**ACTIVITY/PROJECT SPECIFIC PROCEDURE**

**SP 12-6**

PRESSURE TRANSDUCER CALIBRATION USING THE DRUCK DPI-610

Revision 1

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1.0 Purpose and Scope

This procedure prescribes the Sandia National Laboratories (SNL) Waste Isolation Pilot Plant (WIPP) process for the calibration of pressure transducers using the Druck Model DPI-610 pressure controller as the pressure standard.

Calibration of pressure transducers may also require the use of a signal measurement standard and a temperature measurement device. For analog output transducers, the measurement of the signal output can be accomplished using the functions contained in the Druck DPI-610 pressure controller or using a voltmeter measurement device, such as the Martel Model MC-1200. If the pressure transducer has a digital output, the pressure value will already be converted to an engineering unit; therefore, a signal measurement device is not required. The calibration technician will require a readout device to display the digital transducer’s output. For example: a PDA or laptop computer running the In-Situ program can be used to display the pressure measured by a Troll pressure transducer.

This document is not meant to substitute for the manufacturer’s instruction manuals for the Druck DPI-610 or the manufacturer’s recommendations for the pressure transducers being calibrated. The user is responsible for reading and understanding the appropriate manuals for the items being calibrated and the equipment used.

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

2.0 Implementation Actions

2.1 Safety

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.
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.

All personnel performing this procedure shall have completed SNL pressure installer training. For pressurizing the transducer under test, only use the hand pump integral to the Druck DPI-610 pressure standard. If an external pressure source is to be utilized, the system must include a Pressure Safety Package. When removing the pressure from the transducer under test, only use the Druck DPI-610 pressure bleed valve located on the front panel.

During calibration of pressure transducers, the pressure applied to the transducer can reach 300 PSI. The calibration should never exceed the manufacturer's pressure rating for the transducer being tested. The shortest piping from the pressure transducer to the pressure standard should be used to minimize the tubing air volume. All connections between the transducer under test and the Druck DPI-610 pressure standard shall be made with Swagelok or equivalent fittings and tubing.

2.2 Responsibilities

The Principal Investigator (PI), Well Testing Lead (WTL) or designee, whose activities warrant the use of this procedure, shall be responsible for implementing the requirements of this procedure.

The technical staff member performing the calibration following the requirements of this procedure shall have completed SNL Pressure Installer training and shall verify the latest revision of this procedure is being implemented.

If this procedure cannot be worked as written, the user has the responsibility to stop work and resolve all concerns with either the PI, Safety or QA representative, as appropriate, prior to proceeding with the work.

2.3 Standards

The Druck Model DPI-610 will be used to control and apply the desired pressure to the transducer under test. The output of the analog transducers will be measured using the Druck DPI-610, a Martel Model MC-1200, or similar system capable of measuring loop current or voltage. For digital transducers, the output will be displayed using a manufacturer's approved device/method. The temperature during calibration will be monitored using a temperature sensor with an accuracy of +/- 0.5 °C. All standards used during the performance of this procedure shall be calibrated and traceable to NIST through the Sandia Primary Standards laboratory in Albuquerque, NM or an approved supplier. The serial number and expiration dates of the standards will be recorded in the applicable scientific notebook or scientific notebook supplement (supplement). Calibration standards shall not be used in the performance of this procedure if they are past their expiration date without prior approval of the PI or Well Testing Lead (WTL).

2.4 Frequency

The pressure transducers shall be calibrated at a frequency consistent with manufacturer’s specifications or based on a performance history for the transducer. If no baseline exists and the manufacturer has no specification, the transducer will be calibrated semi-annually (on six month intervals).

The PI or WTL may elect to lengthen or shorten the calibration interval based on the results of previous calibrations and the stability of the equipment. Any deviations from the established calibration interval will be justified in the applicable scientific notebook/supplement.
2.5 Acceptance Criteria

The accuracy of the transducer will be based on manufacturer’s specifications or the requirements of the PI or WTL. If the calibration of the transducer deviates from the manufacturer’s or PI’s specifications, the calibration will be identified as ‘Limited’. All pressure calibrations shall be performed with the temperature between 20-30ºC. The temperature shall also be stable, within +/- 2ºC during the calibration of an individual transducer calibration. If the temperature fluctuates beyond these values, abort the calibration and repeat when the temperature has stabilized.

2.6 Corrective Action

If the transducer being calibrated cannot be brought into tolerance during the performance of this procedure or if the equipment becomes damaged, the faulty gage shall be tagged and taken out of service until repaired. If the transducer cannot be repaired, it will be permanently removed from service. If during the performance of an As-Found calibration the transducer is found to be out of tolerance, a Corrective Action Request (CAR) will be issued to document the results and impacts related to the change in transducer performance. Corrective action could include evaluation and adjustment to any data collected by this transducer, re-evaluation of the calibration interval, or an assessment of the process in which the instrument is being utilized. Results of all activities related to the out-of-tolerance condition will be summarized in the CAR.

2.7 As-Found Calibration / Verification

The calibration process includes the following general steps: (1) Perform an As-Found/As-Received Calibration at multiple points (a general guideline is 10 data points) along the transducers range; (2) If the unit fails to meet specifications, the unit will be adjusted (if viable for the transducer being calibrated) or a limited calibration can be accepted; (3) Following adjustment, the performance of the transducer will be verified by performing an As-Left calibration at multiple points spanning the measurement range of the instrument; (4) Calibration uncertainty will be calculated using the error between the input pressure and measured signal output using a best straight line fit routine; and (5) The resulting error will be compared with the established acceptance criteria (tolerances) to determine the adequacy of the calibration. This calibration process and the equipment utilized is described below in greater detail.

*Note:* Transducers that have been used for data collection should first undergo an as-found calibration to determine their received condition.

