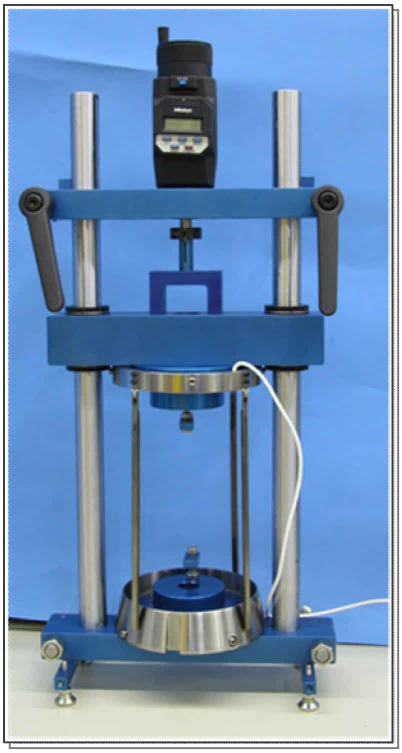
The Calibration Company

DEFORMATION TRANSDUCER CALIBRATOR OPERATION



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1 DEFORMATION TRANSDUCER CALIBRATOR OPERATION

1.1 Introduction

The deformation transducer calibrator is designed for the calibration of specialize transducers used by Calibration Inc. to measure rock properties. Specifically it will calibrate Axial (Vertical) and Radial (Horizontal) deformation transducers. It can also be sued to calibration LVDT and other displacement transducers.

The unit uses a precision digital micrometer for measurements and a mounting fixture to position the transducer.

The basic concept of calibration is to deflect or load the transducer in series with a known calibrated reference (preferably traceable to a national calibration laboratory) over a set of even magnitude increments and record the output of the transducer and the known reference at each increment. The magnitude of the incremental steps should be calculated to cover the full range of the transducer. A series of ten even steps to cover the full range is usually sufficient.

The in-vessel instrumentation requires periodic calibration in order to maintain accuracy in the data acquisition system. If the transducer is connected to the signal conditioner used in the test system, then the calibration will compensate for any errors in signal conditioner amplifiers and cable losses. Therefore it is preferable that the calibration is done at the site of the test machine.

