

PRESSURE TRANSDUCER INSTALLATION, REMOVAL, AND MAINTENANCE

Purpose This procedure 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.

Scope This procedure applies to all ENV and contractor personnel authorized to operate or maintain the water level recording pressure transducers, or assist with these tasks.

In this procedure This procedure addresses the following major topics:

Topic	See Page
General Information About This Procedure	3
Who Requires Training to This Procedure?	3
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Integrated Work Management 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.

CONTROLLED DOCUMENT

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Signatures

First authorization review date is one year from group leader signature below; subsequent authorizations are on file in group office.

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General Information About This Procedure

Attachments This document has the following attachments:

Number	Attachment Title	No. of pages
1	Transducer Performance Check and Maintenance Form	1
2	List of Manufacturer Operating Manuals	1

History of revision This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	5/05	New document. Supersedes ENV-WQH-SOP-16.3
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.

Who requires training to this procedure ENV staff and contractors who work with pressure transducer equipment require training before implementing this procedure.

Training method The training method for this procedure is both **read-training** and field proficiency check. Training is in accordance with group specific procedures for training. Retraining to this procedure is “self-study” (reading) and completed upon instruction of line manager.

Prerequisites In addition to training to this procedure, the following training is also **required** prior to performing this procedure:

- ENV-DO-202, Manual Groundwater Level Measurements

General Information About This Procedure, continued

Terminology Absolute pressure: the total or absolute pressure measured by a sensor without correction for atmospheric pressure. A pressure measurement that includes atmospheric pressure is an 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 is 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 gaged for atmospheric pressure. A vented or gage pressure transducer sensor utilizes 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 gage).

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.

Participant: ENV 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 height in feet of a column of water that can be supported by the gage pressure measured at a point in a well.

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.

General Information About This Procedure, continued

Terminology 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 gage, see gage 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 in order to protect the original data from 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 single completion well at the time of installation of the transducer. Determined by manual measurement of the groundwater elevation according to ENV-DO-202, *Manual Groundwater Measurements*.

Participant: Trained personnel who perform pressure transducer installation, removal, and maintenance in accordance with this document.

Water Elevation: The elevation of the surface of the water in a well, expressed in feet above mean sea level.

Water Level: 1) Depth to water (DTW) in a well below ground surface expressed in feet, or 2) The Water Elevation expressed in feet above mean sea level. Refer to ENV-DO-202, *Manual Groundwater Measurements*, for information about measuring groundwater level in a well.

General Information About This Procedure, continued

Pressure transducer equipment

Transducer equipment is used to periodically 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 ‘gaged’ 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 (pounds per square inch gaged or psig). Using these transducers, 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 ‘gaged’ transducers include the standard In-Situ, Inc. miniTroll[®] and Level Troll[®] transducers.
- ‘Absolute’ or ‘uncompensated’ pressure transducers measure absolute pressure (pounds per square inch absolute, 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 due to 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 that is used so that data can be processed accordingly.

Note

Actions specified within this procedure, unless preceded with “should” or “may,” are to be considered mandatory guidance (i.e., “shall”, “must”).

General Requirements for Transducer Installation or Removal

Equipment	<p>Suggested equipment for installation and removal of transducers in monitoring wells or surface water locations</p> <ul style="list-style-type: none">• Transducer(s)• Transducer cable• Spool or rack for transducer cable• Data logger (if required)• Manufacturer operating manual• Transducer Performance Check and Maintenance Form (Attachment 1)• Portable computer and RS-232 direct-cable connection• Floppy disk(s) or other removable electronic media for data storage• Batteries – most In-Situ products require AA batteries• 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 (GFCI) (where necessary)• Electric extension cord (where necessary)• Tripod or well head roller for installations with cable greater than 300 ft• Deionized water• Paper towels• Trash bags• Keys to wells & access gates where necessary
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Equipment check	<p>Before departing for the well site, the participant shall test data loggers and transducers for functionality, see Calibration and Maintenance of Pressure Transducer section of this procedure. Prepare water level meter according to ENV-DO-202, <i>Manual Groundwater Level Measurements</i>.</p>
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Required personnel	<p>Two people, one supervising operator and one assistant, are required to install or remove a pressure transducer from a monitoring well.</p> <p>A single operator is adequate to retrieve data from the recording data logger if approved by the Operations Team Leader and only when using Enhanced Communications Procedures. Reference the Working Alone Policy in RRES-ES-Field, <i>General Field Safety for All</i>.</p>
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Calibration and Maintenance of Pressure Transducer Equipment

