

**Options available**

**Sample Sizes**

50mm	<input checked="" type="checkbox"/>	70mm	<input checked="" type="checkbox"/>
76mm	<input checked="" type="checkbox"/>	100m	<input checked="" type="checkbox"/>
150mm	<input checked="" type="checkbox"/>	Custom	<input checked="" type="checkbox"/>

**Displacement Ranges**

+/-2.5mm	<input checked="" type="checkbox"/>	+/-5.0mm	<input checked="" type="checkbox"/>
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**Submersion Options**

Low pressure version for use in water up to 3500kPa

High pressure version for use in non-conducting oil up to 200MPa

Low Pressure Temperature Limits  
-20°C to 60°C

High Pressure Temperature Limits  
-20°C to 60°C

# LVDT Local Strain Transducers



## What is it?

The GDS LVDT Local Strain Transducers provide on-sample small strain measurements of axial and radial strain. Accurate determination of soil stiffness is difficult to achieve in routine laboratory testing. Conventionally, stiffness of a triaxial test specimen is based on external measurements of displacement which include a number of extraneous movements. True soil strains can be masked by deflections which originate in the compliances of the loading system and load measuring system. Such equipment compliance errors add to a variety of sample bedding effects to give a poor definition of the stress-strain behaviour of the material under test, particularly over the small strain range. Most triaxial tests therefore tend to give apparent soil stiffnesses far lower than those inferred from field behaviour (Jardine, Symes & Burland, 1984).

## Why measure small strain?

Recent work has demonstrated the rather surprising finding that soils can be equally as brittle as rocks and that an understanding of their behaviour at levels of shear strain below 0.05% is very important. Indeed, K-zero normally consolidated clays may reach peak strength in the triaxial apparatus at axial strains as low as 0.1%. Moreover, even when the behaviour is not brittle, the strains prior to yield are usually very small (loc. cit).

## Why measure locally on the specimen?

In the conventional triaxial test, surface friction arises between the unlubricated ends of the test specimen and the end platens of the test apparatus. The ends are therefore restrained laterally and hence vertically also. Accordingly, the test specimen deforms non-uniformly with a gradient of axial and radial deformation from zero at the ends to a maximum at the middle.

It is widely believed that triaxial test specimens with a height to diameter ratio of 2 have end zones which are more or less restrained while the middle third is more or less unrestrained. It is highly desirable therefore that radial and axial deformations are measured locally in this region if realistic deformation moduli are to be found.

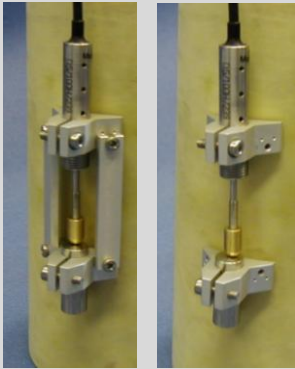
The measurement of axial deformation based on the relative movement between the top cap and the base pedestal is subject to bedding errors. These errors arise because of the difficulty in providing perfectly plane, parallel and smooth ends on the triaxial test specimen. The top cap can rest on surface asperities of the test specimen or make contact imperfectly, perhaps on one edge of the specimen. Owing to this "point" loading effect, rapid deformation will occur during the early stages of triaxial compression until the top cap is properly bedded down.

**Technical specification**

- Range = +/- 2.5mm or +/-5.0mm
- Resolution using 16 bit data acquisition: +/- 2.5mm = <0.1µm, +/- 5.0mm = <0.2µm
- Accuracy = 0.1% FRO
- Radial Caliper Weight, (based on a nominal 70mm caliper) = 74g
- Axial Apparatus Weight (1 off) = 26g
- Transducer Weight (1 off LVDT) = 20g

### The axial strain measuring device

As shown in Fig. 1 below, the axial LVDT is suspended from an upper pad fixed to the test specimen by pins and bonded to the membrane by adhesive. The LVDT armature has a weighted rounded brass end, which rest freely on the lower pad anvil. Aluminum fixing struts may be attached between the upper and lower pads to allow help alignment of the pads when being fixed in place. Once in position, the fixing struts may be removed.



**Fig 1: Axial local strain transducers mounted directly on a triaxial test specimen**

### The radial strain measuring device

As shown in Fig. 2 below, the radial LVDT and caliper is mounted on the test specimen by means of two diametrically opposed pads fixed to the test specimen by pins and bonded to the membrane by adhesive.

The LVDT is positioned across the opening of the caliper where it measures the opening and closing of the jaws. Both the axial and radial devices are designed so that self-weight is partly counteracted by buoyant uplift.



**Fig 2: Radial local strain transducers mounted directly on a triaxial test specimen**

### Connecting LVDT's to a DC data acquisition system

The principal output of a Linear Variable Differential Transformer (LVDT) is an AC waveform. In addition, although an LVDT is an electrical transformer, it requires AC power of an amplitude and frequency quite different from ordinary power lines to operate. Supplying this excitation power for an LVDT is one of several functions of the GDS LVDT signal conditioning equipment, or 'GDS LVDT box', supplied as standard with the transducers from GDS. Other functions include converting the LVDT's low level AC voltage output into more convenient high level DC signals, decoding directional information from the 180 degree output phase shift as an LVDT's core moves through the null point, and providing an electrically adjustable output zero level.

GDS supplies the required calibrated signal conditioning equipment for the LVDT's to output a +/-10V DC signal. This output level is perfectly suitable to all GDS, and most other manufacturer's data acquisition equipment. The LVDT box can be recalibrated by the user for different output levels below 10V if necessary.

### Why buy GDS LVDT Local Strain Transducers?

- Axial and radial deformation measured directly on the triaxial test specimen
- Light and compact assembly
- High output, high resolution
- Designed for use with the GDS Data Acquisition System
- Robust caliper design
- Inherently robust LVDT's as they have no physical contact across the sensing element and therefore zero wear
- Water version can be used up to 3500kPa
- Non-conducting oil version (pressure relieved) can be used up to 200MPa