2.7.1 Turn on the equipment to be used in the performance of this procedure, allow the equipment to warm-up a minimum of 10 minutes before starting the calibration. If applicable zero the multimeter.

2.7.2 While the equipment is warming-up, inspect and clean the transducer orifice. Connect the pressure transducer to the pressure controller using Swagelok or equivalent fittings and tubing. Connect the electrical wiring of the transducer to a power supply and a signal measurement device such as a voltmeter.

2.7.3 If the Druck pressure standard does not display a pressure output of 0.00 with the vent valve open, zero the pressure standard using the on board zeroing function.

*Note:* When using the Druck pressure controller or the Martel, the transducer power and output signal will be measured with the same device.
2.7.4 When applying pressure use the pressure pump integral to the DPI-610. Do not pressurize the unit under test with external pressure sources. When removing the applied pressure, only use the bleed valve located on the DPI-610.

2.7.5 Set the pressure controller to approximately 25 PSI. Monitor the pressure for several minutes, if the pressure remains stable the transducer connection to the pressure standard is leak tight. If the pressure drops, check the mechanical fittings, retighten as necessary and re-attempt the leak test.

2.7.6 Remove all pressure applied to the transducer using the bleed valve on the DPI-610 and record the signal output as the zero pressure reading. Also note the temperature at the time of the reading, record all values in the applicable scientific notebook/supplement.

2.7.7 Using the DPI-610 hand pump, set the pressure to the first setpoint. Each setpoint should represent evenly spaced values spanning the range of the transducer. Record the transducer signal output and the temperature at the time of the reading in the applicable scientific notebook/supplement.

2.7.8 Repeat step 2.7.7 until all setpoints have been reached and the corresponding transducer signal output has been measured and record in the applicable scientific notebook/supplement.

2.7.9 Return the pressure controller output to zero, let the transducer output signal stabilize and record the value in the applicable scientific notebook/supplement.

2.7.10 Calculate the performance of the transducer using a product like Excel’s Regression Analysis Tool to develop a best straight line fit calculation for the calibration results. The transducer calibration performance shall be equal to or better than the manufacturer’s or PI’s specifications. If the transducer performance does not meet specifications issue a Corrective Action Request (CAR). If the transducer has a ‘zero’ and ‘span’ adjustment, proceed to section 2.8. If the transducer cannot be adjusted and the results fail to meet specifications, the unit can either be returned to the manufacturer for repair or derated by assigning a ‘Limited’ calibration. Initiate a CAR per the requirements of NP 16-1 to document the failure of the transducer to meet the established acceptance criteria.

2.7.11 If the As-Found transducer calibration results are acceptable, no further calibration will be required. Proceed to section 3.0

Note: The PI or Well Testing Lead (WTL) may decide to accept an As-Found calibration that exceeds the stated acceptance criteria. The PI or Well Testing Lead (WTL) will need to document this decision and any impact on data collected with this transducer in the scientific notebook/supplement. Both the transducer calibration tag and the applicable scientific notebook/supplement shall document the limited calibration.

2.8 Adjusting or Linearizing the Pressure Transducer Using a Zero and Span Adjustment (Only Perform this Section if the Transducer can be Adjusted)

2.8.1 Connect the pressure transducer to the pressure controller following steps 2.7.1 through 2.7.5.

2.8.2 Set the pressure controller to 0.00 PSI. While monitoring the transducer signal output, adjust the ‘zero’ pot until the transducer output signal is 4.0 mA, 0.00 VDC, or as required by the manufacturer.
2.8.3 Set the pressure controller to the full scale range value of the transducer. While monitoring the transducer signal output, adjust the ‘span’ pot until the transducer signal output equals the full scale electrical output required by the manufacturer. (Typically this should be 20.00 mA or 10.00 VDC, etc.).

2.8.4 Set the pressure controller back to 0.0 PSI. Note the reading, if the value is still 4.00 mA or 0.00 VDC the adjustment is complete. If the value has changed repeat steps 2.8.2 and 2.8.3 until no further adjust of the ‘zero’ and ‘span’ potentiometers is required.

2.8.5 Proceed to section 2.9 to perform a complete As-Left calibration when the adjustments are complete.

2.9 As-Left Calibration

2.9.1 If required, connect the pressure transducer to the pressure controller following steps 2.7.1 through 2.7.5.

2.9.2 Remove all pressure applied to the transducer and record the signal output as the zero pressure reading. Also note the temperature at the time of the reading, record all values in the applicable scientific notebook/supplement.

2.9.3 Set the pressure to the first setpoint. The setpoints should represent evenly spaced increments spanning the range of the transducer. Record the transducer signal output and the temperature at the time of the reading in the applicable scientific notebook/supplement.

2.9.4 Repeat step 2.9.3 until all setpoints have been reached and the corresponding transducer signal output has been measured and recorded in the applicable scientific notebook/supplement.

2.9.5 Return the pressure controller output to zero, let the transducer output signal stabilize and record the value in the applicable scientific notebook/supplement.

2.9.6 Calculate the performance of the transducer using a best straight line fit calculation. The transducer calibration performance shall be equal to or better than the manufacturer’s or PI’s specifications. If the transducer performance does not meet specifications, but the unit has a ‘zero’ and ‘span’ adjustment, proceed to section 2.8.

2.10 References

Druck Model DPI-610 - Operator Manual
Martel Model MC-1200 Operator Manual
3.0 Records

The following QA records, generated through implementation of this procedure, shall be prepared and submitted to the WIPP Records Center in accordance with NP 17-1 (Records):

- Corrective Action Request (CAR), Form NP 16-1-1, if required
- Scientific Notebook or Scientific Notebook Supplement

4.0 Appendices

There are no appendices associated with this document.
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