	Calibration of YSI Multiparameter Data Sondes B-014-OWQ-WAP-XXX-20-T-R0 **Technical Standard Operating Procedure (TSOP)** **Office:** Office of Water Quality **Branch:** Watershed Assessment and Planning Branch **Section:** All **Last Revised:** N/A **Revision Cycle:** Every 4 years **Originally Effective:** January 31, 2020

Purpose (of the TSOP)

This TSOP describes the methods for calibrating YSI multiparameter data sondes. Specifically:

- YSI multiparameter data sondes
  - YSI ProDSS
  - YSI EXO
- parameters:
  - Specific conductivity
  - Dissolved oxygen
  - pH

This TSOP should be used by:

This TSOP applies to agency staff in the Office of Water Quality (OWQ) Watershed Assessment and Planning Branch (WAPB).

Authorizing Signatures

I approve and authorize this technical standard operating procedure:

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OWQ WAPB Probabilistic Monitoring Section
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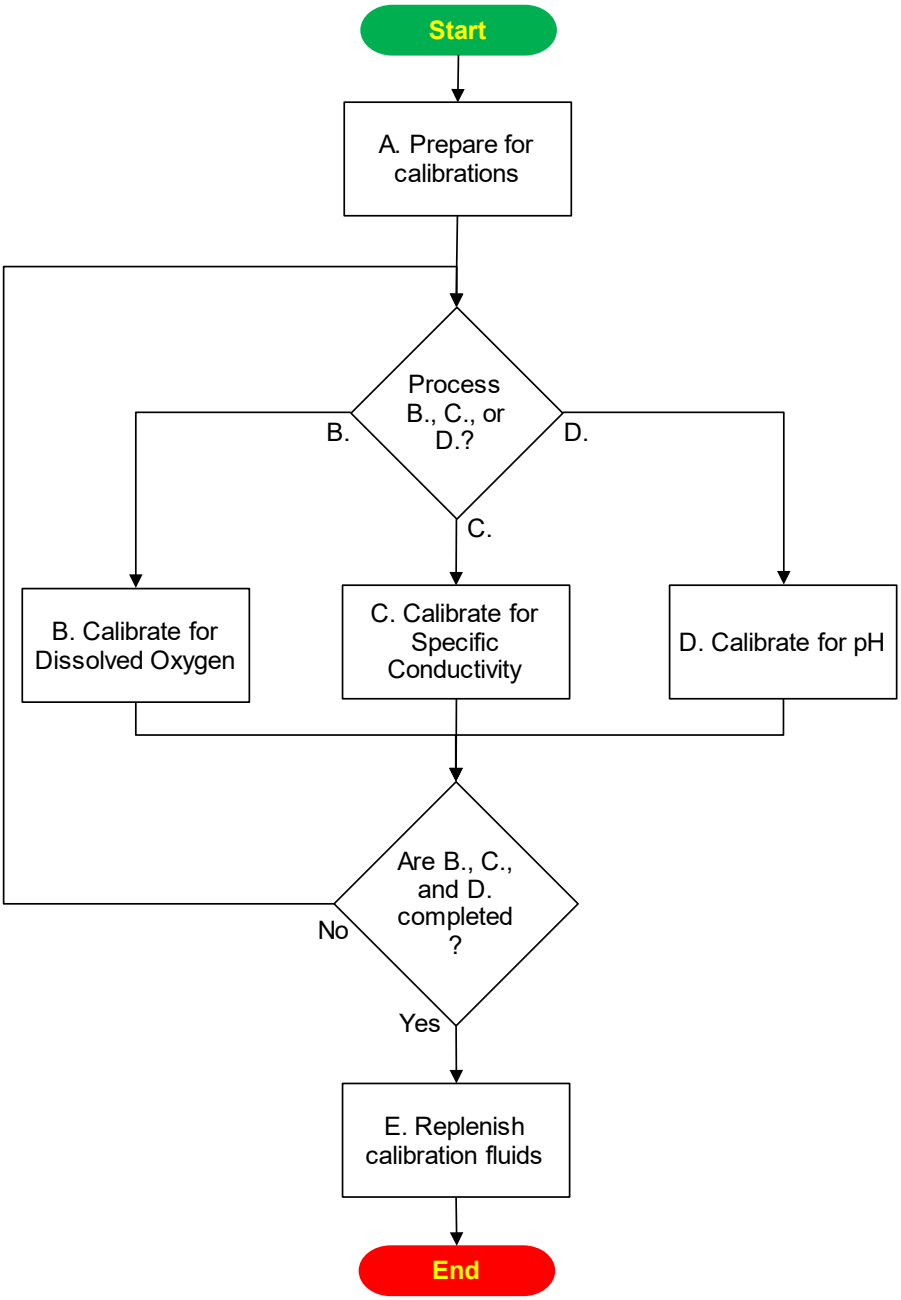
This technical standard operating procedure is consistent with agency requirements.

