Identifier: **SOP-5227**
(formerly ENV-DO-201).
R1 ELW 10/27/08
SC 10/29/08

Revision: 0

Effective Date: ~~TBD~~
October 29, 2008

Next Review Date: October 15, 2013

Los Alamos
NATIONAL LABORATORY
EST. 1943

Environmental Programs Directorate

Standard Operating Procedure

For **PRESSURE TRANSDUCER INSTALLATION, REMOVAL, AND MAINTENANCE**

APPROVAL SIGNATURES:

Author:	**Organization**	**Signature**	**Date**
Tim Goering	WES-RS	Tim Goering	10/15/08
Quality Assurance Specialist:	**Organization**	**Signature**	**Date**
Paul Lowe	QA-IQ	Paul Lowe	10-16-08
Responsible Line Manager:	**Organization**	**Signature**	**Date**
Dwain Farley	WES-RS	Dwain Farley	10/16/08

1. PURPOSE AND SCOPE

This standard operating procedure (SOP) states the responsibilities and describes installation, removal, and maintenance procedures for the pressure transducers that are placed in groundwater monitoring wells, piezometers, or surface water locations for monitoring and recording water-level data.

This procedure applies to all Los Alamos National Laboratory (LANL), Environmental Programs (EP) Directorate personnel and contractor personnel authorized to operate or maintain the water-level-recording pressure transducers, or assist with these tasks.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Transducer equipment is used to periodically to measure water levels in individual wells or surface water locations at user-specified intervals and record these values in computer memory for later retrieval.

Two types of transducer equipment are currently used in monitoring wells at LANL.

- "Compensated" or "gauged" pressure transducers have pressure sensors that are compensated for atmospheric pressure. One side of the pressure sensor diaphragm is vented to the atmosphere, thus compensating for changes in atmospheric pressure and measuring water pressure only (psig). Whe transducers are used calculations of water depth above the transducer exclude atmospheric pressure considerations. These transducers employ a tube in the cabling to vent the transducer to the atmosphere and are used in most shallow monitoring wells and single-completion deep monitoring wells. Examples of "compensated" or "gauged" transducers include: standard In-Situ, Inc. MiniTroll and Level Troll transducers.

- "Absolute" or "uncompensated" pressure transducers measure absolute pressure (psia) and are not compensated for atmospheric pressure. Pressure measurements from this type of transducer include atmospheric pressure as a component; therefore, atmospheric pressure must be subtracted from the absolute measurement to determine the pressure from water. All transducers used with the Westbay MP multiple port monitoring system measure absolute pressure. Additionally, other manufacturers, including In-Situ, Inc., produce absolute pressure measuring transducers; thus, personnel must be aware of the type of transducer used so that data can be processed accordingly.

2.2 Precautions

- WES-RS Project personnel and contractors who work with pressure transducer equipment require training before implementing this procedure.

- The work specified in this procedure shall be conducted in accordance with applicable Integrated Work Documents, in accordance with LANL IMP 300-00-00, Integrated Work Management for Work Activities.

- Project personnel using this procedure should become familiar with the contents of the following documents to properly implement this SOP:

  - SOP-5223, Manual Groundwater Level Measurements

3. EQUIPMENT AND TOOLS

Suggested equipment for **installing and removing transducers** in monitoring wells or surface water locations:

- Transducer(s)

- Transducer cable
- Cable landing hardware (e.g., docking ring)
- Spool or rack for transducer cable
- Tripod and anchoring equipment where necessary
- Data logger (if required)
- Manufacturer operating manual
- Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1)
- Portable computer and RS-232 direct-cable connection
- Memory stick or other removable electronic media for data storage (Note: thumb drive or other removable storage devices are prohibited in security areas.)
- Extra batteries for transducers, water-level tape, and laptop computer
- Silicon lubricating grease
- Waterproof ink pen(s)
- Water level meter
- Groundwater Level Measurement Form
- Well construction diagram
- Water level history of well (if known)
- Generator with ground fault circuit interrupt (where necessary)
- Electric extension cord (where necessary)
- Tripod or well head roller for installations with cable greater than 300 feet
- Deionized water
- Paper towels
- Nitrile gloves
- Trash bags
- Keys to wells & access gates where necessary
- Site-specific equipment permit (ESA)

