

**SOP-04**  
**Instrument Calibration**

**Yerington Mine Site**  
**Standard Operating Procedure**

**Revision 2**  
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**SOP-04  
INSTRUMENT CALIBRATION**

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## 1.0 OBJECTIVES

The objective of this Standard Operating Procedure (SOP) is to provide general procedures for the calibration of field instruments used during field investigations. These instruments are used for field screening and field measurements.

## 2.0 APPLICABILITY

This general procedure will be used during all field activities when field instruments are used for the collection of field data. The general use and calibration of these instruments are discussed in this SOP and always should be supplemented (or superseded, if necessary) with the manufacturer's calibration and maintenance instructions.

## 3.0 RESPONSIBILITIES

The *Project Manager*, or designee, will have the responsibility to oversee and ensure that field instruments are calibrated and that written documentation of calibration is maintained.

The *field sampling personnel* will be responsible for understanding and implementing this SOP during all field activities, as well as, obtaining the appropriate field logbooks, field records, instruments, materials and calibration standards necessary to complete the field task.

## 4.0 DEFINITIONS

Calibration – Procedure used to demonstrate that instrument is reading correctly.

CGI – Combustible Gas Indicator

OVA – Organic Vapor Analyzer

OVM – Organic Vapor Meter

## 5.0 REQUIRED MATERIALS

The materials required for this SOP include the following:

- Bound field logbooks,
- Black or blue water proof and/or indelible ink pens,
- Instrument Calibration Form(s),
- Calibration gases and standard solutions, and materials and secondary collection containers (tedlar bags, tubing, etc.)
- Replacement batteries and parts (if applicable).

Instruments used during field activities may include, but are not limited to, the following:

- Water Quality Instruments (e.g., pH, temperature, conductivity, dissolved oxygen, turbidity, oxidation reduction potential),
- Water level indicators,
- Radiation detectors,
- Organic vapor meters (OVMS),
- Organic vapor analyzers (OVAs),
- Combustible gas indicators (CGI), and
- Oxygen Monitors.

## 6.0 METHODS

This SOP includes the general methods for field instrument calibration, calibration documentation and corrective action procedures that will be implemented during field activities. Detailed instrument calibration procedures should be provided by the manufacturer and will be different for each field instrument used. Field personnel should be familiar with the calibration procedures prior to using the equipment in a field setting.

Prior to field activities, a determination will be made as to which instruments will be needed for the field activities. Some instruments may be available from an office equipment pool or from an equipment rental/supply company. Field personnel should locate, order and coordinate delivery of the necessary instruments, calibration gases and/or standard solutions, and other necessary equipment and materials at least three days before the beginning of the field activities. Consideration should be made for specialty instruments and materials that may take longer to obtain.

Prior to field mobilization, instruments that will be used during the field activities will be checked for possible malfunctions, cleaned and calibrated. Some equipment provided by a rental company are shipped pre-calibrated and a completed calibration sheet is sent with the equipment. These activities will be conducted in accordance with manufacturer's procedures, where applicable. In the event that manufacturer procedures are not available, standard acceptable calibration procedures will be used.

Calibration verification will be performed on field instruments prior to their initial use, at least once daily, or whenever indications of instrument malfunction or questions in readings are observed. Some instruments, such as field water quality meters, or field gas chromatographs, may require more frequent calibration verification depending upon project quality objectives. In general, instrument identification and calibration will include the following steps:

1. Determine which instruments are needed for the specific field tasks;
2. Obtain the necessary instruments and associated calibration gases and/or standard solutions for calibration;
3. Check expiration dates on calibration gases and/or standard solutions, replace if out of date;

4. Assemble the instrument and turn it on, allowing the instrument to warm up;
5. Check battery charge, charge or replace if necessary;
6. Check carrier gas volumes, and recharge if necessary [e.g. hydrogen carrier gas used for in a flame ionization detector (FID)];
7. Clean the instrument (if necessary);
8. Calibrate the instrument prior to field use in accordance with manufacturer's procedures, and if necessary adjust the instrument to meet calibration specifications (this step is sometimes referred to the initial calibration);
9. If instrument malfunctions and can not be corrected, obtain another instrument and have the other repaired (see Section 7.0 for Corrective Action Procedures);
10. Clean and decontaminate the instrument after use, and before storage;
11. Conduct calibration verifications at least once per day, or as needed;
12. Conduct final calibration verification at the end of each day, or at completion of field measurement collection for the day;
13. Document all calibration activities and results, and
14. Recharge batteries and add carrier gases (if applicable) at the end of each day or as needed. This should be carried out in a non-hazardous area.

Some manufacturers recommended field calibration procedures that are inadequate for verifying instrument linearity and calibration range. Some commercially available water quality meters sometimes have a stock calibration mixture that is used during an "easy to conduct" calibration which consists of pressing a "calibrate" button on the instrument while the probes are in stock solution. The problem with this calibration method is that it only provides a one point calibration. This is inadequate for the field measurements collected during water quality monitoring because of the wide range of conditions we may encounter. Typically, more involved calibration of these instruments requires disassembling the instrument, which is not recommended. Instrument calibration and accuracy should be checked by using at least two different commercially-available standard solutions over a range of values (e.g., pH buffers at 4 and 10) to check that the meter is providing accurate readings over a range of conditions. These solutions should be separate from any solution provided by the manufacturer.

