1.0 Purpose and Scope

This document describes the Sandia National Laboratories (SNL) Waste Isolation Pilot Plant (WIPP) procedure for calibration and maintenance of the YSI Professional Plus (Pro Plus) and the EXO1 Multi-Parameter analytical water quality measurement instruments. This SP is in support of activities described in several WIPP Test Plans (TPs). Both SNL and contractor personnel will use this SP.

Acronyms and definitions for terms used in this procedure may be found in the Glossary located at the SNL WIPP Online Documents web site.

2.0 Implementation Actions

These quality measurement instruments will be used for the experimental work in support of the WIPP-related studies. This document is not meant to substitute for the manufacturer instruction manuals for these instruments. The user is responsible for reading and understanding the appropriate manuals. Guidelines for implementing and documenting quality assurance (QA) procedures are presented in this document, and follow the general guidelines given in Nuclear Waste Management Procedure (NP) 12-1 “Control of Measuring and Test Equipment.”

2.1 Safety and Training

The activities described in this SP shall conform to SNL Environmental Health and Safety Programs (ES&H). All activities described in this SP are subject to ES&H requirements governed by the WIPP Industrial Safety Program and the WIPP Industrial Hygiene Program.

Disposal of the pH, Oxidation Reduction Potential (ORP), Dissolved Oxygen (DO), and conductivity solutions used during the performance of this procedure will adhere to the SNL/Carlsbad lab practices.

As defined in the SNL ES&H manual, personnel will not be exposed to hazardous voltages. The voltage levels expected in the performance of this procedure should be 24 VDC or less.
2.2 Responsibility

The Person in Charge (PIC), whose activities warrant the use of this procedure, is responsible for implementing the requirements of this procedure. The PIC is responsible for directing or performing the calibrations and measurements following the requirements of this procedure, documenting calibrations, and assuring that the latest revision of this document is followed. All calibrations performed in support of instruments that will be used on a WIPP testing program shall be documented in the applicable Scientific Notebook or Scientific Notebook Supplement. In this procedure, the term ‘record’ or ‘recorded’ will imply that the results/information are documented in the applicable Scientific Notebook or Scientific Notebook Supplement.

2.3 Water Quality Measurement Instrument Selection

The PIC will ensure that the water quality measurement instruments are of the proper type, design, range, accuracy, and tolerance to accomplish their required function.

2.4 Identification

The water quality measurement instruments are identified by manufacturer, model number, and serial number, if applicable. When not supplied with a serial number, the instruments will each be assigned a permanent number that will be recorded when that instrument is used.

2.5 Instrument Preparation

Prior to calibration of any instrument, inspect the instrument for damage, wear or excess dirt. If the instrument is damaged or in disrepair, notify the PIC and implement corrective actions following their direction. Prior to the calibration of all instruments, clean the instrument and any sensor electrodes following manufacturer’s recommendations.

2.6 Calibration

2.6.1 Standards

Calibration will be performed using commercially obtained solutions that are traceable to the National Institute of Standards and Technology (NIST) or other nationally recognized standards. The use of room air as a zero value conductance standard is normal and acceptable. The identity, manufacturer, lot number, and expiration date of the standards used shall be recorded (N/A for air). A calibration solution will not be used past its expiration date listed on the container by the manufacturer.

As a general guideline, the solution(s) to be used during a calibration should be close to or bracket the expected measurement ranges for the work being performed. During Calibration Adjustments or As-Left Calibrations the upper value solution should match or exceed 50% of the full range of the instrument.

A minimum of one standard shall be used for calibration of water quality measurement instruments. The use of two or more standards is recommended. The following table summarizes the recommendations for each type of instrument. The basis for this table is the manufacturers’ recommendations combined with previous calibration history and experience with these instruments. These recommendations are subject to adjustment by the PIC.
Table 1. Minimum Number of Standards Required During Calibrations

<table>
<thead>
<tr>
<th>Instrument / Calib. Type</th>
<th>YSI Pro-Plus Sonde pH</th>
<th>YSI Pro-Plus Cond.</th>
<th>YSI Pro-Plus ORP</th>
<th>YSI Pro-Plus DO</th>
<th>EXO1 Sonde pH</th>
<th>EXO1 Sonde Cond.</th>
<th>EXO1 Sonde ORP</th>
<th>EXO1 Sonde DO</th>
</tr>
</thead>
<tbody>
<tr>
<td>As-found / As-left Calib.</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Calibration Adjustments</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

2.6.2 Instrument Controls and Software

The Pro-Plus and EXO1 Sondes have installed software that enables the user to follow screen prompts for easier calibration. For ease of reference the images below will assist in familiarizing the user with the keypad functions for the Pro-Plus sonde and the calibration screen of the EXO1 software.