Suggested equipment for **transducer maintenance and calibration performance check**:

- Pressure transducer
- Transducer cable

- Portable computer and RS-232 direct-cable connection
- Tape measure graduated in 0.01 feet
- Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1)
- Marking pen
- Silicon grease for O-ring lubrication
- Batteries for transducer equipment
- 100-feet steel measuring tape traceable to National Institute of Standards and Technology (NIST)
- Capped polyvinyl chloride pipe or clear (acrylic polycarbonate) pipe (approximately 4 to 5 feet in length)

4. STEP BY STEP PROCESS DESCRIPTION

4.1 General Requirements for Transducer Installation or Removal

Field Team Member(s)	1.	Before departing for the well site, test data loggers and transducers for functionality. [NOTE: Refer to the Calibration and Maintenance of Pressure Transducer section of this procedure.]
	2.	Prepare water level meter according to SOP-5223.
	3.	Ensure that two people are available to install or remove the pressure transducer from the monitoring well. [NOTE 1: A single operator is adequate to retrieve data from the recording data logger if approved by the line manager and only when using Enhanced Communications Procedures.] [NOTE 2: Refer to the Working Alone Policy in WES-RS, General Field Safety for All.]
	4.	Transducer equipment is typically installed in a specific well and dedicated to that well; therefore, minimizing the potential for cross-contamination. • If transducer equipment must be installed in a different well, thoroughly wipe the cable and transducer housing with a clean cloth soaked in deionized water before the transducer is installed to prevent cross-contamination.

Field Team Member(s) (continued)

5. Transducer software clocks and internal clocks in the portable computer used with the transducer equipment have the time set to Mountain Standard Time (MST) at all times, without any daylight-savings time adjustment in the spring and fall.
   - Disable the automatic daylight savings time adjustment setting in Microsoft Windows-based computers used with transducer equipment to prevent the clock from changing to daylight savings time.
   - Check the clocks on all portable computers before each use to ensure the time and date on the computer is appropriate and set the MST.

4.2 Calibration and Maintenance of Pressure Transducer Equipment

Field Team Member(s)

1. Ensure that pressure transducer equipment is properly maintained and calibrated according to the manufacturer's instructions.

   [NOTE: All calibration of pressure transducers is performed by the manufacturer. A transducer is considered to be properly calibrated as long as the transducer returns values that are within pre-determined measurement precision specifications (see Attachment 4). How long a transducer will maintain calibration depends how regularly the transducer is used, whether or not the transducer was exposed to environmental extremes, and how the transducer was handled during use, transportation, and storage.]

   - Record transducer calibration date(s) on the Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1) and on the forms maintained in the transducer files.
   - Perform transducer performance checks each time a transducer is installed. If calibration by the manufacturer was done more than 1 year before the installation date, or if transducer is suspected of malfunctioning.

     [NOTE: The performance check is described in the Performance Check section of this procedure.]
   - Document the performance check on the Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1).
   - Maintain equipment maintenance records and calibration data with project records to provide defensible quality data from transducer equipment.

2. Follow the requirements of each equipment manufacturer (Attachment 2) to maintain transducer equipment.
   - Document maintenance on the Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1).

Field Team Member(s) (continued)

- Perform routine checks each time a transducer is installed or removed from a well, and conduct maintenance on an as-needed basis. Routine checks and maintenance activities include the following:
  - Check/change batteries
  - Check/lubricate O-rings
  - Check cables and vent lines
  - Keep equipment clean and work area uncluttered
  - Wipe cable and transducers with a clean cloth soaked in deionized water during removal from well; cap all connections to prevent damage from rust and corrosion
  - Do a performance check if needed, and check date of calibration
  - Ensure desiccant capsule is not saturated, and replace if necessary
  - Disconnect components and package appropriately for transport and storage.

3. Ensure that saturated transducer cable desiccants are dried and re-used.

   - Dry desiccant capsules in the drying oven at a temperature no greater than 125 degrees Fahrenheit.

   [NOTE: An off-the-shelf commercial-grade thermometer is of sufficient accuracy and precision for measuring the temperature of the oven. Most capsules will be dry within 3 days, but times will vary with saturation.]

