MG-DVRT® and SG-DVRT®

Field Calibration of the Gauging DVRT®

Overview

The MG-DVRT® Microminiature Gauging and SG-DVRT® Subminiature Gauging Differential Variable Reluctance Transducers are typically calibrated with their signal conditioning electronics at the factory. These calibrations are highly accurate and are always recommended. However, under certain conditions the user may determine that a field calibration should be performed. This technical note provides a step-by-step instruction to field calibration and assumes the user is familiar with the DVRT® displacement transducer and its signal conditioning electronics (Motherboard, Smart Motherboard, or DEMOD-DC®).

Equipment

In addition to your MG-DVRT® or SG-DVRT® and signal conditioning electronics, the following equipment will be needed:

- Voltmeter or other device for reading DC voltage output from electronics;
- Vice with plastic jaws;
- A spreadsheet program such as Microsoft Excel;
- Precision gauge blocks with thicknesses within the measurement range of the displacement transducer; see the *Gauge Block Set Detail* section below.

Gauge Block Set Detail

For our example we are using a 10 gauge block set from Mitutoyo (model 516-103-26) which range from 1mm to 25mm. Our procedure calls for 10 measurements to be made across the displacement stroke using the blocks. Our measurement range is 38mm. By dividing 38mm into equal steps we arrive at the following block combinations to achieve the measurements:

Displacement in mm	Use gauge block(s)
0	None
1	1
5	5
9	5 + 3 + 1
13	10 + 3
17	10 + 5 + 2
21	20 + 1
25	25
29	25 + 3 + 1
33	25 + 5 + 3
37	25 + 10 + 2

Figure 1: *Gauge Block Combinations*

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Figure 2: *Gauge Block Set*

Procedure

- Ensure that the vice is mounted firmly to the bench so that movement variations do not enter into the measurements.
- In this example we are using an SG-DVRT-38 with a 38mm measurement stroke and a DEMOD-DC® in-line signal conditioner.
- Position the displacement transducer in the vice so that the spring-loaded plunger is pointing down towards the bench. When clamping the transducer body, use care in clamping so as not to deform the device.
- Connect the transducer's cable to the input side of the DEMOD-DC®.
- Connect appropriate power to the DEMOD-DC®.
- Connect the volt meter to the output side of the DEMOD-DC®.
- Now with more precision, position the transducer so that the plunger is slightly depressed against the bench (~0.25mm); this will become our zero (0mm) position.
- Take a first voltage reading from the electronics and record it as the 0mm displacement position. In our example we record 0.02 volts in our spreadsheet.
- Now lift the plunger carefully without disturbing the transducer body and place the first block (or block combination) between the plunger and the table. In our example we are inserting a 1mm block. Take the voltage reading and record it against 1mm. We record 0.23 volts in our spreadsheet.
- Again, lift the plunger carefully without disturbing the transducer body and place the second block (or block combination) between the plunger and the table. In our example we are inserting a 5mm block. Take the voltage reading and record it against 5mm. We record 0.85 volts in our spreadsheet.
- Continue this same process and work your way through each successive displacement measurement until you have recorded measurements for the entire stroke. Figure 3 shows our example.

Measured Voltage	Displacement in mm
0.02	0
0.23	1
0.85	5
1.41	9
1.82	13
2.32	17
2.96	21
3.41	25
3.91	29
4.40	33
4.89	37

Figure 3: *Voltage vs. Displacement*

- With these measurements now recorded in the spreadsheet:
  - plot an XY graph of the data,
  - perform a least squares regression over the calibrated range and,
  - display the slope and offset which corresponds to the best fit straight line.
- Figure 4 shows the spreadsheet view.
- See the *Spreadsheet Steps* section below for the details.
- **NOTE:** The typical calibration will be determined by the standard equation of a line, i.e., y=mx+b where:
  - y = displacement in mm
  - m = slope in mm/volt
  - x = volts
  - b = offset in mm (typically 0 or determined at set-up)

Spreadsheet Steps

- Record your Voltage vs. Displacement in the spreadsheet as shown in Figure 4 with Voltage in first column and Displacement in the second column; this will insure you calculate 'mm per volt'.
- Highlight the headers and data.
- Click the Insert menu item.
- Click Chart.
- Click XY (Scatter).
- Click Finish and the scatter graph will appear with the plotted data points.
- Right-click on one of the data points and a pop-up menu will appear.
- Click Add Trendline and the Add Trendline window will open.
- Click the Options tab.
- Check Display equation on chart.
- Check Display R-squared value on chart.
- Click OK, the Add Trendline window will disappear, and the y=mx+b equation will appear. In our example we see y = 7.6787x – 1.0304. We also see our R^2 - 0.9984.
- In our example, 7.6787 is our slope, meaning there are 7.6787 mm per volt.
- In our example, - 1.0304 is the y-intercept of the trendline; typically we don't recommend that you use this as your offset. The offset for any given system is dependent upon your starting (zero) point.

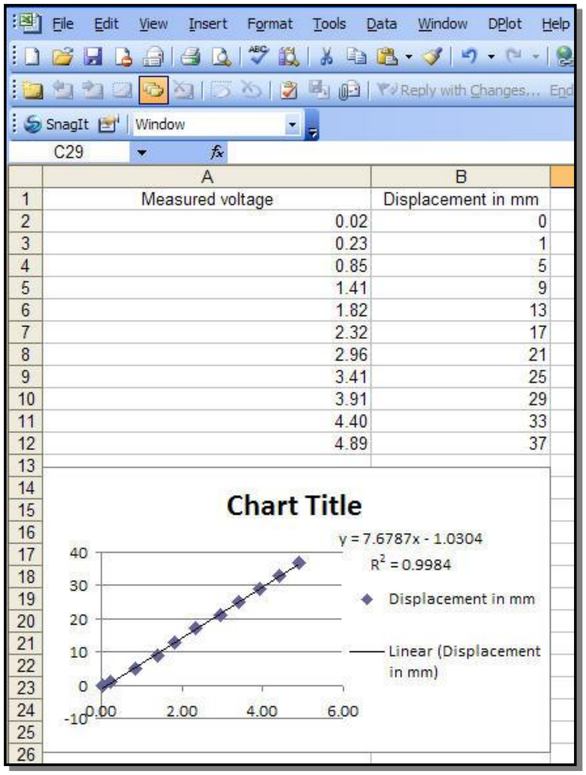

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Figure 4: *Spreadsheet*

Support

LORD MicroStrain® support engineers are always available to expand on this subject and support you in any way we can.

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