Background Pressure transducer equipment shall be properly maintained and calibrated according to manufacturer instructions. Equipment maintenance and calibration records shall be maintained to insure the quality of data from transducer equipment. All calibration of pressure transducers is performed by the manufacturer. The performance of a pressure transducer may be checked through a performance check as described on pages 10 and 11 of this document.

Equipment The following equipment is suggested for transducer maintenance and calibration checking.

- Pressure transducer
 - Transducer Cable
 - Portable computer and RS-232 direct-cable connection
 - Tape measure graduated in 0.01 ft
 - Transducer Performance Check and Maintenance Form (Attachment 1)
 - Marking Pen
 - Silicon grease for O-ring lubrication
 - Batteries for transducer equipment
-

Transducer maintenance The **participant** shall:

- Follow requirements of each equipment manufacturer (Attachment 2) to maintain transducer equipment.
- Document maintenance on the Transducer Performance Check and Maintenance Form (Attachment 1).
- Perform routine maintenance each time a transducer is installed or removed from a well. Routine maintenance includes:
 - Check/change batteries
 - Check/lubricate O-rings
 - Check cables, vent lines
 - Keep equipment clean, work area uncluttered
 - Wipe cable and transducers with 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, check date of calibration

Calibration and Maintenance of Pressure Transducer Equipment, continued

Avoiding cross-contamination Transducer equipment is typically installed in a specific well and dedicated to that well, therefore minimizing cross contamination issues.

If transducer equipment must be installed in a different well, the **participant** shall wipe the cable and transducer housing with a clean cloth soaked in deionized water prior to installation to prevent potential cross contamination.

Automatic daylight savings time adjustment Transducer software clocks and internal clocks in portable computer used with transducer equipment must have the time set to Mountain Standard Time (MST) at all times, without any daylight-savings time adjustment in the spring and fall.

The **participant** shall disable the automatic daylight savings time adjustment setting in Microsoft Windows-based computers used with transducer equipment. This will prevent the clock from changing to daylight savings time.

The clocks on all portable computers used must be checked before each use to ensure the time and date on the computer is appropriate and set to MST.

Transducer calibration and performance checks A transducer may be considered to be properly calibrated as long as the transducer returns values that are within pre-determined measurement precision specifications (see Table 1). How long a transducer will maintain calibration depends on the amount of regular use the transducer has experienced, whether or not the transducer was exposed to environmental extremes, and how the transducer was handled during use, transportation, and storage.

Transducer calibration is performed by the manufacturer. The **participant** shall record transducer calibration date(s) on the Transducer Performance Check and Maintenance form (Attachment 1) and on the forms maintained in the transducer files.

The **participant** shall perform transducer performance checks prior to installation of a transducer if calibration was done more than one year prior to installation date, or if transducer is suspected of malfunctioning, and document the calibration check on the Transducer Performance Check and Maintenance Form (Attachment 1).