4.3 Performance Check

Field Team Member(s)

4. Perform a depth test (step 2) and a drift test (step 3) to conduct a performance check on a pressure transducer.

5. **Depth Test**:

   - For compensated transducers, take a pressure measurement when the transducer is in the air.
     - Ensure that the transducer measurement in air is 0 [pounds per square inch (psi)], within the measurement precision of the transducer.

       [NOTE: Readings that are not 0 psi may be caused by using a cable that has a blocked vent line.]
     - If the transducer is not reading 0 psi, use another cable to determine if the problem is with the transducer or the cable.
     - Record the air measurement on the Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1).
   - Place the transducer in the well or water column at the first position by performing the following steps:
     - Temporarily position the transducer 1 to 2 feet below water level.
     - Record the water depth [PH1 (feet)] on the Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1).
     - Secure the cable and mark the transducer cable at the top of casing or at another

convenient measuring point.

Field Team Member(s) (continued)

- Measure a specific length of the remaining cable that extends from the well using the 100 feet NIST traceable steel tape.
  - Use a measured length that is within the rated capacity of the transducer

    [NOTE: Refer to the Transducer Selection and Installation Guidance within this document.]
  - Record the length measured on the cable [Cable Length (feet)]
  - Use the full range of the transducer for the calibration check if the well/water column depth allows.
- Place transducer in the well or water column at the second position by performing the following steps:
  - Lower the transducer and cable in the well or water column the measured length as determined above.
  - Position the measured mark on the cable at the top of the casing/water column at the previously used measuring point.
  - Record the measured water depth [PH2 (feet)] provided by the transducer on the Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1).
- Verify that the difference between the transducer depth measurements [PH2 – PH1] corresponds with the length measured on the cable within the measurement precision of the transducer.

  [NOTE: Refer to Attachment 4, Guidance for Maximum Water Depths of Transducers.]
  - If not, check the cable or transducer to ensure that it hangs freely in the well or water column and repeat the calibration check.
  - If the transducer does not pass the depth test, discontinue use and ship the transducer to the manufacturer for calibration.

6. **Drift Test**:

- Secure the transducer at a known depth in a contained water column.
- Record the pressure readings every one minute for 15 minutes.
- Determine the error tolerance of the transducer by multiplying the pressure rating of the transducer (psi) by 0.001 (0.1%).
- Check readings for any noticeable drift that is beyond the error tolerance.
- If measurements are not within error tolerance, or a noticeable drift occurs:
  - Recheck the pressure measurements.
  - If there is a possibility that the water column was disturbed during the drift test, repeat the test.
  - If the transducer does not pass the drift test, return transducer to manufacturer for calibration and/or repair.
- Record results on the Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1).

4.4 Transducer Selection and Installation

[NOTE: Do not submerge transducers in water pressures greater than the specific pressure rating of the transducer. The pressure rating is provided by the manufacturer for each transducer. At standard pressures and temperatures in water, a general pressure-depth conversion is 2.31 feet/psi. Attachment 4 provides guidance for maximum water depths of transducers and indicates the measurement precision characteristic of different pressure rated transducers.]

Field Team Member	1.	Before installing a transducer in a well: • Obtain the groundwater level • Consider the range of expected water level fluctuations in the well or surface water location • Determine the depth below water surface that the transducer will be placed to measure the full range of expected fluctuation
	2.	Use a transducer with the lowest pressure rating possible for the specific application because measurement precision decreases with higher pressure ratings (see Attachment 4). [NOTE 1: In monitoring wells open to the atmosphere at LANL, annual water level fluctuations may be less than 15 feet, which would indicate installation of a transducer with a pressure rating of 15 psi at a depth of 15 to 17 feet below the water level. Shallow alluvial wells may experience water level fluctuations of 30 feet or more.] [NOTE 2: In monitoring wells adjacent to water supply wells or in water supply wells, the daily water level drawdown might be 100 to 150 feet or more. Given an anticipated drawdown of 150 feet, a transducer with a pressure rating of 100 psi should be installed at a depth of 170 to 200 feet below the water surface.]
	3.	Manually measure the static groundwater level using a water level meter according to SOP-5223, and perform the following steps: • Record the date, time, and measured depth to water on the Groundwater Level Project Field Form (Field Form) (Attachment 3). • Calculate the groundwater elevation on the Field Form (Attachment 3). • Record the groundwater elevation on the Field Form (Attachment 3). • If possible, measure the total depth of the well and record the depth measured on the Field Form (Attachment 3).
	4.	Apply silicone lubricant to O-rings on transducer connections following manufacturer instructions.
	5.	Connect transducer cable to transducer and to data logger/portable computer according to manufacturer instructions.
Field Team	6.	Check for appropriate communications with transducer.