![Pro-Plus Keypad](image1)

![Calibration Screen](image2)

Figure 1. Pro-Plus Keypad
2.6.3 Temperature & Stability of Readings

During the calibration, the temperature of the area and solutions will be monitored, measured, and recorded. Prior to the start of the calibration, all solutions shall be given sufficient time to equilibrate to room temperature.

When an instrument is initially placed into a calibration solution, rapid changes in values will be observed while the instrument acclimates (temperature equalization is a significant part of this process). Stabilization cannot be rushed and requires sufficient time to allow completion (recommended times are specified within the procedure section for each instrument). A change of less than 1% in subsequent readings demonstrates that stability has been achieved. EXO1 Sonde software automatically detects stable readings and will prompt the user when stability is achieved.

2.6.4 Frequency

The instruments will be calibrated prior to initial use in the collection of qualified data and on a frequency identified by the PIC and the manufacturers’ recommendations. After being used in a testing activity for the collection of WIPP QA-type data, the instruments will undergo an As-Found calibration check to establish their accuracy. If the user of the instrument observes any irregularities in the instrument, the instrument will be tagged to document the concern and will be immediately recalibration.

2.6.5 Acceptance Criteria

The water quality measurement instruments’ calibration results are acceptable when they meet or exceed (better than) the uncertainty specifications identified by the manufacturers or the PIC. The
acceptance criteria used to approve or reject the calibration results will be listed in the applicable Scientific Notebook or supplement to the Scientific Notebook.

2.6.6 Troubleshooting

If the water quality measurement instrument cannot meet the acceptance criteria (see section above), the calibration solution should be replaced and a subsequent re-calibration attempted. If the instrument still does not meet the acceptance criteria, the instrument will be removed from service, labeled with an ‘Out of Service’ tag and returned to the manufacturer for repair or removed from permanent service.

2.7 pH Parameter Calibration As-Found or As-Left Check

For all pH measuring instruments that have been used to collect data in support of a WIPP program activity, perform an As-Found calibration check to determine the accuracy of the device prior to performing any adjustments. If the pH instrument has been adjusted, perform an As-Left calibration check to document the instrument’s accuracy. The steps are the same whether it’s an As-Found or As-Left calibration check.

2.7.1 Both instruments have removable sensors that screw into ports in the main body of the instrument. This allows for the removal and installation of sensors depending on the parameter being measured. All sensors can be left in place during the calibration of other sensors, however if removed, a port plug should be inserted in the empty port to keep the instrument free of dust and moisture.

2.7.2 For all As-Found or As-Left Calibrations, a minimum single point solution check shall be performed. Additional buffer solutions may also be incorporated into the check as directed by the PIC.

2.7.3 For all pH buffer solutions, following placement on the instrument probe, allow sufficient time for the instrument to equilibrate to the applied solution. Stable pH readings indicate that the pH instrument and solution have equilibrated.

2.7.4 Place the pH probe being calibrated into the first pH buffer solution. Once the value being measured by the pH instrument has stabilized, follow the software’s on-screen instructions by type instrument to proceed to next step(s). The instrument should automatically record the value of the buffer solution and the pH probe readings. These can be printed for recording in the scientific notebook or supplemental. It is recommended, however, that the values also be manually recorded to ensure the data is captured.

2.7.5 Rinse the probe with deionized water and dry it with clean wipes and lab-grade compressed air or equivalent. If this is a single-point calibration, proceed to step 2.7.7.

2.7.6 Repeat step 2.7.4 for any additional pH buffer solutions being used for the applicable calibration.

2.7.7 For the pH instrument being calibrated, the results of the calibration check shall be compared against the expected uncertainty or accuracy requirement of the instrument. If the calibration check is an As-Found calibration and the results do not fall within the expected uncertainty or accuracy requirements, a Corrective Action Request (CAR) will be issued to document the results and impacts related to the change in pH instrument’s performance.

2.7.8 If the As-Found results are out of tolerance or if improved performance is desired, perform the complete calibration adjustment section related to the type instrument being calibrated.

2.7.9 If the calibration check was an As-Left calibration and the results are out of tolerance, repeat the applicable calibration adjustment section related to the type instrument being calibrated. Remove the instrument from service if the calibration adjustment has been performed more than two times, and the instrument still does not meet the expected uncertainty or accuracy requirements. Tag and label the pH instrument accordingly, and if practical, return it to the manufacturer for repair.
2.8 YSI Pro Plus pH Meter Calibration Adjustment

2.8.1 Turn the instrument on by pressing the on/off key. Press Cal. Highlight Probe ID or User ID if you wish to add, select, edit, or delete an ID. User ID will appear automatically. Select ‘None’ if you do not want a User ID stored with the calibration.