Quality Assurance Staff
Office of Program Support
Date: 24 Feb 2020

Table of Contents

1.0 Overview Flowchart



2.0 Procedure

2.1. Procedural Flowchart:

2.2. Procedural Steps:

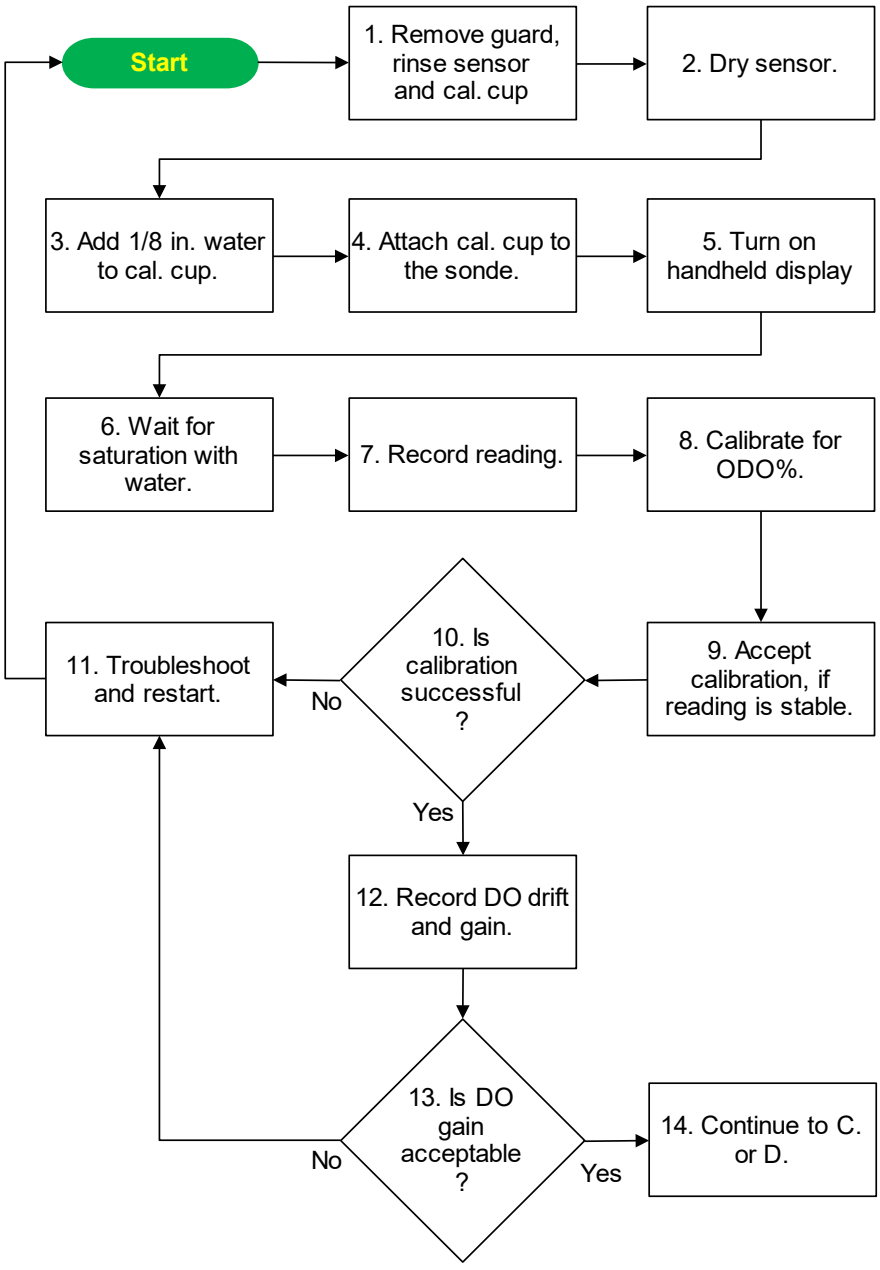
Note: B., C, and D. can be performed in any order.

A. Prepare for calibrations

Step 1. Retrieve Sonde Maintenance and Calibration Log sheet. (See Appendix 9.1). Record YSI Model and Unit# / Serial# at the top of the log sheet; and record date and initials.

Step 2. Have all necessary equipment and solutions ready. If solutions need to be made (i.e., pH buffers or conductivity standard), see section E.

B. Calibrate Dissolved Oxygen (DO) Sensor by DO% in Saturated Air.



Step 1. Remove cover and protective sensor guard. Rinse sensor and calibration cap with deionized (DI) water.

Step 2. Wipe sensor and sensor cap clean and dry using Kimwipes®. Ensure no water droplets are on the optical dissolved oxygen (ODO) sensor cap or temperature sensor. Make sure the cap is not scratched.

Step 3. Place a small amount, 1/8 inch, of clean DI water into a clean calibration cup.

Step 4. Carefully place the sensor into the calibration cup after reattaching the sensor guard. Loosely thread the calibration cup onto the bulkhead. The calibration cup should be secure enough to not fall off, but not so tight to allow some entry of air. Note: The sensor should not touch the water.

Step 5. Turn on the handheld display by pushing the green power button.

