



Figure 1. Pressure Calibration System



Figure2. Pressure Calibrator Front Panel/Touch Screen

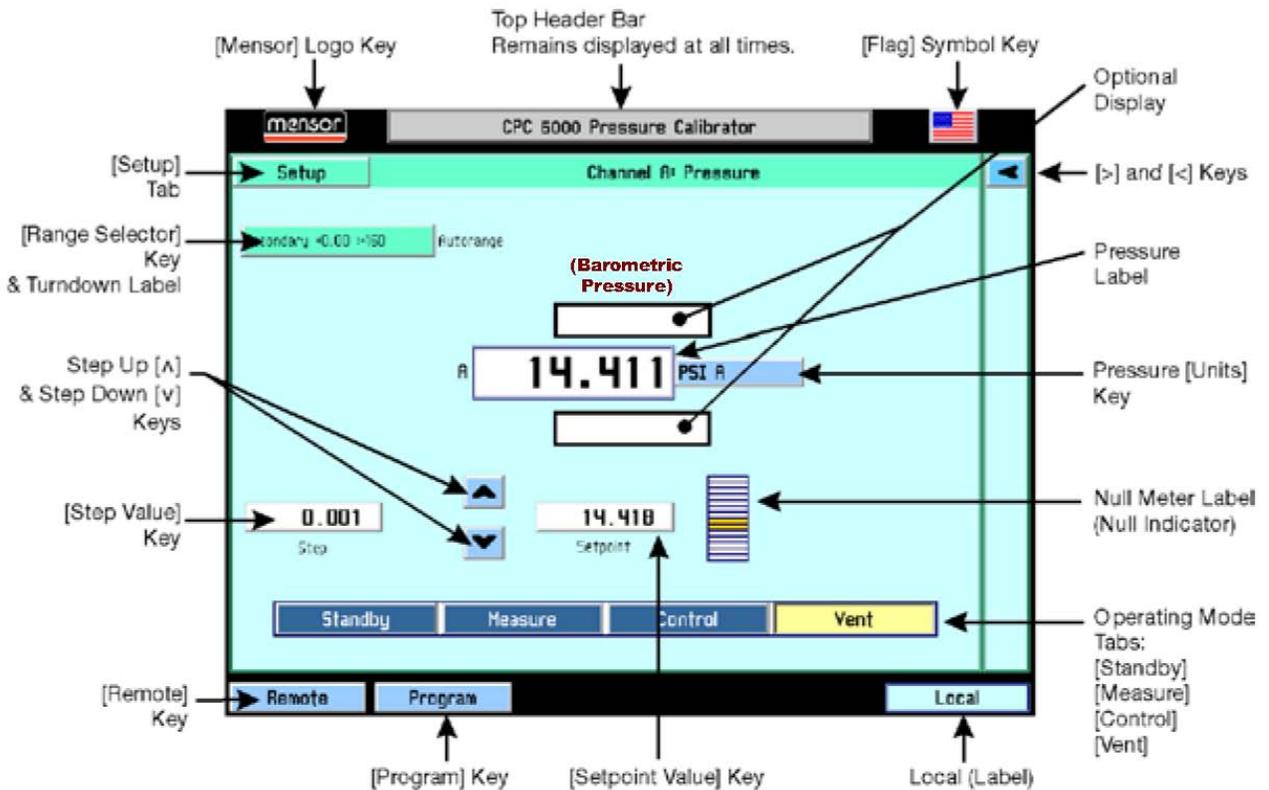


Figure 3. Terminology of Touch Screen Icons

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.

The pressure calibrator, and any ancillary equipment, is powered by 120 VAC plug and cord. Personnel will not come into contact with the 120 VAC. The only voltage levels expected in the performance of this procedure, from the connection of a transducer to a power supply or display device, will be 50 VDC or less. Therefore, as defined in the SNL Electrical Safety Manual, personnel will not be exposed to hazardous voltages and lock-out tag-out (LOTO) is not required to troubleshoot this equipment.

All personnel performing this procedure shall have completed SNL pressure installer training. Since an external pressure source (compressed inert gas cylinders such as dry nitrogen or dry air) is to be utilized, the system includes a Pressure Safety Data Package (PSDP).