Calibration and Maintenance of Pressure Transducer Equipment, continued

Performance check To conduct a performance check on a pressure transducer, the **participant** shall perform a depth test and/or a drift test. The following steps describe a depth test:

Step	Action								
1	For compensated transducers, take a pressure measurement when the transducer is in the air. Insure that the transducer measurement in air is 0 psi, within the measurement precision of the transducer. Record air measurement on the Transducer Performance Check and Maintenance Form [Air Pressure (psi)]. (Attachment 1)								
2	Place transducer in well or water column at first position by performing the following steps: <table border="1" data-bbox="516 831 1425 1125"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Temporarily position the transducer 1 to 2 ft below water level.</td> </tr> <tr> <td>2</td> <td>Record the water depth [PH1 (ft)] on the Transducer Performance Check and Maintenance Form.</td> </tr> <tr> <td>3</td> <td>Secure the cable and mark the transducer cable at the top of casing or at another convenient Measuring Point.</td> </tr> </tbody> </table>	Step	Action	1	Temporarily position the transducer 1 to 2 ft below water level.	2	Record the water depth [PH1 (ft)] on the Transducer Performance Check and Maintenance Form.	3	Secure the cable and mark the transducer cable at the top of casing or at another convenient Measuring Point.
Step	Action								
1	Temporarily position the transducer 1 to 2 ft below water level.								
2	Record the water depth [PH1 (ft)] on the Transducer Performance Check and Maintenance Form.								
3	Secure the cable and mark the transducer cable at the top of casing or at another convenient Measuring Point.								
3	Measure a specific length of the remaining cable that extends from the well. Use a measured length that is within the rated capacity of the transducer (reference Transducer Selection & Installation Guidance in this document). Record the length measured on the cable [Cable Length (ft)]. Use the full range of the transducer for the calibration check if the well/water column depth allows.								

Table continued on next page.

Calibration and Maintenance of Pressure Transducer Equipment, continued

Performance check, continued

Step	Action								
4	Place transducer in well or water column at the second position by performing the following steps:								
	<table border="1"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Lower the transducer and cable in the well or water column the measured length as determined in Step 3 above.</td> </tr> <tr> <td>2</td> <td>Position the measured mark on the cable at the top of casing/water column at the previously used Measuring Point.</td> </tr> <tr> <td>3</td> <td>Record the measured water depth provided by the transducer on the Transducer Maintenance and Performance Check Form [PH2 (ft)].</td> </tr> </tbody> </table>	Step	Action	1	Lower the transducer and cable in the well or water column the measured length as determined in Step 3 above.	2	Position the measured mark on the cable at the top of casing/water column at the previously used Measuring Point.	3	Record the measured water depth provided by the transducer on the Transducer Maintenance and Performance Check Form [PH2 (ft)].
Step	Action								
1	Lower the transducer and cable in the well or water column the measured length as determined in Step 3 above.								
2	Position the measured mark on the cable at the top of casing/water column at the previously used Measuring Point.								
3	Record the measured water depth provided by the transducer on the Transducer Maintenance and Performance Check Form [PH2 (ft)].								
5	<p>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 (reference Transducer Selection & Installation Guidance, Table 1, in this document).</p> <p>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.</p>								

Calibration and Maintenance of Pressure Transducer Equipment, continued

Performance check, continued A drift test may also be done to evaluate performance of a pressure transducer. To do a drift test, the **participant** shall perform the following steps:

Step	Action
1	Secure transducer at a known depth in a contained water column.
2	Record pressure readings every one minute for 15 minutes.
3	Determine the error tolerance of the transducer by multiplying the pressure rating of the transducer (psi) by 0.001 (0.1%).
4	Check readings for any noticeable drift that is beyond the error tolerance.
5	If measurements are not within error tolerance, or a noticeable drift occurs: <ul style="list-style-type: none">• 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.
6	Record results on the Transducer Performance Check and Maintenance Form (Attachment 1).

Transducer Selection and Installation Guidance

Transducer selection and installation guidance for pressure transducers 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 ft/psi. Table 1 provides guidance for maximum water depths of transducers and indicates the measurement precision characteristic of different pressure rated transducers.

Table 1

Pressure Rating (psi)	Maximum Depth Below Water Surface (ft)	Measurement Precision (ft) (±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

Before installing a transducer in a well, the **participant** shall:

- 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.