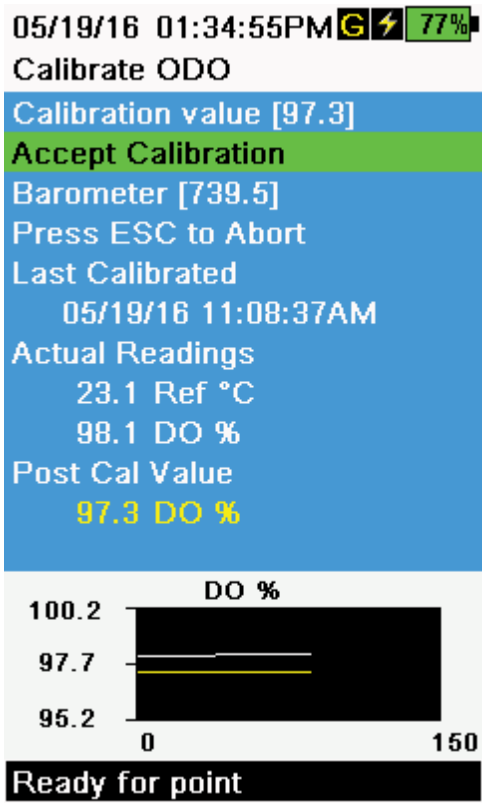
Step 6. Wait at least 10 minutes for the air in the calibration cup to become completely saturated with water.

Step 7. After the D.O. reading has stabilized, record the precalibration value on the Sonde Maintenance and Calibration Log sheet.

Step 8. If using the ProDSS handheld display, push the Cal key, then select ODO. If using the EXO handheld display, select DO% or ODO% – Calibrate – DO% in calibration menus. This will calibrate the instrument's DO% measurement.
Note: YSI data sondes have internal factory calibrated barometers, as barometric pressure is used to calculate the DO% measurement. For each sonde in use monthly, check the barometric pressure displayed on the handheld with an external barometer. Recalibrate, if the pressure is off by more than 2 mmHg. To recalibrate the barometer see the appropriate owner's manual.

Step 9. Observe the actual measurement readings for stability. The reading is considered stable when the white line on graph shows no significant change for 40 seconds (See Figure 1).
Then select Accept Calibration.

Figure 1. ProDSS Handheld Display of Dissolved Oxygen Calibration



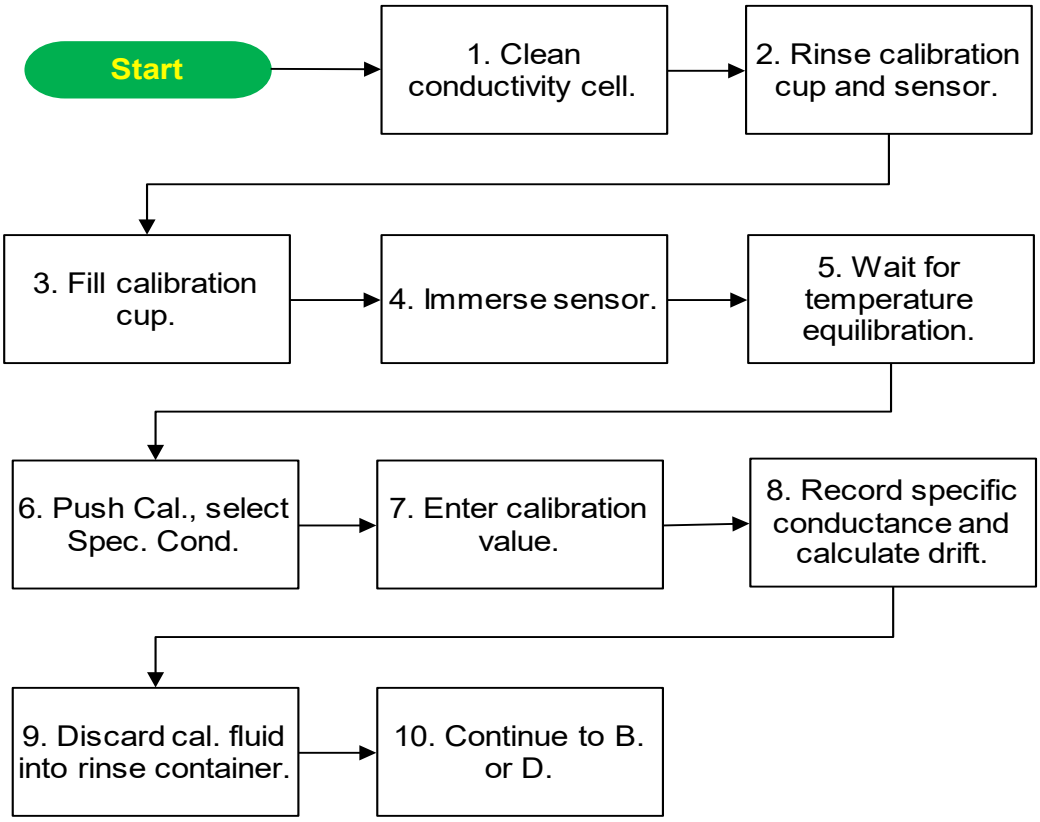
Step 10. If “Calibration successful!” is displayed in the message area at the bottom of the screen, continue to Step 12.
If “Calibration is questionable” is displayed, go to Step 11.