2.8.2 After selecting your User ID and/or Probe ID if appropriate, highlight ISE (pH) and press enter. The message line will show the instrument is “Ready for point 1”.

2.8.3 Place the sensor in a traceable pH buffer solution. The instrument should automatically recognize the buffer value and display it at the top of the calibration screen.

NOTE: If the calibration value is incorrect, the auto buffer recognition setting in the Sensor Setup menu may be incorrect. If necessary, highlight the Calibration Value and press enter to input the correct buffer value.

2.8.4 Once the pH and temperature readings stabilize, highlight Accept Calibration and press enter to accept the first calibration point. The message line will then display “Ready for point 2”.

2.8.5 If User Field 1 or 2 are enabled, you will be prompted to select these fields and then press Cal to finalize the calibration.

2.8.6 To continue with the 2nd point, place the sensor in the second buffer solution. The instrument should automatically recognize the second buffer value and display it at the top of the screen. If necessary, highlight the Calibration Value and press enter to input the correct buffer value.

2.8.7 Once the pH and temperature readings stabilize, highlight Accept Calibration and press enter to confirm the second calibration point.

NOTE: The message line will then display ‘Ready for point 3’ and you can continue with the 3rd calibration point if desired.

2.8.8 If you do not wish to perform a 3rd calibration point, press Cal to complete the calibration. If User Field 1 or 2 are enabled, you will be prompted to select these fields and then press Cal to finalize the calibration. Continue in this fashion until the desired number of calibration points is achieved (up to six).

2.9 EXO1 Sonde pH Sensor Calibration Adjustment

2.9.1 Turn on the instrument by launching the KOR software on a laptop computer

NOTE: If using the Bluetooth connection follow instructions in user’s manual for interface instructions.

2.9.2 Select the 1-point option to calibrate the pH probe using one calibration standard

2.9.3 Select the 2-point option to calibrate the pH probe using two calibration standards. In this procedure, the pH sensor is calibrated with a pH 7 buffer and a pH 10 or pH 4 buffer depending on the desired bracketed range of your environmental water.

2.9.4 Select the 3-point option to calibrate the pH probe using three calibration standards. 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.

2.9.5 Pour the correct amount of pH buffer in a clean and dry or pre-rinsed cup. Carefully immerse the probe end of the sonde into the solution, making sure the sensor’s glass bulb is in solution by at least 1 cm. Allow at least 1 minute for temperature equilibration before proceeding.

2.9.6 In the calibrate menu, select pH or pH/ORP, then select pH.
2.9.7 Select the number of points desired for the calibration. Enter the values(s) of the pH buffer(s) that will be used for calibration.

**NOTE:** Observe the temperature reading above the standard value. The actual pH value of all buffers varies with temperature. Enter the correct value from the bottle label for your calibration temperature for maximum accuracy. For example, the pH of one manufacturer’s pH 7 Buffer is 7.00 at 25 C, but 7.02 at 20 C. If no temperature sensor is installed, user can manually update temperature by entering a value.

2.9.8 Click Start Calibration. Observe the readings under Current and Pending data points and when they are Stable (or data shows no significant change for approximately 40 seconds), click Apply to accept this calibration point. Kor Software will normally prompt when stabilization is achieved. Confirm that the Pending data value is close to the Setpoint value. Click Proceed and wait for the software to prompt you to move the sensor to the next standard solution.

2.9.10 Rinse the sensor in deionized water. Pour the correct amount of an additional pH buffer standard into a clean, dry or pre-rinsed calibration cup, and carefully immerse the probe end of the sonde into the solution. Allow at least 1 minute for temperature equilibration before proceeding.

2.9.11 Repeat the calibration procedure and click Apply when the data are stable. Rinse the sensor and pour additional pH buffer, if necessary. Repeat calibration procedure for the third point and click Apply when data are stable.

2.9.12 Click Complete. View the Calibration Summary screen and QC score. Click Exit to return to the sensor calibration menu, and then the back arrows to return to main Calibrate menu.

2.10 **Conductivity Sensor As-Found or As-Left Calibration Check**

For all Conductivity measuring instruments, perform an As-Found calibration to determine the accuracy of the device prior to performing any adjustments. If the conductivity instrument has been adjusted, perform an As-Left calibration to document the instrument’s accuracy. The steps are the same whether it is an As-Found or As-Left calibration.

2.10.1 The minimum requirement for all As-Found or As-Left Calibrations is a single point calibration check. Additional checks with other conductivity solutions may also be performed. The specific number and the solutions used will be identified by the PIC.

2.10.2 For all conductivity solutions, following placement on the instrument probe, allow sufficient time to equilibrate with the applied solution. Allow a minimum dwell time of 1 minute. Stable conductance readings indicate that the conductivity instrument and solution have equilibrated.