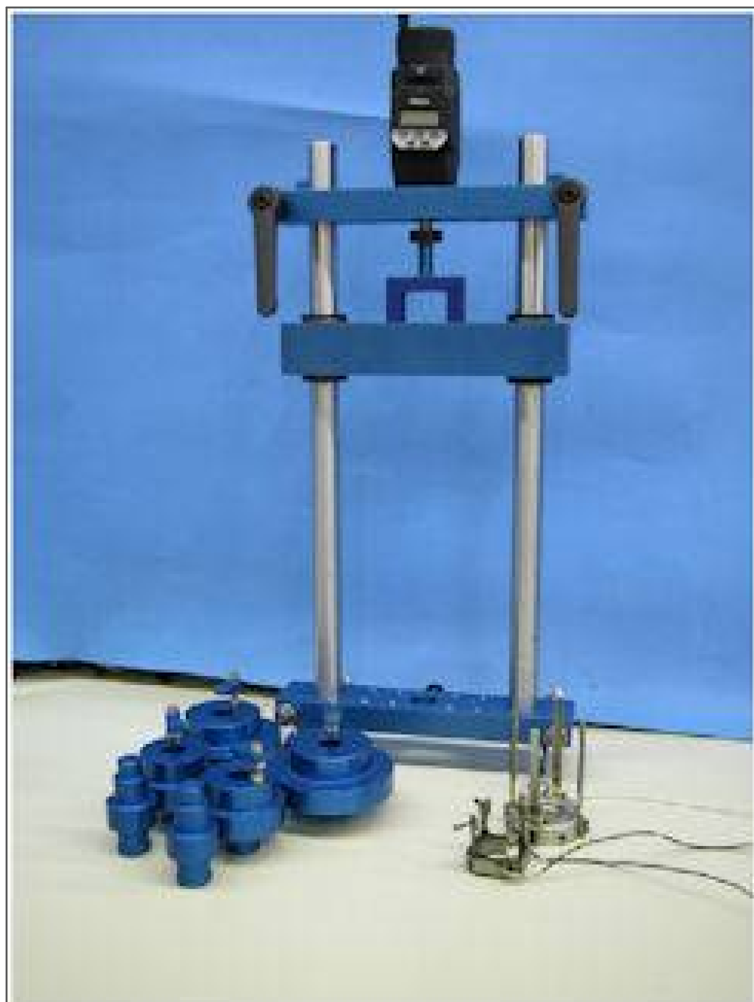


Figure 1 - Transducer Calibrator

1.2 Initial Setup

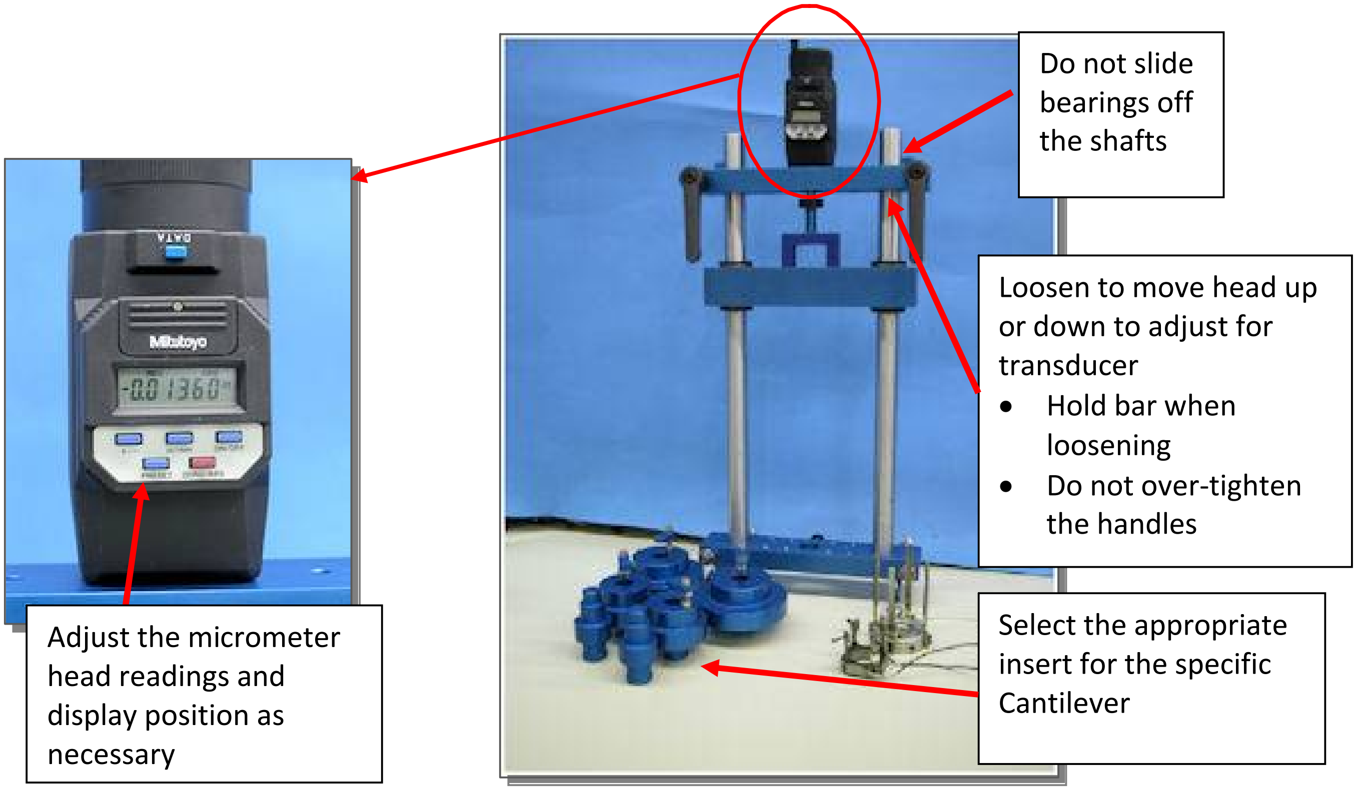


Figure 2 - Transducer Calibrator with Micrometer

2 AXIAL CANTILEVER CALIBRATION

The axial cantilevers are calibrated by deflecting the cone through a set of even displacement increments. The following procedure assumes that you are using the calibration fixture standing up (see Figure 3).

Calculate the displacement increments that you will use, and make a chart of the target deflections.

1. Clamp the base of the axial cantilever to the moving head of the calibration fixture. Verify that the lead is not pinched between the base and the fixture.
2. Set the cone on the base of the fixture and adjust the frame height so that the arms will be deflected outward as the fixture is deflected downward.
3. Adjust the position of the cone and the base until the cone makes contact with each of the cantilever arms.

4. Adjust the vertical position of the fixture to the desired zero position. This should be the zero position used when performing a rock mechanics test. Set the micrometer indicator to the zero position.

