

3.4.13 After typing the proper turbidity value and cleaning, the screen will display real-time readings that will help determine when the turbidity reading has stabilized (stable for 30 seconds).

3.4.14 Record the pre-calibration turbidity reading to the logsheet.

3.4.15 When reading stabilizes, press **Enter** to confirm the calibration. Record the post-calibration turbidity value into the logsheet.

3.4.16 Rinse the sensors with DI water, and dry with Kimwipes® or pre-rinse with an appropriate standard solution.

3.5 Calibration of the ROX® Optical DO Sensor (YSI 6150)

It is recommended that the1-point, water-saturated air calibration be used for the optical DO sensor.

3.5.1 Fill the bottom of the calibration cup with 1/8 inch (3 mm) DI water and loosely screw (1 turn) the cup onto the Sonde. Air should be able to flow freely into the calibration cup. If the calibration cup is tightened onto the Sonde, pressure will build up inside of the calibration cup, resulting in a falsely high DO reading.

3.5.2 Select and press **Calibrate, Optic-C Dissolved Oxy**, **ODO sat%**, and **1-point calibration**.

3.5.3 Enter the current barometric pressure in mm Hg (displayed on MDS) and record this value on the logsheet.

3.5.4 Press **Enter** and the screen will display real-time readings of DO% and other parameters.

3.5.5 Select and press **Clean optics** to clean the optic DO sensor.

3.5.6 Wait for 10 min for temperature and oxygen pressure to equilibrate and for the air inside the cup to saturate with water vapor.

3.5.7 Observe the **ODOsat%** readings. When they are stable for 30 seconds, record the pre-calibration DO readings (both DO% and DOmg/L) to the logsheet.

3.5.8 Press **Enter** to confirm the calibration. Record the post-calibration DO values (both DOsat% and DOmg/L) to the logsheet.

3.5.9 Select and press **Advanced, Cal Constants, and DO gain,** and record the DO gain value into the logsheet. If this value is out of the pre-defined range of 0.75 to 1.25, the sensor must be serviced or replaced.

3.5.10 Rinse the sensors with DI water, and dry with Kimwipes® or pre-rinse with the confidence solution as described in Section 3.1.7 and 3.1.8.

3.6 Check with the Confidence Solution (YSI 5580) and 123 NTU Turbidity Standard Solution

If the Sonde has not been calibrated within the last 15 days, recalibrate all sensors on the Sonde prior to use as in sections 3.1 to 3.5. If the Sonde sensors have been calibrated, confidence solution should be used to check the performance of conductivity and pH sensors prior to each daily field use. The YSI confidence solution provides standard values for specific conductivity and pH and can be used to quickly check the accuracy of the conductivity and pH sensors. Also, the 123 NTU turbidity standard solution should be used to check the performance of the turbidity sensor prior to each daily use. However, the DO sensor should be re-calibrated according to section 3.5 prior to each daily use.

3.6.1 Screw on the cup containing the confidence or standard solution. Make sure all sensors are submerged. Invert or tap the side of the calibration cup to dislodge bubbles from all sensors.

3.6.2 From the main menu, select and press **Sonde Run**, **Discrete sample**, and **Enter**. The Sonde should automatically clean the optical sensors.

3.6.3 When stabilized, record the readings of temperature, specific conductivity, and pH for the confidence solution, or the reading of turbidity for the turbidity standard solution to the logsheet.

3.6.4 Compare the recorded values of specific conductivity and pH, or turbidity with their respective recommended values for the confidence or standard solution. If these values are within the range of the recommended values, the conductivity, pH, and turbidity sensors are confirmed to have accurate performance and ready for field measurements. If a value falls outside the range of the recommended values, the sensor reporting incorrect values must be re-calibrated.

3.6.5 Rinse the Sonde and sensors and the calibration cup with DI water.

3.7 Field Measurement for Spot Sampling

This section outlines procedures for operation of the 6920 V2-2 Sonde for spot sampling. Procedures for long-term deployment of the Sonde will be written in a future SOP. Record the measurements on the appropriate Field Datasheet or field notebook and save them in a file on the MDS.