Member(s) (continued)

7. Check the date and time on the portable computer, and on the transducer.
   - Ensure that the transducer or data logger is reading the correct date and time and that the time is MST.

8. Record the transducer serial number, transducer battery and memory storage information, the transducer measurement in air, and well information on the Field Form (Attachment 3).

9. Carefully lower transducer into the well:
   - Lower the transducer **slowly** into the water.
   - Do not allow the cable to rub against the sharp edge of metal casing.
   - Do not allow the transducer to contact the water level at a high rate of speed; this will damage the pressure sensor.
   - Do not submerge the transducer to a water depth pressure greater than the pressure rating of the transducer.

10. If a bench performance check was not performed, and the transducer has not been calibrated by the manufacturer in the last year, perform the performance check in the well as described in the Performance Check section of this procedure.
    - Record performance check data on the Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1).

11. Install pressure transducer:
    - Install pressure transducer at an appropriate depth to monitor the full range of expected water level fluctuation (see Attachment 4) and according to manufacturer instructions.
    - Affix and secure the transducer cable at the top of the casing to prevent cable slippage.
    - Do not kink or pinch the vent tube in a compensated transducer cable.
    - Ensure that the cable desiccant is dry and in good condition, replace desiccant if necessary.
    - Mark the transducer cable to document cable placement and detect cable slippage or tampering with a piece of electrical tape.

Field Team Member(s) (continued)

12. Initialize measurement software/data logging software according to manufacturer instructions:
    - Program the software for appropriate measurement sampling interval for the intended purpose and use of the data.
        - Record the measurement interval on the Field Form (Attachment 3).
    - When installing an In-Situ Level Troll® transducer, enter the latitude, longitude, and elevation of the ground water in the site header. These values are:
        - Latitude: 36 degrees north
        - Longitude: 106 degrees west
        - Elevation: elevation of the groundwater, rounded to no decimal points
    - Program the transducer reference level with the groundwater elevation measurement obtained before installation of the transducer as the reference level.

      [NOTE: The reference level should be entered to an accuracy of 0.01 feet.]
        - In a shallow well installation, obtain another groundwater level measurement after the transducer is installed, if possible, to ensure the reference level has not changed after installation of the transducer.
        - If the groundwater elevation has changed due to disturbance of the water column, enter the new value as the reference level.
    - Program software to begin measurements as soon as possible after installation.
    - Record the transducer test name and start date/time on the Field Form (Attachment 3).

13. For deep well installations where manual water levels are not possible after transducer is installed, watch for cable straightening and groundwater equilibration for at least 15 minutes.
    - Record the transducer measurement every few minutes during this time on the Field Form (Attachment 3).
    - If groundwater elevations change more than 0.05 feet over a 15 minute period, reset the reference level to the initial measured value.
    - If more than 0.10 feet of change is observed over a 15 minute period, wait for stabilization of groundwater values, and then reset the reference level.

    [NOTE: This is especially important in the lower Baski system screens where stabilization of the water in the gage tubes may take up to 1 hour to equilibrate after transducers are removed and installed. If stabilization is difficult to achieve in an intermediate or regional well it is possible that the well is experiencing drawdown or recharge in response to activity at another nearby well.]

14. Replace caps and locks on well shelter.

15. Properly dispose of contact waste generated during installation according to requirements in the Waste Characterization Strategy Form (WCSF) or Waste Profile Form (WPF) for each well.