Step 11. Investigate the cause of the questionable results and restart the process.

Step 12. Calculate %DO drift by subtracting the Post Cal Value from the Actual %DO reading. Record %DO Drift. For the YSI ProDSS handheld, view the DO gain on display by pushing the file button, then view GLP. The ODO gain will be displayed. If the DO gain displayed on the screen is outside of 0.75 to 1.50, go to Step 11. If the DO gain is between 0.75 and 1.50, DO calibration is complete. On the EXO handheld display, the DO gain will be displayed in the calibration summary.

Step 13. Continue to C. or D. If C and D complete continue to E.

C. Calibrate Specific Conductivity Sensor



Step 1. If necessary, clean the conductivity sensor with the supplied soft brush or Kimwipe®.

Step 2. Rinse calibration cup and sensor with DI water. Then rinse the calibration cup and sensor with conductivity standard in the designated rinse cup. Discard contents of cup after rinsing.

Step 3. Fill calibration cup with conductivity standard to the second marked line ensuring the surface of the standard is above the vent holes on the conductivity sensor.

Step 4. Immerse the sensor into the solution. Gently rotate the sonde, move it up and down, or both to remove any bubbles from the conductivity cell.

Step 5. Allow at least one minute for temperature equilibration before proceeding.

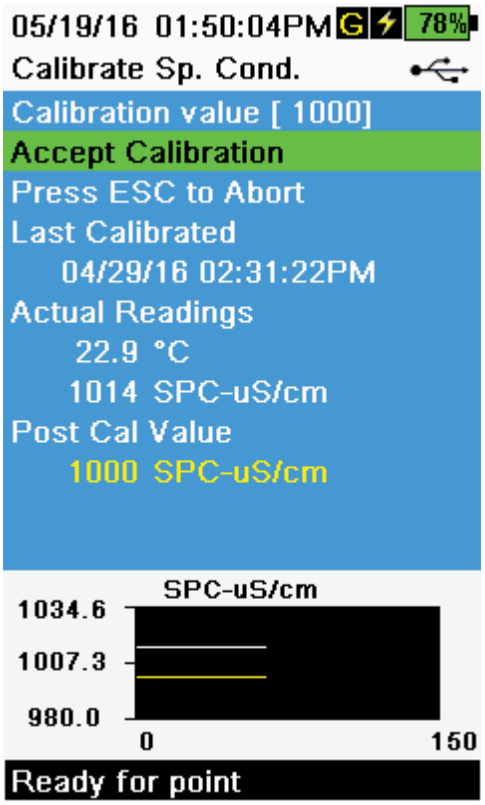
Step 6. If using the ProDSS, push the Cal key, select Conductivity, then select Specific Conductance. If using the EXO handheld, enter the calibrate menu, select conductivity, and in the second menu select specific conductivity.

Step 7. If using the ProDSS, select Calibration Value. Enter the calibration value of the standard used (i.e., 718). If using the

EXO, select Specific Conductance and enter 718. Click start calibration.

Step 8. Observe the actual reading for stability, then select accept calibration. “Calibration successful” will be displayed in the message area at the bottom of the screen. EXO handheld users view the calibration summary screen and QC score. Record specific conductance drift by subtracting the post from the precalibration values. Click ESC to return to the sensor calibration menu, and then the back arrows to return to main Calibrate menu.

