# 125 Helpsheet

GDS INSTRUMENTS LIMITED

*World Leaders in Computer Controlled Testing Systems for Geotechnical Engineers and Geologists*

Hardware

Transducers

Calculating Sensitivity and Full Scale Output

## 1 Introduction

Many GDS transducers work using an excitation voltage, and return a linear output in millivolts directly proportional to the parameter being measured. To correlate this millivolt output with an actual quantity trying to be measured it is necessary to calibrate the transducer.

The full-scale output value, the excitation voltage and the range of the transducer enables the sensitivity of the transducer to be calculated.

All transducers calibrated by GDS have the sensitivity value shown on the calibration certificate, but some certificates require a calculation to be made.

Copies of all calibration certificates are kept at GDS UK, so do not hesitate to contact us if you have mislaid one.

## 2 Full Scale Output

All GDS transducers are supplied with a calibration certificate, which shows the millivolts that the transducer will output when at it's maximum range. This is the **full scale output** and is usually given as a the value at full scale in millivolts.

Some transducer calibration certificates give this full scale output value as *millivolts **per** volt*. In this case this value will need to be multiplied by the excitation voltage used (usually 10 Volts) to give the full scale output at that specific excitation voltage.

***Example 1***

Full Scale Output = 29.95mV
Excitation Voltage used at calibration = 10V

So long as we are ALSO using the transducer with 10V excitation, the transducer FULL SCALE OUTPUT = 29.95mV.

***Example 2***

Full Scale Output = 2.995mV/V
Excitation Voltage used at calibration = 10V

Here, the full scale output is given ***per volt excitation***. Here we must multiply the full scale output supplied by the excitation voltage used. Using an excitation of 10V therefore fives a FULL SCALE OUTPUT = 2.995 x 10 = 29.95mV.

# 3 Calculating the Sensitivity of the Transducer

To calculate the sensitivity value of a transducer, simply divide the **range in units** of the transducer by the **full scale output** value (as calculated in section 2).

$$Sensitivity = \frac{Transducer Range}{Full Range Output}$$

# 4 Example sensitivity calculations

### GDS Load Cell (required units are kN)

Example1:
GDS BA4958 Submersible Load Cell
Range = 4kN  Full scale output = 19.55mV
Excitation Voltage used at calibration = 10V
Excitation Voltage that will be used in Lab = 10V

$$Sensitivity = \frac{kN}{mV} = kN/mV$$

$$Sensitivity = \frac{4}{19.55} = 0.2kN/mV$$

Example2:
GDS BA4958 Submersible Load Cell
Range = 4kN  Full scale output = 1.955mV/V
Excitation Voltage used at calibration = 10V
Excitation Voltage that will be used in Lab = 10V

$$Sensitivity = \frac{kN}{mV/V \times V} = kN/mV$$

$$Sensitivity = \frac{4}{1.955 \times 10} = 0.2kN/mV$$

### GDS Pressure Transducer (required units are kPa)

Range = 500psi Full scale output = 200mV
Excitation Voltage used at calibration = 10V
Excitation Voltage that will be used in Lab = 10V

To convert from PSI to kPa multiply by 6.8948

$$Sensitivity = \frac{psi \times 6.8948}{mV} = kPa/mV$$

$$Sensitivity = \frac{500 \times 6.8948}{200} = 17.237 kPa/mV$$

## GDS Displacement Transducer (required units are mm)

Range = 50mm Full Scale Output = 1000mV/V
Excitation Voltage used at calibration = 10V
Excitation Voltage that will be used in Lab = 10V

Sensitivity value is shown on calibration certificate = 0.005mm/mV

$$Sensitivity = \frac{mm}{mV} = mm/mV$$

$$Sensitivity = \frac{50}{10000} = 0.005 mm/mV$$

## GDS Hall Effect Transducer (required units are mm)

Range = 6mm Full Scale Output = 2727mV
Excitation Voltage used at calibration = 10V
Excitation Voltage that will be used in Lab = 10V

Sensitivity value shown on calibration certificate = 2.2micron/mV = .0022mm/mV

$$Sensitivity = \frac{mm}{mV} = mm/mV$$

$$Sensitivity = \frac{6}{2727} = 0.0022 mm/mV$$

## GDS Mid Plane Pore Pressure Transducer (required units are kPa)

Range = 15bar g Full Scale Output = 1.13mV/V/bar
Excitation Voltage used at calibration = 5V
Excitation Voltage that will be used in Lab = 5V

To convert from bar to kPa multiply by 100

$$Sensitivity = \frac{bar \times 100}{mV \times V \times bar} = kPa/mV$$

$$Sensitivity = \frac{15 \times 100}{1.13 \times 5 \times 15} = 17.699 kPa/mV$$