2.10.3 Clean the instrument with deionized water and dry it with clean wipes and lab-grade compressed air or equivalent and place it into the first and lowest conductivity solution. Once the value being measured by the conductivity instrument has stabilized, follow the software’s on-screen instructions by type instrument to proceed to next step(s). The instrument should automatically record the value of the buffer solution and the conductivity probe readings. These can be printed for recording in the scientific notebook or supplemental. It is recommended, however, that the values also be manually recorded to ensure the data is captured.

2.10.4 Rinse the probe with deionized water and dry it with clean wipes and lab-grade compressed air or equivalent. If this is a single-point calibration proceed to step 2.10.6, otherwise place the conductivity instrument being calibrated into the next conductivity solution. Once the value being measured by the conductivity instrument has stabilized, follow the software’s on-screen instructions by instrument type to proceed to next step(s). The instrument should
automatically record the value of the buffer solution and the conductivity probe readings. These can be printed for recording in the scientific notebook or supplemental. It is recommended, however, that the values also be manually recorded to ensure the data is captured.

2.10.5 Repeat step 2.10.4 for any additional conductivity solutions being used in the calibration.

2.10.6 For the conductivity instrument being calibrated, the results of the calibration check shall be compared against the expected uncertainty or accuracy requirement of the instrument.

2.10.7 If the calibration check is an As-Found calibration and the results do not fall within the expected uncertainty or accuracy requirements, a Corrective Action Request (CAR) will be issued to document the results and impacts related to the change in conductivity instrument’s performance.

2.10.8 If the As-Found results are out of tolerance or if improved performance is desired, perform the calibration adjustment section related to the type instrument being calibrated.

2.10.9 If the As-Left results are out of tolerance or if improved performance is desired, perform the applicable calibration adjustment section related to the type instrument being calibrated. Remove the instrument from service, if the calibration adjustment has been performed more than two times and the instrument still does not meet the expected uncertainty or accuracy requirements. Tag and label the conductivity instrument accordingly, and if practical, return it to the manufacturer for repair.

2.11 YSI ProPlus Conductivity Instrument Calibration Adjustment

2.11.1 Turn the instrument on by pressing the on/off key. Press Cal. Highlight Probe ID or User ID if you wish to add, select, edit, or delete an ID. Probe ID must be enabled in the System GLP menu to appear in the Calibrate menu. User ID will appear automatically.

2.11.2 Select ‘None’ if you do not want a User ID stored with the calibration. When enabled, these IDs are stored with each calibration record in the GLP file.

2.11.3 After selecting the User ID and/or Probe ID if appropriate, highlight Conductivity and press enter.

2.11.4 Highlight the desired calibration method; Sp. Conductance, Conductivity, or Salinity and press enter.

NOTE: YSI recommends calibrating in specific conductance for greatest ease.

2.11.5 For calibrating in Specific (Sp.) Conductance or Conductivity Place the sensor into a fresh, traceable conductivity calibration solution. The solution must cover the holes of the conductivity sensor that are closest to the cable.

NOTE: Ensure the entire conductivity sensor is submerged in the solution or the instrument will read approximately of half the expected value!

2.11.6 Choose the units in either SPC-us/cm, C-us/cm or SPC-ms/cm, C-ms/cm and press enter.

2.11.7 Highlight Calibration value and press enter to input the value of the calibration standard.

2.11.8 Once the temperature and conductivity readings stabilize, highlight Accept Calibration and press enter. Or, press Esc to cancel the calibration.

2.11.9 If User Field 1 or 2 are enabled in the GLP menu, you will be prompted to select the fields and then press Cal to complete the calibration. After completing the calibration, the message line at the bottom of the screen will display “Calibrating Channel...” and then “Saving Configuration...”.

2.11.10 Remove the instrument from service, if the calibration adjustment has been performed more than two times and the instrument still does not meet the expected uncertainty or accuracy requirements. Tag and label the conductivity instrument accordingly, and if practical, return it to the manufacturer for repair.
2.12 EXO Sonde Conductivity/Temperature Calibration

2.12.1 Turn the instrument on by connecting the device to a laptop computer with KOR software installed.

2.12.2 Clean the conductivity cell with the supplied soft brush before calibrating.

2.12.3 Place the correct amount of conductivity standard into a clean and dry or pre-rinsed calibration cup. A variety of standards are available based on the salinity of your environment. Select the appropriate calibration standard for your deployment environment. The recommended standard is greater than 1 mS/cm for greatest stability.

2.12.4 Carefully immerse the probe end of the Sonde into the solution, making sure the standard is above the vent holes on the conductivity sensor. Gently rotate and/or move the sonde up and down to remove any bubbles from the conductivity cell.