3.7.1 Make sure that the Sonde is calibrated or checked for accurate

performance. At a minimum, the following three steps should be taken prior to each field use of a Sonde.

3.7.1.1 Check the conductivity and pH sensors using the confidence solution.

3.7.1.2 Check the turbidity sensor using the 123 NTU turbidity standard solution.

3.7.1.3 Re-calibrate the DO sensor prior to each daily field use.

3.7.2 Connect the field cable and the Chinese finger stress relief lanyards appropriately between the MDS and the metal ring on the Sonde.

3.7.3 Remove the calibration cup and screw on the provided Sonde guard onto the Sonde.

3.7.4 Lower the Sonde into the water slowly to avoid disturbance of bottom sediment. Make sure all sensors are fully submerged.

3.7.5 When water levels are too shallow to submerse the Sonde, use a large container to collect water, into which the Sonde can be submersed for proper measurements or use the smaller instruments described in SOPs EQWA002.00, EQWA003.00 and EQWA004.00. Note this on the Field Datasheet to document how the measurement is taken.

3.7.6 Leave the Sonde in the water undisturbed for five (5) minutes to allow readings to stabilize. Note: Turbidity and DO readings are likely to jump at the beginning and stabilize in a few minutes.

3.7.7 From the MDS Main Menu, select and press **Logging** setup.

3.7.8 Ensure the correct parameters are selected. Interval for spot sampling is one second. Press **Esc** to return to the main menu.

3.7.9 Select and press **Sonde Run**.

3.7.10 In the upper right hand screen, under Sonde, select and press **Clean optics.**

3.7.11 When the readings have stabilized, begin to record the data. In the upper left hand screen, under 650, select **LOG one sample**.

3.7.12 The user will be prompted for a Filename and Site description.

3.7.13 Using the arrow keys, highlight the Filename window and press **Enter**. Enter the file name and press **Enter** to confirm the file name.

3.7.14 Highlight the Site description window, press **Enter**, and enter the site name (optional); press **Enter** to confirm site name.

3.7.15 Highlight **OK** window and press **Enter** to return to the Sonde Run screen. The screen will read "Sample logged"**.**

3.7.16 To view the data in a file, from the Main Menu, select File and press **Enter**. Highlight the **View file** selection and select your file. Use arrow keys to scroll horizontally to view all the data.

3.7.17 Record the temperature, pH, turbidity, specific conductivity, and DO to the Field Datasheet.

3.7.18 When using the Sonde for several sampling sites in one day, remove the Sonde from the water and rinse the Sonde and the Sonde guard with DI water.

3.7.19 Disconnect the Sonde from the field cable and immediately screw the waterproof cap on the Sonde connector.

3.7.20 Replace the Sonde guard with the calibration cup containing a small amount of DI water.

3.7.21 Dry the outside of the Sonde and the Sonde guard with a soft cloth or Kimwipes®. Place the Sonde, Sonde guard, field cable, and MDS in the Sonde's carrying case.

3.8 Cleaning and Short-term Storage of the YSI 6920 V2-2 Multiparameter Sonde

Short-term storage applies for periods shorter than two months. For storage directions for periods longer than two months, see section 3.9.

3.8.1 After each use at a site in the field, clean and remove any solids, oil layers, or debris from the Sonde with DI water.

3.8.2 After each daily use in the field, clean the sonde by the following steps.

3.8.2.1 Rinse and clean the Sonde thoroughly with DI water.

3.8.2.2 Clean the conductivity sensor with the brush provided in the Maintenance Kit 6570. Wet the small brush from the Maintenance Kit with DI water and insert it into each hole of the conductivity sensor 15 to 20 times.

3.8.2.3 Inspect the pH, turbidity, and DO sensors for fouling; also inspect the wipers on the turbidity and DO sensors for wear and replace them if necessary. The surface of the DO sensor can only be gently cleaned with DI water moistened lens cleaning paper.