Use a transducer with the lowest pressure rating possible for the specific application, because measurement precision decreases with higher pressure ratings (see Table 1 above).

Examples:

In single completion monitoring wells open to the atmosphere at LANL, annual water level fluctuations may be less than 15 ft, which would indicate installation of a transducer with a pressure rating of 15 psi at a depth of 15 to 17 ft below the water level. Shallow alluvial wells may experience water level fluctuations of 30 ft or more.

In monitoring wells adjacent to water supply wells or in water supply wells, the daily water level drawdown might be 100 to 150 ft or more. Given an anticipated drawdown of 150 ft, a transducer with a pressure rating of 100 psi should be installed at a depth of 170 to 200 ft below the water surface, for example.

Transducer Installation

Prepare for transducer installation

To prepare for transducer installation in single completion wells, the **participant** shall perform the following steps:

Step	Action										
1	Manually measure the groundwater level using a water level meter according to ENV-DO-202, <i>Manual Groundwater Level Measurements</i> , and perform the following steps: <table border="1" data-bbox="516 604 1425 947"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Record the date, time, and measured depth to water.</td> </tr> <tr> <td>2</td> <td>Calculate the groundwater elevation on the Groundwater Level Measurement Form or in the field notebook.</td> </tr> <tr> <td>3</td> <td>Record the groundwater elevation on the Groundwater Level Measurement Form.</td> </tr> <tr> <td>4</td> <td>If possible, measure the total depth of the well and record depth on Groundwater Level Measurement Form</td> </tr> </tbody> </table>	Step	Action	1	Record the date, time, and measured depth to water.	2	Calculate the groundwater elevation on the Groundwater Level Measurement Form or in the field notebook.	3	Record the groundwater elevation on the Groundwater Level Measurement Form.	4	If possible, measure the total depth of the well and record depth on Groundwater Level Measurement Form
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3	Record the groundwater elevation on the Groundwater Level Measurement Form.										
4	If possible, measure the total depth of the well and record depth on Groundwater Level Measurement Form										
2	Apply silicone lubricant to O-rings on transducer connections following manufacturer instructions.										
3	Connect transducer cable to pressure probe and to data logger/portable computer according to manufacturer instructions.										
4	Check for appropriate communications with transducer.										
5	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 Mountain Standard Time.										
6	Record the transducer serial number, transducer battery and storage information, and well information in the field notebook										

Transducer Installation, continued

Install transducer

To install the transducer(s), the **participant** shall perform the following steps:

Step	Action								
1	Carefully lower transducer into the well. <ul style="list-style-type: none"> Do not allow cable to rub against sharp edge of metal casing and Do not allow the transducer to contact water level at high rate of speed; this will damage the pressure sensor. Do not submerge transducer to a water depth pressure greater than the pressure rating of the transducer (reference Transducer Selection and Installation Guidance in this document) 								
2	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 Transducer Calibration section. Record performance check data on the Transducer Performance Check and Maintenance Form (Attachment 1).								
3	Install pressure transducer: <table border="1" data-bbox="511 1031 1425 1434"> <thead> <tr> <th>Step</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Install pressure transducer at an appropriate depth to monitor the full range of expected water level fluctuation (reference Transducer Selection and Installation Guidance in this document) and according to manufacturer instructions.</td> </tr> <tr> <td>2</td> <td>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.</td> </tr> <tr> <td>3</td> <td>Mark the transducer cable to document cable placement and detect cable slippage or tampering.</td> </tr> </tbody> </table>	Step	Action	1	Install pressure transducer at an appropriate depth to monitor the full range of expected water level fluctuation (reference Transducer Selection and Installation Guidance in this document) and according to manufacturer instructions.	2	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.	3	Mark the transducer cable to document cable placement and detect cable slippage or tampering.
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1	Install pressure transducer at an appropriate depth to monitor the full range of expected water level fluctuation (reference Transducer Selection and Installation Guidance in this document) and according to manufacturer instructions.								
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3	Mark the transducer cable to document cable placement and detect cable slippage or tampering.								