2.12.5 Allow at least one minute for temperature equilibration before proceeding.

2.12.6 In the Calibrate menu, select Conductivity and then a second menu will offer the options of calibrating conductivity, nLF conductivity, specific conductance, or salinity. Calibrating any one option automatically calibrates the other parameters. After selecting the option of choice (specific conductance is normally recommended), enter the value of the standard used during calibration. Be certain that the units are correct and match the units displayed in the second window at the top of the menu.

2.12.7 Click Start Calibration. Observe the readings under Current and Pending data points and when they are Stable (or data shows no significant change for approximately 40 seconds), click Apply to accept this calibration point.

NOTE: If the data do not stabilize after 40 seconds, gently rotate the sonde or remove/reinstall the calibration cup to make sure there are not air bubbles in the conductivity cell.

2.12.8 Click Complete. View the Calibration Summary screen and QC score. Click Exit to return to the sensor calibration menu, and then the back arrows to return to main Calibrate menu.

2.12.9 Rinse the sonde and sensor(s) in tap or purified water and dry.

2.13 Oxidation/Reduction Potential (ORP) Sensor As-Found or As-Left Calibration Check

For all ORP measuring instruments, perform an As-Found calibration to determine the accuracy of the device prior to performing any adjustments. If the ORP instrument has been adjusted, perform an As-Left calibration to document the instrument’s accuracy. The steps are the same whether it’s an As-Found or As-Left calibration.

There is an effect of temperature on ORP for this instrument. The oxidation reduction potential value shows an inverse relationship with temperature. This effect must be accounted for when calibrating the EXO ORP sensor with Zobell solution. Enter the mV value from the table below that corresponds to the temperature of the standard.
2.13.1 The minimum requirement for all As-Found or As-Left Calibrations is a single point calibration check. The ORP is only calibrated at a single point.

2.13.2 For all ORP solutions, following placement on the instrument probe, allow sufficient time to equilibrate with the applied solution. Allow a minimum dwell time of 1 minute. Stable ORP readings indicate that the ORP instrument and solution have equilibrated.

2.13.3 Clean the instrument with deionized water and dry it with clean wipes and lab-grade compressed air or equivalent and place it into the ORP solution (recommend Zobell solution). Once the value being measured by the ORP instrument has stabilized, follow the software’s on-screen instructions by instrument type to proceed to next step(s). The instrument should automatically record the value of the buffer solution and the ORP probe readings. These can be printed for recording in the scientific notebook or supplemental. It is recommended, however, that the values also be manually recorded to ensure the data is captured.

2.13.4 Rinse the probe with deionized water and dry it with clean wipes and lab-grade compressed air or equivalent.

2.13.5 For the ORP instrument being calibrated, the results of the calibration check shall be compared against the expected uncertainty or accuracy requirement of the instrument.

2.13.6 If the calibration check is an As-Found calibration and the results do not fall within the expected uncertainty or accuracy requirements, a Corrective Action Request (CAR) will be issued to document the results and impacts related to the change in ORP instrument’s performance.

2.13.7 If the As-Found results are out of tolerance or if improved performance is desired, perform the calibration adjustment section related to the type instrument being calibrated.

2.13.8 If the calibration check was an As-Left calibration and the results are out of tolerance, repeat the applicable calibration adjustment section related to the type instrument being calibrated. Remove the instrument from service, if the calibration adjustment has been performed more than two times and the instrument still does not meet the expected uncertainty or accuracy requirements. Tag and label the ORP instrument accordingly, and if practical, return it to the manufacturer for repair.

2.14 YSI ProPlus ORP Instrument Calibration Adjustment

2.14.1 Turn the instrument on by pressing the on/off key. Press Cal. Highlight Probe ID or User ID if you wish to add, select, edit, or delete an ID. Probe ID must be enabled in the System GLP menu to appear in the Calibrate menu. User ID will appear automatically.

2.14.2 Select ‘None’ if you do not want a User ID stored with the calibration. When enabled, these IDs are stored with each calibration record in the GLP file.
2.14.3 After selecting your User ID and/or Probe ID if appropriate, highlight **ISE (ORP)** and press enter. The message line will show the instrument is “Ready for point”.

2.14.4 Place the sensor in a solution of known ORP and wait for the readings to stabilize.

2.14.5 Highlight **Calibration value** and press enter to input the value of the ORP calibration standard.

**NOTE:** If using the YSI Zobell calibration solution, the Pro Plus will automatically determine the calibration value. However, the calibration value should be verified against the chart on the side of the Zobell bottle.

2.14.6 Next, once the temperature and ORP readings stabilize, highlight **Accept Calibration** and press enter to calibrate. Or, press Esc to cancel the calibration.