4.5 Transducer Data Retrieval

Field Team Member	1.	Retrieve transducer data from wells on a regular basis to insure the continued quality of the transducer data. [NOTE: The frequency of retrievals will be determined by the work plan under which the data is collected.]
	2.	Connect portable computer to data logging equipment or transducer cable and start manufacturer provided software specific for the transducer equipment. • Record transducer and cable serial numbers and measurements at time of connection on the Field Form (Attachment 3).
	3.	For deep wells, check tape on cable to check to previous cable slippage or movement of transducer. • Record on the Field Form (Attachment 3) any slippage or movement that is observed.
	4.	Extract the transducer data set according to manufacturer instructions. [NOTE: If a new data file is going to be started, stop logging to the current file prior to downloading.] • Record data retrieval information on the Field Form (Attachment 3). • Document data retrieval information on the Field Form (Attachment 3), including: - Transducer serial number - Transducer operating condition - Battery power - Remaining storage capacity of transducer - Groundwater elevation at time of data retrieval - Raw data file name
	5.	View the data collected since transducer installation. • Ascertain that appropriate data have been collected.
	6.	Copy the data file to floppy disk or other removable electronic media for safe keeping. [NOTE: Only delete the transducer data after insuring that the data file has been properly transferred and stored to the portable computer, and has been backed up on a removable disk.]
	7.	If a manual groundwater level is going to be obtained, go to step 8, or if a manual groundwater level is not going to be obtained, go to step 11.
	8.	Manually measure the groundwater level according to SOP-5223.
Field Team	9.	If the well construction allows manual groundwater level measurement without disturbing the

Member(s) (continued)		transducer (separate access ports), perform the following steps: • Manually measure the groundwater level. • Record the groundwater elevation measurement on the Field Form (Attachment 3) or in the field notebook. • Compare the groundwater elevation obtained from the manual measurement with the groundwater elevation reading from the transducer. • If these values are off by more than the measurement precision of the transducer (see Attachment 4 for measurement precisions), reset the level reference to the new groundwater elevation value obtained during the manual measurement.
	10.	If the well does not have separate access tubes for the transducer and the water level meter, perform the following steps if the well is due for a manual measurement: • Remove the transducer from the well. • Manually measure the groundwater level. • Record the groundwater elevation measurement on the Field Form (Attachment 3) or in the field notebook. • Reinstall the transducer following the Transducer Installation procedure.
	11.	Check that the transducer clock is the correct time (MST), with no correction for daylight savings.
	12.	If logging was stopped or the transducer reading is not accurate: • Restart the data logger software following the transducer installation procedure and use the newly obtained groundwater elevation as the reference level. • Document activities on the Field Form (Attachment 3).
	13.	Check cable desiccant. • If desiccant is saturated (pink), replace desiccant capsule with a dry desiccant (blue).
	14.	Properly dispose of contact waste generated during data retrieval according to requirements in the WCSF or WPF for each well.
	15.	Transmit data file to a backed up server for safe keeping. • Ensure that data file is secured and data transmittal is completed. • Do not remove data file from portable computer or removable media before data is backed up on a server.

4.6 Transducer Removal

Field Team Member	1.	Discontinue the data logging program per manufacturer instructions.
	2.	Retrieve transducer data from data logger as described in the Transducer Data Retrieval section above. • Record the time (MST), pressure head, and groundwater elevation data in the Field Form (Attachment 3).
	3.	For a shallow installation, manually measure the groundwater level according to SOP-5223. • For deep well installations, go to step 4 within this section first, then take a manual water level.
	4.	Remove the cable and transducer(s) from the well: • Use cable-pulling system if cable is longer than 500 feet. • Ensure that the cable does not scrape against the sharp edges of well casing. • Clean and maintain transducer equipment as described in the Transducer Equipment Maintenance section of this procedure. • Package transducers appropriately for transportation according to the manufacturer instructions.
	5.	Replace well caps and locks.
	6.	Properly dispose of contact waste generated during transducer removal according to requirements in the WCSF or WPF for each well.