Table continued on next page.

Transducer Installation, continued

**Install
transducer,
continued**

Step	Action
4	<p>Initialize measurement software / data logging software according to manufacturer instructions.</p> <ul style="list-style-type: none"> • Program the software for appropriate measurement sampling interval for the intended purpose and use of the data. • When installing an In-Situ Level Troll® transducer, enter the latitude, longitude, and elevation of the ground water. These values are: Latitude: 36 degrees north Longitude: 106 degrees west Elevation: Elevation of the groundwater, rounded to no decimal points. • Enter the groundwater elevation measurement obtained before installation of the transducer as the reference level. The reference level should be entered to an accuracy of 0.01ft. In a shallow well installation, another water level may be taken after the transducer is installed. • Program software to begin measurements as soon as possible after installation.
5	<p>For deep well installations where manual water levels are not possible after the transducer is installed, watch for cable straightening and groundwater equilibration for at least 15 minutes. If groundwater elevations change more than 0.05 ft over a 15 minute period, reset the level reference to the initial value. If more than 0.10 ft of change is observed over a 15 minute period, wait for stabilization of groundwater values, then reset the level reference.</p>
6	<p>Replace caps and locks on well shelter.</p>
7	<p>To verify that the transducer is functioning correctly, check transducer within 1 week after installation.</p> <ul style="list-style-type: none"> • Check for cable slippage and cable stretch. • Check measurement data for signs of cable slippage, stretch or sensor drift. • Check measurement data for appropriate frequency. • If indications of data problems exist, measure the groundwater level and reinstall the transducer, if problems persist, replace the transducer.

Transducer Data Retrieval

Transducer Data Retrieval Retrieve transducer data from wells on a regular basis to insure the continued quality of the transducer data. The frequency of retrievals will be determined by the work plan under which the data is collected. To retrieve data from transducer equipment, the **participant** shall perform the following steps:

Step	Action
1	Connect portable computer to data logging equipment or transducer cable and start manufacturer provided software specific for the transducer equipment.
2	Extract the transducer data set according to manufacturer instructions. (If a new data file is going to be started, stop logging to the current file prior to downloading.) Record data retrieval information in field notebook. Document data retrieval information, including: <ul style="list-style-type: none"> • Transducer serial number • Transducer operating condition • Battery power • Remaining storage capacity of transducer • Groundwater elevation at time of data retrieval. • Raw data file name.
4	View the data collected since transducer installation. Ascertain that appropriate data have been collected.
5	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.
6	If a manual groundwater level is going to be obtained, go to step 7. If a manual groundwater level is not going to be obtained, go to step 8.

Table continued on next page.