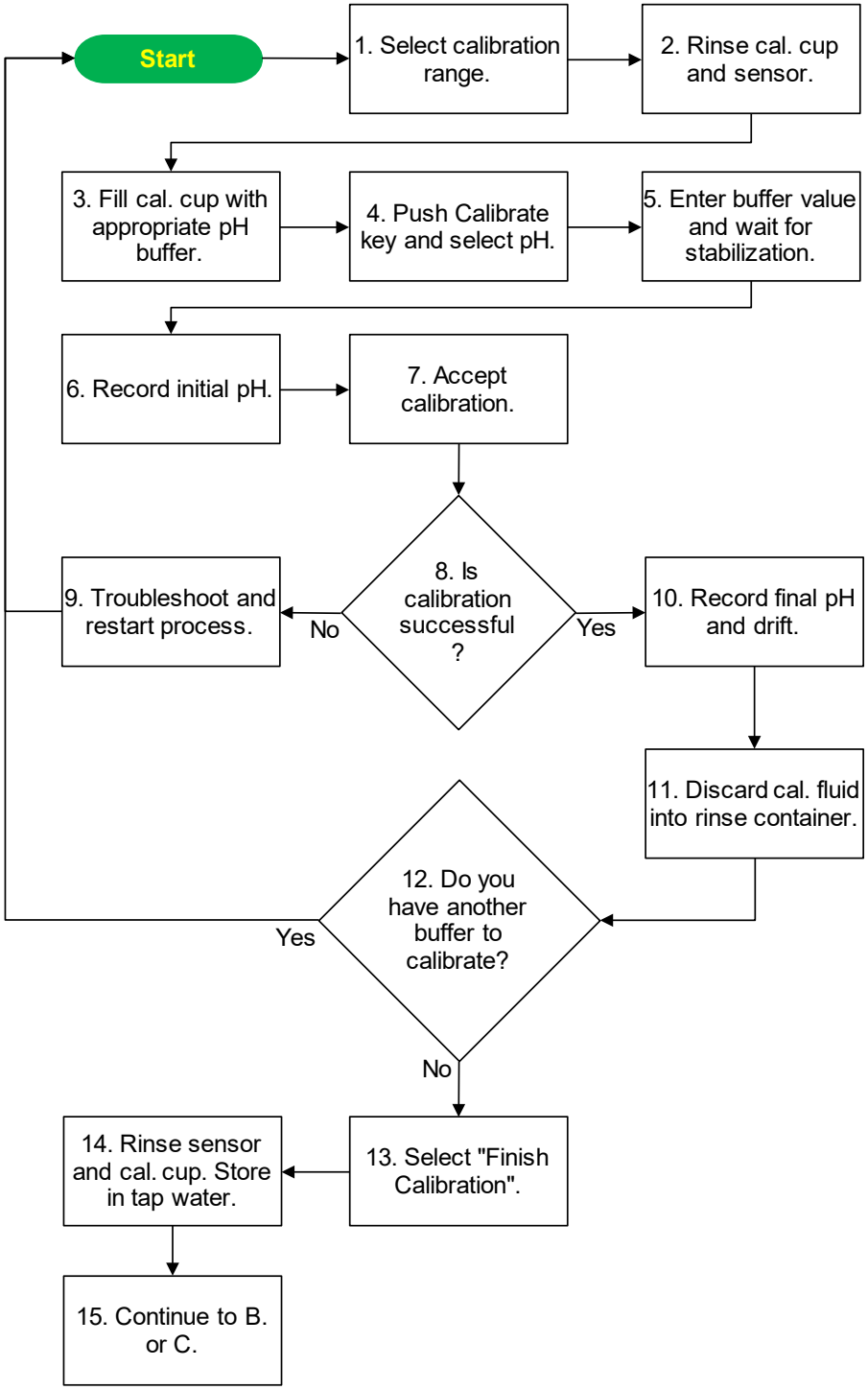
Figure 2. ProDSS Handheld Display of Specific Conductivity Calibration



Step 9. Empty calibration cup into the KCl Specific Conductance Rinse container.

Step 10. Continue to B. or D. If B. and D. complete continue to E.

D. Calibrate pH Sensor



Step 1. Typically, a two point calibration with pH 7 and 10 buffers is sufficient. However, if taking pH readings of acidic water (e.g., in acid mine drainage areas), it is necessary to include the pH 4

buffer as well. **Always start the calibration with the pH 7 buffer.** Follow Steps 2. – 11. for each buffer solution to be used.

Step 2. Rinse the calibration cup and sensor with DI water. Then rinse with the appropriate pH standard in the rinse cup.

Step 3. Fill the calibration cup to Line 1 with pH buffer. With the sensor guard installed, carefully immerse the sensor into the buffer solution. Both the pH sensor and temperature sensor should be submerged.

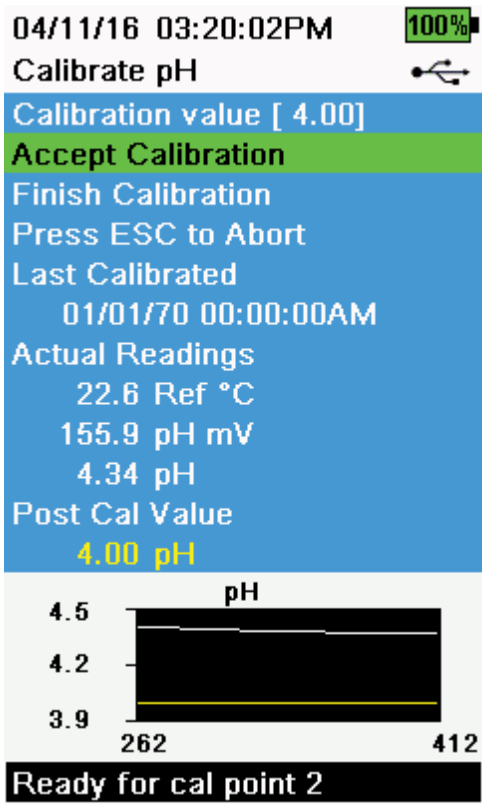
Step 4. If using the ProDSS, push the Cal key, then select pH. If using the EXO handheld, in the Calibrate menu, select 2-pH or 3-pH (depending on how many buffer solutions are being used). Then select calibrate. Display will read Ready for Cal pt. 1. (or 2. or 3. respectively) at the bottom of the screen.

Step 5. Wait for temperature and pH reading to stabilize. The calibration value will automatically be adjusted based on the buffer used (4, 7, or 10) and temperature of the buffer.

Step 6. Record initial pH (under Actual Readings on handheld display) after the reading stabilizes.