5. Plug the cantilevers into the base plug with the extension cable as needed. *Note: Allow the transducer to warm up 30 minutes before calibrating.*

6. Adjust the signal conditioner so that the output voltage is zero.

7. Check the gain setting by moving the calibration fixture through the full scale positive and negative range of the transducer. The output voltage should be between ±9.90 and ±10 volts. The output should not exceed ±10 volts, since this would cause the A/D converters in the computer to saturate at full scale. Record the original gain settings. Adjust the gain if required to correctly set the output voltage. Record the new gain setting.

8. Return the transducer back to the zero deflection position and check the zero voltage. Adjust the zero voltage if required and repeat Step 7 if the gain was changed.

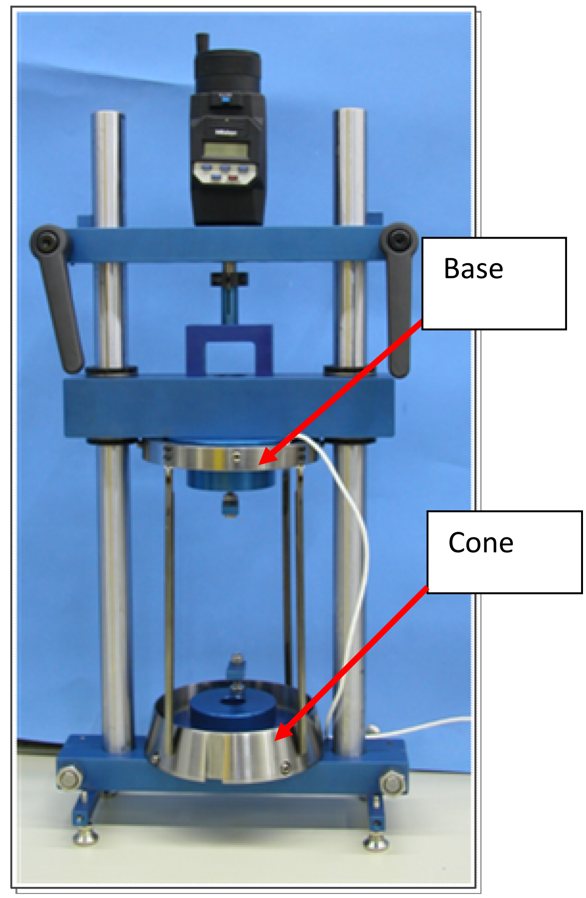


Figure 3 - Axial Cantilever Calibration

9. Repeat Steps 7 and 8 as needed until the full scale voltage is between ±9.90 and ±10 volts and the transducer zeros.

10. Adjust the micrometer position if needed.

11. Start the calibration program to take the data through the computer program if desired or prepare a notebook to take data, or use the spreadsheet.

12. Position the transducer to a maximum negative working voltage and zero the micrometer.

13. Adjust the micrometer to the first deflection point allow the transducer to stabilize.

14. Record the voltage and the actual displacement from the micrometer.

15. Repeat Steps 13 and 14 until the transducer has been displaced through the entire working range.

16. Reverse the steps and record data going back to zero.

Once the calibration has been completed, check the resulting data and perform a linear regression and error fit. The regression output should be checked; usually the R SQUARED number should be around 0.999 – which means the percent error is less than .5% of full scale.

If the error is worse (over 1%) then the calibration should be run again. In this case, more attention should be paid to the set up and the accuracy of the increments. The units per volt slope should be recorded.

3 RADIAL CANTILEVER CALIBRATION

The radial cantilevers are calibrated by deflecting the arms through a set of even displacement increments. The calibration fixture is set horizontally with the radial transducer mounted as shown (see Figure 4).

Calculate the displacement increments that you will use and make a chart of the target deflections.