4.7 Records Management

Field Team Leader	1.	Maintain and submit the following records and/or documents, generated as a result of this procedure, to the Records Processing Facility according to EP-DIR-SOP-4004, Records Transmittal and Retrieval Process. • Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form (Attachment 1) • Groundwater Level Project Field Form (Attachment 3) • Groundwater Level Measurement Form (SOP-5223, Attachment 3) • Raw water level data electronic file on electronic media • Other associated information

5. DEFINITIONS

Absolute pressure – The total or absolute pressure measured by a sensor without correction for atmospheric pressure. A pressure measurement that includes atmospheric pressure is and absolute pressure. Units are expressed in psia (pounds per square inch absolute).

Depth test – A test performed to evaluate the accuracy of a pressure transducer in which the actual known depth under the surface of water a transducer is placed is compared to the reading given by the transducer.

Drift test – A test performed to evaluate the stability of a pressure sensor. A transducer is suspended at a known depth below water surface, and is set to record values over a set period of time. Data are then evaluated to ensure the transducer has recorded stable water pressure values for the duration of the test. Any variation in values must be within the measurement precision of the instrument.

Gage pressure – The pressure measured relative to atmospheric pressure. Measurements exclude atmospheric pressure and are said to be compensated or gauged for atmospheric pressure. A vented or gage pressure transducer sensor uses a vent tube in the cable that exposes one side of the pressure sensor to atmospheric pressure, measuring pressure of the water column only. Units are expressed in psig (pounds per square inch gauged).

Ground elevation – The elevation of the ground surface of the well expressed in feet above mean sea level. If the well has a concrete surface pad, usually the elevation of the top of the concrete pad is used. If a brass cap is present to identify a well, usually the elevation of the brass cap in the concrete pad.

Field team member – LWSP or contractor personnel trained to this procedure and authorized to conduct the work prescribed in this procedure.

Performance check – A check of the performance of the transducer to ensure the transducer is still within calibration. Performance checks consist of a drift test and/or a depth test.

Pressure head – The pressure measured by the transducer in a well which can be used to calculate the height of the column of water above the transducer.

Pressure transducer (Transducer) – A device that measures pressure. There are two types of pressure transducers, those that measure absolute pressure, and those that measure gage pressure.

psi – Unit of pressure measurement in pounds per square inch.

psia – Unit of pressure measurement in pounds per square inch absolute (see absolute pressure).

psig – Unit of pressure measurement in pounds per square inch gauged (see gauge pressure).

Raw data files – Electronic pressure transducer data files that are obtained from pressure transducers or data loggers at a well site. Raw data files are usually binary computer files that can be opened, read, and interpreted only by software developed by the transducer manufacturer. The raw data files must be stored and archived appropriately to protect the original data recorded by the pressure transducer. Raw data files contain the raw pressure measurements and date/time stamp from the transducer and may also contain information entered into the transducer software program at the time of installation, such as well name, date/time, measurement interval, reference water elevation at the time of installation, etc.

Reference level – The elevation of the surface of the water in a well at the time of installation of the transducer is installed. Determined by manual measurement of the groundwater elevation according to SOP-5223.

Water elevation (GWE) – The elevation of the surface of the water in a well, expressed in feet above mean sea level.

Water level – (1) Depth to water in a well below ground surface expressed in feet, or (2) the water elevation expressed in feet above mean sea level. Refer to SOP-5223 for information about measuring groundwater level in a well.

6. PROCESS FLOW CHART

Not applicable.

7. ATTACHMENTS

Attachment 1 Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form

Attachment 2 Manufacturer Operating Manuals

Attachment 3 Groundwater Level Project Field Form

Attachment 4 Guidance for Maximum Water Depths of Transducers

8. REVISION HISTORY

Revision No. *(Enter current revision number, beginning with Rev.0)*	Effective Date *(DCC inserts effective date for revision)*	Description of Changes *(List specific changes made since the previous revision)*	Type of Change *(Technical [T] or Editorial [E])*
0	5/05	New document. Supersedes ENV-WQH-SOP-16.3.	T
1	3/06	Incorporated references to ENV-DO procedures and ECR QA review comments. Procedure updated, minor changes made, steps were added to accommodate new pressure transducer equipment.	T
0	10/29/08	New document. Added section on avoiding cross-contamination, daylight savings time adjustments, and transducer calibration and performance checks. Groundwater Level Project Field Form was added to the procedure. Supersedes ENV-DO-201.	0