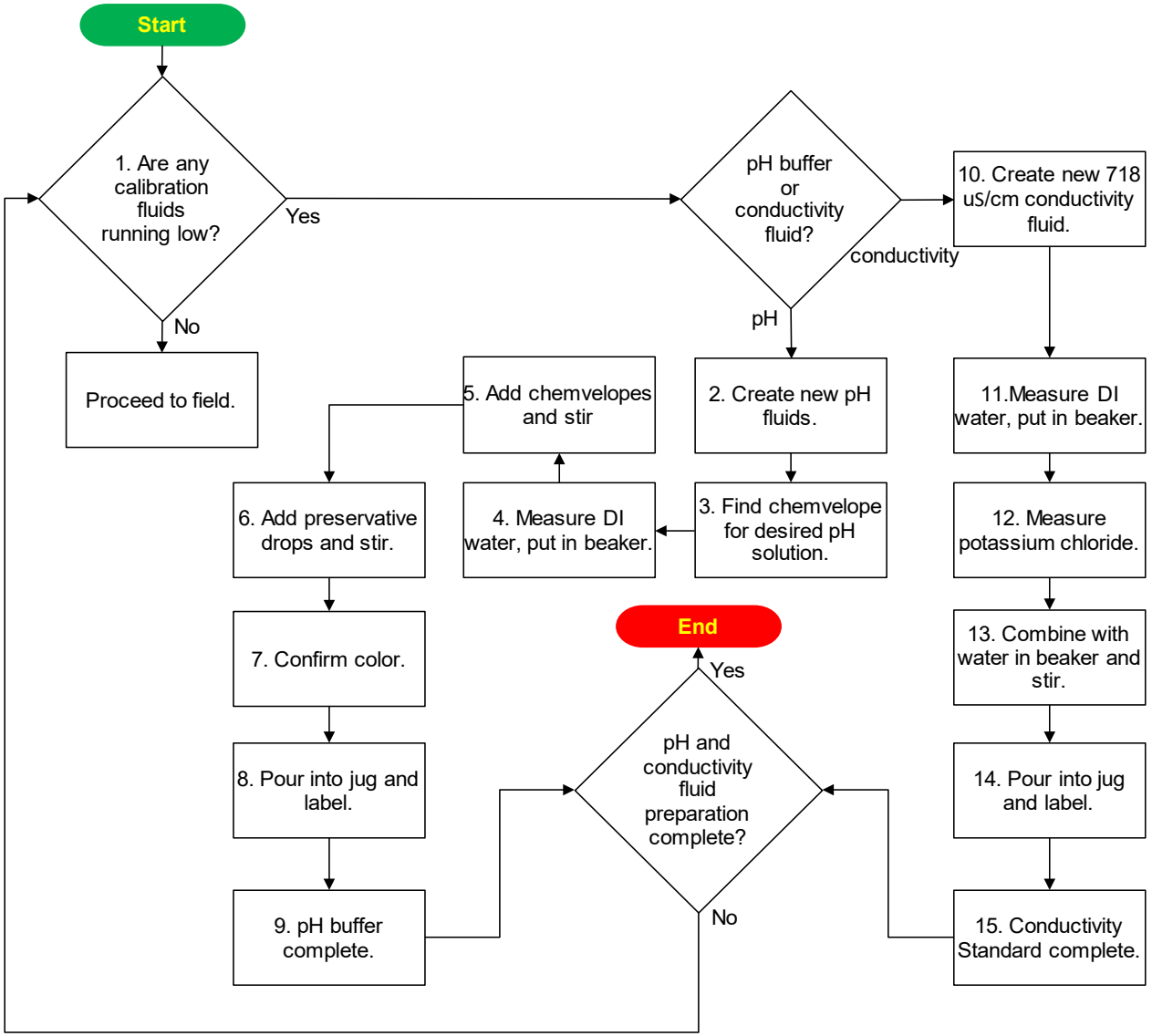
Step 7. Press Enter to accept calibration.

Figure 3. ProDSS Handheld Display of pH Calibration



Step 8. “Calibration successful” or “Calibration is questionable” will be displayed. The display will prompt readiness for the next cal point, at the bottom of the screen.
Step 9. If calibration is questionable, troubleshoot and restart process.
Step 10. Record the final pH and calculate drift by subtracting the final pH value (Post Cal Value) from the initial (Step 6.) value.
Step 11. Empty the buffer from the calibration cup into the rinse container.
Step 12. Repeat Steps 2.–11. until calibration is successful for each buffer in the selected range.
Step 13. Then select Finish Calibration to end calibration.
Step 14. Rinse sensor and cal cup with DI water. Finally, if this step concludes the calibrations, reattach the calibration cup used for storage containing about 1.5 inches of fresh TAP WATER (or stream water if calibrating in the field). Do NOT store sensors in DI water.
Step 15. Continue to either B. or C. If B. and C. complete, continue to E.

E. Replenish Calibration Fluids



Step 1. If no solutions are needed, calibration is complete. The sonde is now ready for use in the field. If calibration fluids are running low, replenish them, proceed to Step 2. for pH buffers, proceed to Step 10. for conductivity standard.

Step 2. Create new pH buffers: follow directions on Hydrion® Buffer Chemvelope Box (outlined below). Note: About 1500 mL (1.5 L) fit in a half gallon jug. It is recommended to make 2L of solution at a time, in order to mostly fill 2 half gallon jugs.