**Important Note:** Some types of rental equipment come with calibration standards. However, any rental equipment that requires gases for calibration will NOT come with the calibration gases. Shippers are restricted to Department of Transportation laws and regulations that prohibit the shipment of compressed gas cylinders by air. Therefore, calibration gases must be obtained from a separate source by ground transport.

## 6.1 Accuracy Requirements

In order for an instrument to be considered calibrated and ready for use, the instrument must read within at least 10% of the calibration standard. If the instrument reads >10% difference from the standard it should be recalibrated or taken out of service. Consult the manufacturer's instruction manual for more specific details on the instrument in use.

Personnel responsible for the use of these instruments will read the manufacturer's instruction manual and will be trained for the use, calibration, and maintenance of the instrument prior to instrument use. The calibration, maintenance and use of these instruments will be conducted in accordance with the manufacturer's specifications and procedures. If instrument calibration cannot be met or if the instrument is malfunctioning, obtain another instrument and repair the malfunctioning instrument immediately (see Section 7.0 Corrective Action).

## 6.2 Records

A record will be maintained of the calibrations and calibration verification. The records will include the following information, where applicable:

- Date and time of activities,
- Project name and number,
- Personnel conducting the calibration,
- Serial and/or meter numbers,
- Instrument name and model number,
- Calibration gases or standard solutions used, concentration of the gases and solutions used, and the associated units (if applicable), and lot numbers of calibration intervals;
- Instrument readings before and after calibration, and
- Instrument readings of calibration verification data.

Calibration activities will be recorded in the field logbooks. Calibration data will be recorded in the Instrument Calibration Record or similar form. An example of this calibration record is included as an attachment. This record can be modified as necessary to accommodate specific instruments.

## 7.0 CORRECTIVE ACTION PROCEDURES

If an instrument can not be successfully calibrated or if it is malfunctioning, the instrument will be repaired immediately. In the event that this occurs during the course of the field activities, it will be the field personnel's responsibility to ensure that a replacement instrument is obtained as quickly as possible and that the Project Manager, or designee, is immediately notified. Under no circumstances should field personnel continue with activities until a replacement is obtained or approval from the PM or their designee is obtained. Instances of instrument failure and corrective actions taken will be documented in the field logbook.

Field instruments can be affected by changes in temperature, humidity, and barometric pressure. Instrument calibration should be checked when significant changes in weather occur. In addition, instrument calibration should be checked if maintenance activities (e.g. battery replacement, lamp replacement, or refueling) are required, if instrument malfunctions occur, or when questionable readings are observed. Calibration verification and recalibration activities shall be conducted and documented as outlined in Section 6.0.

## **8.0 CORRECTIONS AND REVIEWS**

Corrections and reviews of calibration records will be completed in accordance with the SOP for Field Notes and Documentation. Errors will be corrected by drawing a single line through the error, entering the correct information, initialing and dating the change. Materials that obliterate the original information, such as correction fluids and/or mark-out tapes, are prohibited. All corrections will be initialed and dated.

Periodically, the Project Manager, or designee, will review the calibration records pertaining to the activities under their supervision. This review will be conducted to confirm that instrument calibrations are being conducted and documented. Discrepancies and errors identified during the review should be resolved between reviewer and author of the calibration records. Corrections and/or additions of information shall be initialed and dated by the field author or reviewer.

## **9.0 DOCUMENTATION ARCHIVE**

At the completion of the project, all original calibration records will be stored in the project files in accordance with project procedures.

## **10.0 REFERENCES**

None cited.

## **11.0 ATTACHMENTS**

Example Calibration Form

# Water Quality Equipment Calibration Form

Project: \_\_\_\_\_

Date: \_\_\_\_\_

## Water Quality Parameter Meter

Unit Name/ID: \_\_\_\_\_ Serial Number: \_\_\_\_\_

Calibrated By: \_\_\_\_\_ Assigned User: \_\_\_\_\_

	Cal Std. Expiration Date	Initial Calibration		Re-Calibration		Drift Check	
		Time:		Time:		Time:	
		Cal	Read	Cal	Read	Read	Acceptable Performance
<b>pH (3-point)</b>							
Buffer 2.0							
Buffer 4.0							
Buffer 7.0							
Buffer 10.0							
<b>Conductivity</b>							
447 uS/cm							
1413 uS/cm							
8974 uS/cm							
15,000 uS/cm							
<b>ORP</b>							
220 mv							
<b>Dissolved Oxygen</b>							
Open Air mg/L							
Zero Oxy Std mg/L							
Barometer (mm Hg)							

## Turbidity Meter

Unit Name/ID: \_\_\_\_\_ Serial Number: \_\_\_\_\_

Calibrated By: \_\_\_\_\_ Assigned User: \_\_\_\_\_

	Cal Std. Expiration Date	Initial Calibration		Re-Calibration		Drift Check	
		Time:		Time:		Time:	
		Cal	Read	Cal	Read	Read	Acceptable Performance
<b>Turbidity</b>							
0.02 Standard							
10.0 Standard							
1,000 Standard							