2.14.7 If User Field 1 or 2 are enabled, you will be prompted to select the fields and then press Cal to complete the calibration.

2.15 **EXO Sonde ORP Instrument/Calibration Adjustment**

2.15.1 Turn the instrument on by connecting the device to a laptop computer with KOR software installed. Go to the Calibrate menu in KOR software. This menu’s appearance will vary depending on the sensors installed in the sonde.

2.15.2 Pour the correct amount of standard with a known oxidation reduction potential value (recommend using Zobell solution) in a clean and dry or pre-rinsed calibration cup. Carefully immerse the probe end of the sonde into the solution.

2.15.3 In the Calibrate menu of the KOR software, select pH/ORP, then select ORP mV.

2.15.4 Click Start Calibration. Observe the readings under Current and Pending data points and when they are Stable (or data shows no significant change for approximately 40 seconds), click Apply to accept this calibration point.

**NOTE:** Do not leave sensors in Zobell solution for more than one hour. A chemical reaction occurs with the copper on the sonde (sonde bulkhead, central wiper assembly, copper tape). While the reaction does not impact calibration, it will degrade the sonde materials over time. Discard used standard. Refer to lab chemicals procedure.

2.15.5 Click Complete. View the Calibration Summary screen and QC score. Click Exit to return to the sensor calibration menu, and then the back arrows to return to main Calibrate menu.

2.15.6 Rinse the sonde in tap or purified water and dry the sonde.

2.16 **Dissolved Oxygen (DO) Sensor As-Found or As-Left Calibration Check**

For all DO measuring instruments, perform an As-Found calibration to determine the accuracy of the device prior to performing any adjustments. If the DO instrument has been adjusted, perform an As-Left calibration to document the instrument’s accuracy. The steps are the same whether its an As-Found or As-Left calibration.

2.16.1 The minimum requirement for all As-Found or As-Left Calibrations is a single point calibration check. Additional checks with other DO solutions may also be performed. The specific number and the solutions used will be identified by the PIC.

2.16.2 For all DO solutions, following placement on the instrument probe, allow sufficient time to equilibrate with the applied solution. For DO it is recommended that the probe dwell in the medium for 10 – 15 minutes before starting the calibration. Stable DO readings indicate that the DO instrument and solution have equilibrated.

2.16.3 A 0-point solution is needed when performing 2-point DO calibrations. This can be achieved by mixing 8-10 grams of Sodium Sulfite with 500 mL of tap water. Prepare the solution at a
concentration of approximately 8-10 grams/500 mL at least two hours prior to use and keep it sealed in a bottle which does not allow diffusion of oxygen through the sides of the container. Transfer the sodium sulfite solution rapidly from its container to the calibration cup, fill the cup as full as possible with solution to minimize head space, and seal the cup to the sonde to prevent diffusion of air into the vessel.

2.16.4 Clean the instrument with deionized water and dry it with clean wipes and lab-grade compressed air or equivalent and place it into the first and lowest DO solution. Once the value being measured by the DO instrument has stabilized, record the solution value and the value displayed by the DO instrument.

2.16.5 Rinse the probe with deionized water and dry it with clean wipes and lab-grade compressed air or equivalent. If this is a single-point calibration proceed to step 2.17.6, otherwise place the DO instrument being calibrated into the next DO solution. Once the value being measured by the DO instrument has stabilized, record the value of the DO solution and the value displayed by the DO instrument.

2.16.6 Repeat step 2.17.4 for any additional DO solutions being used in the calibration.

2.16.7 For the DO instrument being calibrated, the results of the calibration check shall be compared against the expected uncertainty or accuracy requirement of the instrument.

2.16.8 If the calibration check is an As-Found calibration and the results do not fall within the expected uncertainty or accuracy requirements, a Corrective Action Request (CAR) will be issued to document the results and impacts related to the change in DO instrument’s performance.

2.16.9 If the As-Found results are out of tolerance or if improved performance is desired, perform the calibration adjustment section related to the type instrument being calibrated.

2.16.10 If the calibration check was an As-Left calibration and the results are out of tolerance, repeat the applicable calibration adjustment section related to the type instrument being calibrated. Remove the instrument from service, if the calibration adjustment has been performed more than two times and the instrument still does not meet the expected uncertainty or accuracy requirements. Tag and label the DO instrument accordingly, and if practical, return it to the manufacturer for repair.

2.17 YSI ProPlus DO Instrument Calibration Adjustment

For both ease of use and accuracy, YSI recommends performing the following 1-point DO % water saturated air calibration:

Calibrating in % will simultaneously calibrate mg/L and ppm and vice versa.

Calibrating DO % in Water Saturated Air:

NOTE: The supplied sensor storage container (a grey sleeve for a single port cable or a screw on plastic cup for the dual-port and Quatro cables) can be used for DO calibration purposes.