Step 3. Find the appropriate Hydrion Buffer Chemvelope for the desired solution (pH 4, 7, or 10).

Step 4. Use a volumetric flask or graduated cylinder to measure desired volume of DI water (must be a multiple of 500 mL). Pour into beaker.

Step 5. Add 1 chemvelope for desired pH per 500 mL of water. Use clean magnet and spin plate to stir until dissolved.

Step 6. Add 3 drops buffer preservative per 100 mL (15 drops per 500mL, or 30 per 1L). Stir.

Step 7. Confirm color of solution. pH 4 should be orange, 7 is green, and 10 is blue. If color doesn't match start over.

Step 8. Pour into clean, empty half gallon jug. Label with buffer type, date, and initials.

Step 9. Your pH buffer is complete, return to Step 1.

Step 10. Create New 718 us/cm conductivity standard:
Note: About 1500 mL (1.5 L) fit in a half gallon jug. It is recommended to make 2L of solution at a time, in order to mostly fill 2 half gallon jugs.

Step 11. Use a volumetric flask or graduated cylinder to measure desired volume of DI water (must be a multiple of 500 mL). Pour into beaker.

Step 12. Use a clean weigh boat and metal scoop to measure 0.1864 g of dry potassium chloride per 500 mL water. (i.e., If 1 L water, use 0.3728 g.)

Step 13. Add potassium chloride to the beaker of water. Stir until dissolved using clean magnetic bar and stir plate.

Step 14. Pour into clean, empty half gallon jug. Label as 718 uS/cm conductivity standard. Mark with the date and preparer's initials.

Step 15. The conductivity standard is complete, return to Step 1.
Note: pH buffers and conductivity standards once prepared have a one month shelf life.

2.3. Related Technical Issues:

A. Health and Safety Warnings:

1. Safety issues are the responsibility of all crew members; however, any questions in the field or lab should be directed to the crew chief. The crew chief is responsible for the completion of all work listed in this TSOP; the health and safety aspects of the sampling event; and successful interactions with landowners and members of the public.
2. Due to possible hazards presented by the pH buffers and potassium chloride, review the safety data sheets (SDS) and wear the required PPE:
    a. Chemical resistant latex or nitrile gloves
    b. UV Safety Glasses

B. Cautions:

- To ensure equipment measurements are correct, ensure conductivity standards or pH buffers used are not expired.
- To ensure accurate calibration of equipment, ensure enough solution is used to cover the sensor(s) when measuring pH and conductivity.
- Ensure the correct mode is used when calibrating the equipment, to ensure proper calibration.

C. Interferences:

- To ensure readings are accurate, ensure a clean sensor guard is attached before taking readings. This includes calibrations.

D. Troubleshooting:

- Refer to the ProDSS Calibration Guide and to the ProDSS User Manual for Troubleshooting Tips when using the ProDSS sonde.
- Refer to the EXO Handheld Display Manual for further Troubleshooting Tips when using the EXO sonde.

3.0 Roles

3.1 Responsibilities:

A. Crew Chief

1. Calibration and Maintenance of YSI data sondes

3.2 Training requirements:

A. Calibration of YSI Multiparameter Data Sondes B-014-OWQ-WAP-XXX-20-T-R0

4.0 List forms, equipment, and/or software to be used

4.1 Forms

A. Sonde Maintenance and Calibration Log

4.2 Equipment:

A. YSI ProDSS sonde and ProDIGITAL handheld display

B. YSI EXO sonde and EXO handheld display

4.3 Reagents

A. Potassium chloride (conductivity standard)

B. pH buffer 4.0 (if necessary)

C. pH buffer 7.0

D. pH buffer 10.0

Note: pH buffers are made from Hydrion® Buffer Chemvelopes from Microessential Laboratory

4.4 Software:

A. N/A

5.0 Records Management

- The Sonde Maintenance and Calibration Logs are kept in a binder in the Survey's Lab for a period of 5 years.
- After 5 years these logs are scanned into the Virtual File Cabinet (VFC)