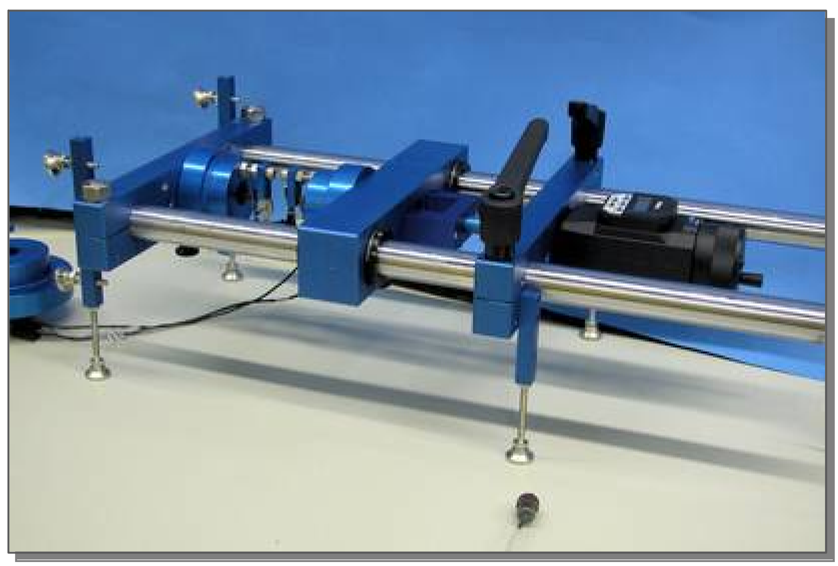
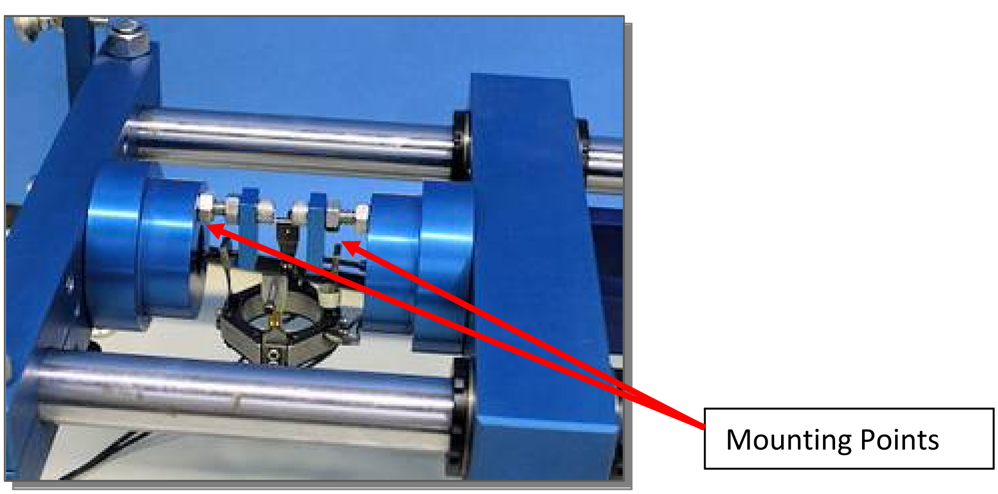


Figure 4 – Radial Cantilever Calibration



1. Place the extension screws of the radial cantilever arms into the calibration fixture.
2. Verify that the extension screws are stable.
3. Adjust the position of the arms to the desired zero position. This should be the zero position used when performing a rock mechanics test. Set the micrometer reading to zero.
4. Plug the cantilevers into the base plug with the extension cable. Allow the transducer to warm up 30 minutes before calibrating.
5. Adjust the signal conditioner so that the output voltage is zero.
6. Check the gain setting by deflecting the arms through the full scale range of the transducer. The output voltage should be between 9.95 and 10 volts. The output should not exceed 10 volts, since this would cause the A/D converters in the computer to saturate at full scale. Record the original gain setting. Adjust the gain if required to reduce the output voltage. Record the new gain setting.
7. Return the arms back to the zero deflection position by returning the arm position beyond the zero point, reverse direction and adjust the arms back to zero point. This will compensate for backlash in the screw threads. Check the zero voltage, adjust the zero voltage if required and repeat Step 6 if the gain was changed.
8. Repeat Steps 6 and 7 as needed until the full scale voltage is between 9.95 and 10 volts and the transducer zeros.
9. Adjust the dial indicator if needed.
10. Start the calibration program to take the data through the computer program if desired or prepare a notebook to take data.
11. Record the zero voltage.
12. Deflect the arms using the micrometer displacement control. Stop when the micrometer indicator displays the target value. If you overshoot the target value do not reverse the displacement control.
13. Record the voltage and the actual displacement from the dial indicator.
14. Repeat Steps 12 and 13 until the radial cantilever has been displaced through the entire range.
15. Return the arms to the zero position.

Once the calibration has been completed, check the resulting data and perform a linear regression and error fit. The regression output should be checked; usually the R SQUARED number should be around 0.999 – which means the percent error is less than .5% of full scale.

If the error is worse (over 1%) then the calibration should be run again. In this case, more attention should be paid to the set up and the accuracy of the increments. The transducers are specified at an accuracy of .5% of full scale so you should expect your calibration data to be that good.