During the calibration of transducers, the pressure applied to the transducer can reach 1,000 PSI. Also, during the calibration of ambient transducers the vacuum applied to the pressure calibrator can reach 100 mTorr. The calibration should never exceed the manufacturer's pressure rating for the transducer being tested. The shortest piping from the transducer to the pressure calibrator should be used to minimize the tubing air volume. All connections between the transducer under test and the pressure calibrator shall be made with Swagelok or equivalent fittings and tubing.

Refer to the *Pressure Calibrations Using Mensor CPC 6000 or Druck DP1650 Pressure Controllers* JSA and the Pressure Safety Data Package, for safety concerns and their mitigation.

2.2 Responsibilities

The Principal Investigator (PI), Field Testing Lead (FTL) 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 shall follow the requirements of this procedure, verify the latest revision of this procedure is being implemented and have completed SNL Pressure Installer training. The technical staff member shall also be thoroughly familiar with the Mensor CPC 6000 Operating Instructions before using the pressure calibrator.

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

2.3 Standards

The pressure calibrator will be used to control and apply the desired pressure or vacuum to the transducer being calibrated. The output of analog transducers will be measured using a HP 3456A, 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 calibration report developed in Excel, scientific notebook or scientific notebook 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 FTL.

Note: The scientific notebook supplement may include an Excel spreadsheet containing all pertinent transducer calibration data.

2.4 Frequency

The 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 yearly (on a 12 month interval).

The PI or FTL may elect to length 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 FTL. A calibration will be identified as 'Limited' if the calibration of the transducer deviates from the manufacturer's specifications. All pressure calibrations shall be performed with the temperature between 20-30°C. The temperature shall also be stable, within $\pm 2^{\circ}\text{C}$ 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 either a best straight line fit routine percent full scale (FS) error calculation or similar method 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 are 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 transducer to the pressure calibrator at one of the PCS Output Ports (output ports) using Swagelok or equivalent fittings and tubing (Figure 4). Turn the Output Port Valve on the PCS Output Pressure Control Panel (pressure control panel) to the desired port (Figure 5). Attach the pressure manifold to one of the output ports to calibrate multiple transducers, up to six at a time. Select the desired pressure module using the Pressure Module Valve on the pressure control panel. If applicable, connect the electrical wiring of the transducer to a power supply and a signal measurement device, such as a voltmeter, or to the readout device for the digital gage. If calibrating a pressure transducer below ambient pressure, connect the vacuum pump to the Exhaust Port of the selected pressure module using the Exhaust Vacuum Valve on the pressure control panel.



Figure 4. Pressure Calibration System Output Ports

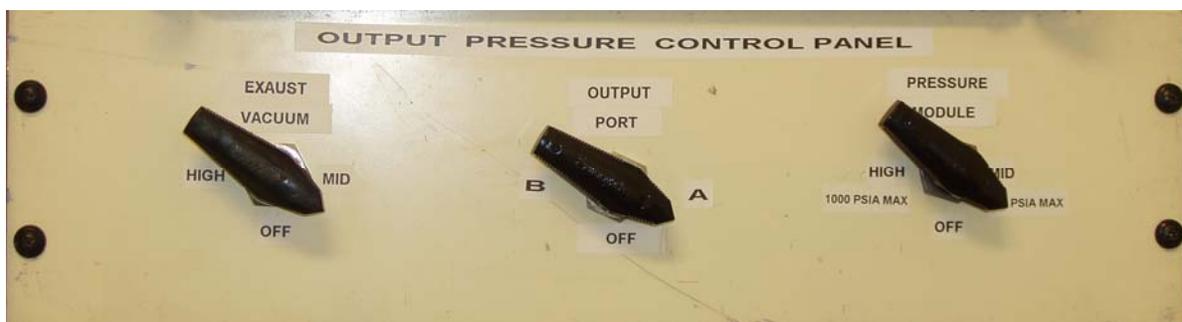


Figure 5. Pressure Calibration System Output Pressure Control Panel

2.7.3 The Absolute barometric pressure should be displayed on the touch screen in the Upper Optional Display of the Mid Range Pressure Module. The Pressure Key of the selected pressure module should display 'PSIA' on the touch screen. Press the Vent Operation Mode Tab on the touch screen. Compare the Pressure Label reading with the reading on the Upper Optional Display. These readings should be within 0.01% range full scale (FS) of each other.

Note: The transducer power and output signal can be measured with the same or two different signal measurement devices, such as a HP 3456A Digital Multimeter.