1-Point Calibration

2.17.1 Moisten the sponge in the storage sleeve or plastic cup with a small amount of clean water. The sponge should be clean since bacterial growth may consume oxygen and interfere with the calibration. If using the cup and you no longer have the sponge, place a small amount of clean water (1/8 inch) in the plastic storage cup instead.

2.17.2 Make sure there are no water droplets on the DO membrane or temperature sensor. Then install the storage sleeve or cup over the sensors. The storage sleeve ensures venting to the atmosphere. If using the cup, screw it on the cable and then disengage one or two threads to ensure atmospheric venting.
2.17.3 Make sure the DO and temperature sensors are not immersed in water.

2.17.4 Turn the instrument on and wait approximately 5 to 15 minutes for the storage container to become completely saturated and to allow the sensors to stabilize.

2.17.5 Press Cal. Highlight Probe ID or User ID if you wish to add, select, edit, or delete an ID. Probe ID must be enabled in the System GLP menu to appear in the Calibrate menu. User ID will appear automatically.

2.17.6 Select ‘None’ if you do not want a User ID stored with the calibration. When enabled, these IDs are stored with each calibration record in the GLP file. After selecting your User ID and/or Probe ID if appropriate, highlight DO and press enter.

2.17.7 Highlight DO % and press enter to confirm. The instrument will use the internal barometer during calibration and will display this value in brackets at the top of the display.

2.17.8 Highlight Barometer and press enter to adjust it if needed. If the barometer reading is incorrect, it is recommended that you calibrate the barometer.

NOTE: The barometer should be reading “true” barometric pressure (refer to the YSI Professional Plus User Manual for more information on “true” barometric pressure). If the value is acceptable, there is no need to change it or perform a barometer calibration. For a true barometric pressure value use a calibrated Troll or INW pressure transducer to obtain a reading.

2.17.9 The Salinity value displayed near the top of the screen is either the salinity correction value entered in the Sensor menu or the Salinity value as measured by the conductivity sensor in use and enabled. If you are not using a conductivity sensor, the Salinity correction value should be the salinity of the water you will be testing.

2.17.10 Highlight Salinity and press enter to modify this setting if necessary (refer to the YSI Professional Plus User Manual for more information on Salinity Correction).

2.17.11 Wait for the temperature and DO% values under “Actual Readings” to stabilize, then highlight Accept Calibration and press enter to calibrate. Or, press Esc to cancel the calibration.

2.17.12 If User Field 1 or 2 are enabled in the GLP menu, you will be prompted to select these inputs and then press Cal to complete the calibration.

2.17.13 Place the sensor in a solution of zero DO.

NOTE: A zero DO solution can be made by dissolving approximately 8 - 10 grams of sodium sulfite (Na2SO3) into 500 mL tap water or DI water. Mix the solution thoroughly. It may take the solution 60 minutes to be oxygen-free.

2.17.14 Press Cal. Highlight Probe ID or User ID if you wish to add, select, edit, or delete an ID. Probe ID must be enabled in the System GLP menu to appear in the Calibrate menu. When enabled, these IDs are stored with each calibration record in the GLP file.

2.17.15 After selecting the Probe ID and/or User ID if appropriate, highlight DO and press enter.

2.17.16 Highlight Zero and press enter. Wait for the temperature and DO% values under “Actual Readings” to stabilize, then press enter to Accept Calibration.

2.17.17 If User Field 1 or 2 are enabled, you will be prompted to select the fields and then press Cal to complete the calibration. The screen will then prompt for a follow-up second point calibration. Highlight DO% and press enter to continue with the next calibration point.

2.17.18 Rinse the sensor of any zero oxygen solution using clean water.

2.17.19 Follow the steps under Calibrating DO % in Water Saturated Air, 1-Point Calibration, to complete the second point.
2.18 EXO1 Sonde Dissolved Oxygen (DO) Instrument/Calibration Adjustment

ODO % sat – 1-point

2.18.1 Place the sonde with sensor into either saturated air or saturated water:
Saturated air: Ensure there are no water droplets on the DO sensor or the thermistor. Place into a calibration cup containing about 1/8 inch of water that is vented by loosening the threads. (Do not seal the cup to the sonde.) Wait 10-15 minutes before proceeding to allow the temperature and oxygen pressure to equilibrate. Keep out of direct sunlight.
Saturated water: Place into a container of water which has been continuously sparged with an aquarium pump and air stone for one hour. Wait approximately 5 minutes before proceeding to allow the temperature and oxygen pressure to equilibrate.

2.18.2 In the Calibrate menu, select ODO, then select ODO % sat. Calibrating in ODO % sat automatically calibrates ODO mg/L and ODO % local and vice versa.