6.0 Definitions

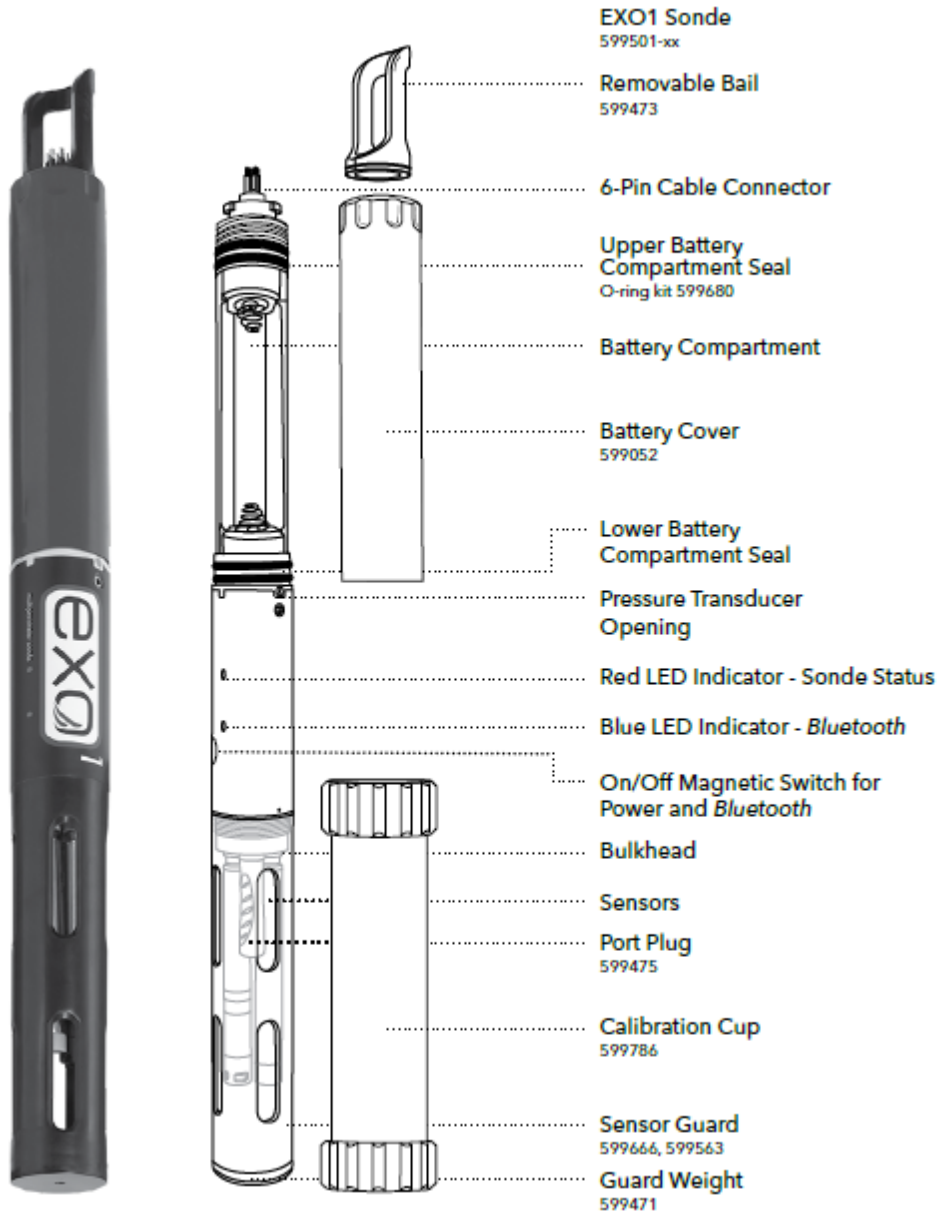
6.1 "Virtual File Cabinet (VFC)" – The agency's electronic document management repository. This repository has all of the functionality necessary to capture, store, file, index, redact, reassemble, and securely access electronic documents of all types both received and created by the various programs within the agency and allows public viewing, searching, and printing capabilities.

6.2 Multiparameter data sonde (MDS) – An instrument that collects water quality data with multiple replaceable sensors. Each sensor measures its

parameter via a variety of electrochemical, optical, or physical detection methods. Data is stored onboard the sonde. Data can be transferred to a data collection platform or relayed directly to a PC or a handheld display. Users typically communicate with the sonde via a cable assembly (also called a field cable) to a handheld display.

Figure 4. Image of a ProDSS sonde with Cable Assembly and Calibration Cup Attached and an EXO sonde with Calibration Cup Attached.

Figure 5. Diagram of an EXO sonde



6.3 Handheld display – a microcomputer-based instrument that allows the user to display sonde readings, configure sondes, store and retrieve data, and transfer data from sondes to a computer. An image of both the ProDSS and EXO handheld displays are seen.

Figure 6. Image of YSI ProDSS and YSI EXO Handheld Displays

7.0 Quality Assurance / Quality Control

- Calibration of a multiparameter data sonde is good for one week.
- Failures during calibration should be recorded in the comments section.

8.0 References

8.1. YSI ProDSS User Manual English, ITEM# 626973-01REF, Revision F, Xylem, August 2018

8.2. ProDSS Calibration Guide, W89, Xylem, January 2017.

8.3. EXO Handheld Operation Guide, E117 Mini-Manual Revision A, Xylem, July 2016

9.0 Appendices

Appendix 9.1 Sonde Maintenance and Calibration Log

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
SONDE MAINTENANCE AND CALIBRATION LOG
Revised 2-2019

YSI Model: ________________ Unit # / Serial#: ________________

Date	Initials	CALIBRATION															
		DO Y/N	DO Drift	DO Gain in GLP After Cal (0.75 to 1.50)	pH Y/N	pH 7 Drift	pH mV Buffer 7 (-50 to 50 mV)	pH mV Buffer 10 (-165 to -185 mV From pH 7 Buffer mV Value)	pH Slope in GLP After Cal (abt. 55-60, ideal 59)	Spec Cond Y/N	Spec Cond Drift	Spec Cond Cal Const. in GLP (4.5-6.5)	TAL-PC RFU 0 Drift	TAL-PC RFU 0.625 Drift	TAL-Chlor. RFU 0 Drift	TAL-Chlor. RFU 0.625 Drift	
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