ATTACHMENT 1

SOP-5227-1

Records Use Only

Water Quality and Hydrology In Situ Transducer Performance Check and Maintenance Form

Los Alamos National Laboratory
Water Quality and Hydrology
In Situ Transducer Performance Check and Maintenance Form

						Performance Check							
Date	Time	Well Name	Inspector Name	Serial Number	Battery Voltage Check/ replace	Factory Cali-bration Date	Air Pres-sure (psi)	PH 1 (ft)	Cable Length (ft)	PH 2 (ft)	PH 2 - PH 1 (ft)	Check OK?	Equipment Condition, Comments, Describe Maintenance, Calibration Check

Note: To convert pressure measurements to ft, use conversion factor: 2.31 ft/psi

ATTACHMENT 2	
SOP-5227-2 **Manufacturer Operating Manuals**	Records Use Only Los Alamos NATIONAL LABORATORY EST.1943

1. In Situ Operations Manuals for Pressure Transducers
2. MiniTROLL Operator's Manual for MiniTROLL Model SSP-100
3. WinSitu 4.0 User's Guide
4. Hermit 3000 Data Logger Operator's Manual
5. In-Situ Inc. Data Manager Software Operator Manual
6. Solinst Level Logger Manual

ATTACHMENT 3

SOP-5227-3

Records Use Only

Los Alamos NATIONAL LABORATORY EST.1943

Groundwater Level Project Field Form

Well Name:		Date:	Time onsite (MST):	Water Level Tape Mfgr Serial #:	
Personnel:			Cable SN:	Cable Length:	Computer #
Connect Time:	Connect to transducer SN#:		MT LT	In-Situ Version:	
WL Reading Time:	WL (ft) ☐	AD (ft)	Battery Capacity:	Storage Capacity Remaining:	
T [C] ☐	PH (psi) ☐ ☐	Stop Test Prior to DL	File Name: ☐ ☐		
Pull Transducer for DTW Measurement? Yes NO		File Comments / Start Date of Data File:			

Manual Depth to Water Measurement

Measuring Point: TOC (outer w/cross bar) TIC (inner)		Stick-up Measured on Site	MP Diagram Used		
Time (MST):		Approximate DTW Calculation		Measurements in feet	
DTW (ft bMP):		MP elev		LSD:	
TD (ft bMP):		- WL Read	-	+ MP Height:	
Time (MST): ☐		= appx. DTW ☐	=	= MP Elevation:	
DTW (ft bMP): ☐		☐		- DTW:	
Time (MST):				= Groundwater Elevation (GWE)	
DTW (ft bMP):					
DTW Comments:		Synchronized Clocks:		Computer time:	Transducer time:
☐-Calibrated to Surface Pressure:		psi ☐			

Transducer Measurement of Groundwater Level Elevation

Readings at time of initial connect:		Add New Test	Reset Ref. Level	Readings after transducer reinstall	
Time (MST):		Time (MST):		Time (MST):	
Transducer Reading (ft):		New Test Name:		Transducer Reading (ft):	
GWE from MM		Reference Level (calculated GWE):		GWE from MM	
Difference in value:		Meas. Interval:		Difference in value:	
Error tolerance of transducer:		Start date/time:		Error tolerance of transducer:	
Within Error Tolerance ☐		Deleted Tests?		Within Error Tolerance	
Outside Error Tolerance				Outside Error Tolerance	

Comments:	Stabilization after transducer installation (list time and reading):
Transducer Pressure Tolerance:	
PSI: Tolerance: Max Depth:	
15 0.03 34.7 ft	
30 0.07 69.3 ft	
100 0.23 231 ft	
OFFSITE (mst):	

ATTACHMENT 4

SOP-5227-4

Guidance for Maximum Water Depths of Transducers

Records Use Only

Los Alamos NATIONAL LABORATORY EST.1943

Pressure Rating (psi)	Maximum Depth Below Water Surface (feet)	Measurement Precision (feet) (±0.1% Full Scale)
15	34.7	0.03
30	69.3	0.07
50	115.5	0.12
100	231.0	0.23
200	462.0	0.46
250	577.5	0.58
300	693.0	0.69
500	1155.0	1.16
1000	2310.0	2.31