**Transducer
Data,
Retrieval,
continued**

Step	Action																		
7	<p>Manually measure the groundwater level according to ENV-DO-202, <i>Manual Groundwater Level Measurements</i>.</p> <p>If the well construction allows manual groundwater level measurement without disturbing the transducer (separate access ports), perform the following steps:</p> <table border="1" data-bbox="516 527 1421 1003"> <thead> <tr> <th data-bbox="516 527 639 569">Step</th> <th data-bbox="639 527 1421 569">Action</th> </tr> </thead> <tbody> <tr> <td data-bbox="516 569 639 617">1</td> <td data-bbox="639 569 1421 617">Manually measure the groundwater level</td> </tr> <tr> <td data-bbox="516 617 639 737">2</td> <td data-bbox="639 617 1421 737">Record the groundwater elevation measurement on the Groundwater Level Measurement Form, or in the field notebook.</td> </tr> <tr> <td data-bbox="516 737 639 1003">3</td> <td data-bbox="639 737 1421 1003">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 Table 1 on p. 13 for measurement precisions), reset the level reference to the new groundwater elevation value obtained during the manual measurement.</td> </tr> </tbody> </table> <p>If the well does not have separate access tubes for the transducer and the water level meter, perform the following steps:</p> <table border="1" data-bbox="516 1108 1421 1486"> <thead> <tr> <th data-bbox="516 1108 639 1150">Step</th> <th data-bbox="639 1108 1421 1150">Action</th> </tr> </thead> <tbody> <tr> <td data-bbox="516 1150 639 1241">1</td> <td data-bbox="639 1150 1421 1241">Remove the transducer from the well (see steps in following section: Transducer Removal.)</td> </tr> <tr> <td data-bbox="516 1241 639 1289">2</td> <td data-bbox="639 1241 1421 1289">Manually measure the groundwater level</td> </tr> <tr> <td data-bbox="516 1289 639 1402">3</td> <td data-bbox="639 1289 1421 1402">Record the groundwater elevation measurement on the Groundwater Level Measurement Form, or in the field notebook.</td> </tr> <tr> <td data-bbox="516 1402 639 1486">4</td> <td data-bbox="639 1402 1421 1486">Reinstall the transducer following the Transducer Installation Procedure.</td> </tr> </tbody> </table>	Step	Action	1	Manually measure the groundwater level	2	Record the groundwater elevation measurement on the Groundwater Level Measurement Form, or in the field notebook.	3	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 Table 1 on p. 13 for measurement precisions), reset the level reference to the new groundwater elevation value obtained during the manual measurement.	Step	Action	1	Remove the transducer from the well (see steps in following section: Transducer Removal.)	2	Manually measure the groundwater level	3	Record the groundwater elevation measurement on the Groundwater Level Measurement Form, or in the field notebook.	4	Reinstall the transducer following the Transducer Installation Procedure.
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2	Manually measure the groundwater level																		
3	Record the groundwater elevation measurement on the Groundwater Level Measurement Form, or in the field notebook.																		
4	Reinstall the transducer following the Transducer Installation Procedure.																		
8	Check that the transducer clock is the correct time (MST).																		
9	If logging was stopped or the transducer reading not accurate, restart the data logger software following the transducer installation procedure, use the newly obtained groundwater elevation as the reference level.																		
10	<p>Transmit data file to a backed up server for safe keeping.</p> <ul style="list-style-type: none"> • Insure 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. 																		

Transducer Removal

Transducer Removal To remove the transducer from a single completion well, the **participant** shall perform the following steps:

Step	Action
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 notebook.
3	For a shallow installation, manually measure the groundwater level according to ENV-DO-202, <i>Manual Groundwater Level Measurements</i> . For deep well installations, go to step 4 first, then take a manual water level.
4	Remove the cable and transducer(s) from the well. <ul style="list-style-type: none"> • Use cable pulling system if cable longer than 500 ft. • The cable should not scrape against sharp edges of well casing. • Clean and maintain transducer equipment as described in Transducer Equipment Maintenance section. • Package transducers appropriately for transportation according to manufacturer instructions.
5	Replace well caps and locks.

Records Resulting From This Procedure

Records

The **participant** shall ensure that the following records, generated as a result of this procedure, shall be permanently stored with ENV-WQH in accordance with ENV-WQH-QP-025, Records Management.:

- Transducer Performance Check and Maintenance Form (Attachment 1)
- Groundwater Level Measurement Form (ENV-DO-202, Attachment 3)
- Raw water level data electronic file on electronic media
- Field logbook with pressure transducer activities
- Other associated information

[Click here to record “self-study” training to this procedure.](#)

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 Calibration Date	Air Pressure (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

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MANUFACTURER OPERATING MANUALS

In-Situ Operations Manuals for Pressure Transducers

MiniTROLL Operator's Manual for MiniTROLL Model SSP-100

WinSitu 4.0 User's Guide

Hermit 3000 Data Logger Operator's Manual

In-Situ Inc. Data Manager Software Operator Manual

Solinst Level Logger Manual