3.8.2.4 Fill the provided syringe with DI water and pass the water through the pressure sensor (the hole right below the YSI logo on the Sonde).

3.8.3 If oily contamination cannot be removed with rinsing, instrument cleaning detergents (e.g., diluted LiquiNox® solution) may be used for cleaning the Sonde and the temperature, conductivity, pH, and turbidity sensors. Never clean the optical DO sensor with anything but DI-water moistened lens-cleaning paper. Remove the DO sensor, and install the appropriate dummy plug before cleaning with a detergent and reinstall the DO sensor following the cleaning.

3.8.4 Fill the bottom of the calibration cup with a small amount (i.e., 0.5 inch) of DI water and screw it on tightly so no air can get in. The sensors should not be immersed in water but at no time be allowed to dry out.

3.8.5 Dry the outside of the Sonde housing with a soft cloth or paper towels. Place the Sonde, Sonde guard, field cable, and MDS in the carrying case and store in a safe and secure place.

3.9 Long-term Storage of the YSI 6920 V2-2 Multiparameter Sonde

For periods longer than two months, long-term storage techniques should be applied.

3.9.1 Clean all sensors with DI water or with an instrument cleaning detergent if necessary as described in 3.8.3.

3.9.2 Remove all batteries from the Sonde and from the MDS.

3.9.3 Remove pH and turbidity sensors from the Sonde and store according to the

instructions in 3.9.7 and 3.9.8. Cover the empty ports with the provided dummy plugs.

3.9.4 Leave the conductivity/temperature and the ROX® DO sensors in the Sonde.

3.9.5 Cap the DO sensor using the provided cap with a wet sponge inside. Inspect the sponge every 30 days to make sure it is still moist.

3.9.6 Screw the Sonde on a dry, clean calibration/storage cup and dry the outside of the Sonde housing. Place the Sonde in the carrying case and store in a safe and secure place.

3.9.7 The pH sensor should be fully submerged in a pH 4 buffer solution. A storage bottle must be used, which has a slot on the lid to insert the sensor so the glass bulb is fully submerged. Store in a safe and secure.

3.9.8 Dry and cap the turbidity sensor. Place in a plastic bag and store in a safe and secure area.

3.10 Reassembly of Sensors after Long-term Storage

3.10.1 Collect the removed sensors from storage and visually inspect them for damage.

3.10.2 Lightly grease all O-rings on the connections to the Sonde with silicone grease. The grease should not be applied in large quantities, but a very thin film.

3.10.3 Screw in the turbidity sensors first then the pH sensor with the provided sensor installation/removal tool.

3.10.4 Calibrate all sensors as described in 3.1 to 3.5.

4.0 REMEDIAL ACTION IN CASE OF MALFUNCTION

4.1.1 When technical problems occur, make efforts to resolve them. If not, report them to the field coordinator and the project leader.

4.1.2 For further technical support, contact YSI at (800) 765-4974 or at the website: www.ysi.com.

5.0 SAFETY

5.1.1 Personnel safety is of primary importance at all times.

5.1.2 Wear gloves while performing calibration and field measurements.

5.1.3 Walk carefully when carrying the monitoring system in the field.

5.1.4 Always use the provided storage bag during transportation.

5.1.5 MSDS's are available at the field warehouse. Contact your supervisor or field safety officer for more information.

6.0 REPORTING REQUIREMENTS

6.1.1 While performing the calibration and/or checking with the confidence solution of a Sonde, all data must be recorded onto the YSI Sonde Calibration and Confidence Solution Check Logsheet (Appendix 1). These logsheets should be kept for the life of the instrument.

6.1.2 Report low stocks of standard solutions, confidence solutions, or other supplies to the field coordinator and the project leader so that they can be ordered in a timely manner.

7.0 REFERENCES

Multiparameter Water Quality Sonde User Manual. 6-Series. YSI Incorporated. October 2006.

8.0 APPENDICES

Appendix 1. YSI Sonde Calibration and Confidence Solution Check Logsheet.

9.0 ACKNOWLEDGEMENT

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