2.7.4 Press the Control Operating Mode Tab on the touch screen to apply pressure to the transducer being calibrated. The output pressure is increased/decreased by pressing the Step Up/Step Down Key next to the Setpoint Display on the touch screen. The Setpoint Display should increase/decrease one PSI setting per push of the Step Up/Step Down Key. Press the Vent Operating Mode Tab on the touch screen to remove the applied pressure to the transducer being tested.

2.7.5 If the transducer has a pressure range of 50 psi or greater, set the Setpoint Display on the touch screen to output a pressure of approximately 35 PSIA/40 PSIG. If the transducer is below 50 psi, set the Set Point Display to output a pressure that is equal to approximately 50% of the pressure rating of the transducer being calibrated. Monitor the Pressure Label reading for several minutes. If the pressure remains stable, the transducer connection to the pressure calibrator 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 by pressing the Vent Operating Mode Tab on the touch screen. Record the signal output as the zero pressure reading. Also, note the temperature at the time of the reading, and record all values in the calibration report or applicable scientific notebook/supplement.

Note: To achieve a zero or below barometric pressure reading on an ambient pressure transducer a vacuum must be applied to the Exhaust port of the selected pressure module following step 2.7.2.

2.7.7 Using the Step Up Key on the touch screen, 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 calibration report or 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 calibration report or applicable scientific notebook/supplement.

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

2.7.10 Calculate the performance of the transducer based on the calibration results. The transducer calibration performance shall be equal to or better than the manufacturer's, FTL's or designee'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 has field calibration adjustment through a manufacturer's program, such as INW Aqua4Plus, proceed to section 2.9. 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.

Note: Return the Pressure Calibration System to a zero energy condition (vent the pressure), upon completion of the testing or calibration of a pressure transducer, and at the termination of testing and calibration for the day.

Note: The PI, FTL, or designee may decide to accept an As-Found calibration that exceeds the stated acceptance criteria. The PI, FTL, or designee 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 calibration report or 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 in this Manner)

- 2.8.1** Connect the transducer to the appropriate pressure calibrator's pressure module following steps 2.7.1 through 2.7.5.
- 2.8.2** Set the pressure module to the zero or beginning pressure of the transducer being calibrated. 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 module 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 module back to the zero or beginning pressure. 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 2.10 to perform a complete As-Left calibration when the adjustments are complete.

2.9 Adjusting or Linearizing the Pressure Transducer Using a Field Calibration Program (Only Perform this Section if the Transducer can be Adjusted in this Manner)

- 2.9.1** Connect the transducer to the appropriate pressure calibrator's pressure module following steps 2.7.1 through 2.7.5.
- 2.9.2** Set the pressure module to the zero or beginning pressure of the transducer being calibrated. Allow the applied pressure to stabilize. Record or measure this pressure as the first point in a two-point calibration in the field calibration program.
- 2.9.3** Set the pressure module to the full-scale or final pressure of the transducer being calibrated. Allow the applied pressure to stabilize. Record or measure this pressure as the second point in the two-point calibration.

2.9.4 Apply or accept the entered pressure values. The field calibration program will generate new slope (m) and y-intercept (b) values to linearize the transducer. Record the new 'm' and 'b' values in the calibration report or applicable scientific notebook/supplement.

2.9.5 Proceed to section 2.10 to perform a complete As-Left calibration when the adjustments are complete.

2.10 As-Left Calibration

2.10.1 If required, connect the transducer to the appropriate pressure calibrator's pressure module following steps 2.7.1 through 2.7.5.

2.10.2 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, and record all values in the calibration report or the applicable scientific notebook/supplement.

2.10.3 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 calibration report or the applicable scientific notebook/supplement.

2.10.4 Repeat step 2.10.3 until all setpoints have been reached and the corresponding transducer signal output has been measured and recorded in the calibration report or the applicable scientific notebook/supplement.

2.10.5 Return the pressure module output to ambient pressure, let the transducer output signal stabilize and record the value in the calibration report or the applicable scientific notebook/supplement.

2.10.6 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, FTL's or designee's specifications. If the transducer performance does not meet specifications, but the unit has a 'zero' and 'span' adjustment or a field calibration program, proceed to section 2.8 or 2.9, respectively.

2.11 References

- Mensor CPC Automated Pressure Calibrator Operating Instructions
- HP 3456A Digital Multimeter, or Equivalent, Operator Manual/Operating Instructions
- HP 6271B DC Power Supply, or Equivalent, Operator Manual/Operating Instructions

3.0 Records

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

QA Record

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

4.0 Appendices

There are no appendices associated with this document.

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