2.18.3 Enter the current barometric pressure in mm of Hg (Inches of Hg x 25.4 = mm Hg).

NOTE: Laboratory barometer readings are usually “true” (uncorrected) values of air pressure and can be used “as is” for oxygen calibration. Weather service readings are usually not “true”, i.e., they are corrected to sea level, and therefore cannot be used until that are “uncorrected”. An approximate formula for this “uncorrection” (where the BP readings MUST be in mm Hg) is: True BP = [Corrected BP] – [2.5* (Local Altitude in ft above sea level/100]. For a true barometric pressure value use a calibrated Troll or INW pressure transducer to obtain a reading.

2.18.4 Click 1 Point for the Calibration Points. Enter the standard value (air saturated).
2.18.5 Click Start Calibration. Observe the readings under Current and Pending data points and when they are Stable (or data shows no significant change for approximately 40 seconds), click Apply to accept this calibration point.
2.18.6 Click Complete. View the Calibration Summary screen and QC score. Click Exit to return to the sensor calibration menu, and then the back arrows to return to main Calibrate menu.

ODO % sat – 2-point (or zero point)

For ODO% sat calibrate your sonde at zero oxygen and in water-saturated air or air-saturated water. The key to performing a 2-point calibration is to make certain that your zero-oxygen medium is truly oxygen-free, refer to section 2.16.3

2.18.7 Place the sonde with DO and temperature sensors in a zero-oxygen medium.
2.18.8 In the Calibrate menu, select ODO, then select ODO % sat.
2.18.9 Click 2 Point for the Calibration Points. Enter Zero Point as the value of the first standard.
2.18.10 Click Start Calibration. Observe the readings under Current and Pending data points and when they are Stable (or data shows no significant change for approximately 40 seconds), click Apply to accept this calibration point.

NOTE: If you used sodium sulfite solution as your zero calibration medium, you must thoroughly remove all traces of the reagent from the probes and wiper prior to proceeding to the second point. We recommend that the second calibration point be in air-saturated water if you use sodium sulfite solution.

2.18.11 Next place the sensors in the medium containing a known oxygen pressure or concentration and wait at least 10 minutes for temperature equilibration. Click Proceed in the pop-up window. Then enter either the barometer reading in mm Hg (for ODO %). Observe the readings under Current and Pending data points and when they are Stable (or data shows
no significant change for approximately 40 seconds), click Apply to accept this calibration point.

2.18.12 Click Complete. View the Calibration Summary screen and QC score. Click Exit to return to the sensor calibration menu, and then the back arrows to return to main Calibrate menu.

2.18.13 Rinse the sonde and sensor(s) in tap or purified water and dry.

2.19 **EXO Sonde Calibration Depth and Level**

This calibration option is available only for the EXO sonde and not the Pro-Plus. For the calibration, make certain that the depth sensor or vented level sensor is in air and not immersed in any solution.

2.19.1 In the Calibrate menu, select Port D-Depth, then select Depth or Level from the second menu.

2.19.2 Click 1 Point for the Calibration Points. Enter 0 or go to the Advanced menu to enter a known sensor offset.

**NOTE:** If a depth offset is entered, the output value will shift by the value of the offset. Users may use an offset if referencing a water elevation against a known datum.

2.19.3 Click Start Calibration. Observe the readings under Current and Pending data points and when they are Stable (or data shows no significant change for approximately 40 seconds), click Apply to accept this calibration point. This process zeros the sensor with regard to current barometric pressure.

2.19.4 Click Exit to return the sensor calibration menu, and then the back arrows to return the main Calibrate menu.

**NOTE:** For best performance of depth measurements, users should ensure that the orientation of the sonde remains constant while taking readings. This is especially important for vented level measurements. Keep the sonde still and in one position while calibrating.

![Figure 4. Screenshot of Advanced Depth Menu](image)

**Advanced –**

**Mounting:** Use the advanced menu to select if sonde will be mounted in a moving/profiling deployment instead of a fixed location.

**Depth Offset:** Enter a datum or barometric pressure offset at time of calibration. Barometric pressure offset allows the depth data to be post-processed for barometric pressure changes over the course of the deployment.
Altitude/Latitude: Enter the coordinates for the local altitude (in feet, relative to sea level) and latitude (in degrees) where the sonde is sampling. Latitude values are used in the calculation of depth or level to account for global variations in the gravitational field.

2.20 References


3.0 Records

The following records generated through implementation of this procedure shall be prepared and submitted to the WIPP Records Center in accordance with NP 17-1, “Records”.

QA Record

- Scientific Notebook
- Scientific Notebook Supplement

4.0 Appendices

Not Applicable. There are no appendices associated with this document.
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