Geotechnical Testing

- Pressure Controllers
- Consolidation Testing Systems
- Triaxial Testing Systems
- Unsaturated Testing Systems
- Dynamic Triaxial Testing Systems
- Dynamic Cyclic Simple Shear
- Back Pressure Shearbox
- Bender Elements

Supplying Testing & Monitoring Instruments Since 1946
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What is it?

GDSLAB is control and data acquisition software for geotechnical laboratory applications. The main advantage of GDSLAB is that as well as the ability to integrate all existing GDS hardware, other manufacturers’ hardware can also be used. Whether performing Triaxial, CBR, Direct Shear box, Simple Shear, Hollow Cylinder or simple Consolidation Logging tests, GDSLAB represents a breakthrough in geotechnical laboratory control software.

What are its uses?

GDSLAB can be integrated with existing or new laboratory equipment to provide data acquisition and control for standard or advanced testing. Commercial or research testing is possible with the choice of modules available. In addition, equipment manufactured by other leading manufacturers may be brought under the control of GDSLAB to enable testing to be carried out under computer control.

Alternatively, where computer control is not available, GDSLAB may be used to acquire data from your existing hardware then present data using GDSLAB REPORTS. For the first time the test software will not be tied to the OEM software supplied.

**Required PC Specification**

- **Operating System:** Win 95 or higher (XP recommended)
- **Min PC Spec Hardware:**
  - 233 MHz Pentium minimum
  - 128 Megabytes Ram minimum
  - CD Rom

**Note 1:** Free serial ports/PCI slots/ISA slots/USB ports as required for individual hardware connection.

**Note 2:** Due to the flexible nature of the GDSLAB software, as many stations may be configured on a single PC as can be physically connected to it! In systems that have multiple and complex stations, a higher specification PC may be required.
What is it?

GDSLAB REPORTS is a laboratory test results presentation package to National Standards e.g. BS 1377:1990. This program can be used to present data whether saved in a GDSLAB data file, or input by hand. Additionally, it can be used with other manufacturer’s dataloggers.

What are its uses?

GDSLAB REPORTS is a program that combines the simplicity of a Windows user interface, with the power of Microsoft Excel. Data obtained using GDSLAB control and data acquisition software (or directly from your logger’s software) may be selected, viewed and manipulated where necessary before being exported directly as an Excel spreadsheet.

The GDSLAB REPORTS user interface is designed to manage your test data files as well as provide a means for essential user input procedures such as locating t90.

The Excel template spreadsheet created by GDSLAB REPORTS may then be selected for a particular national standard (eg. BS 1377). The template spreadsheet can be customised to a specific company format as required. Excel is widely accepted as the most popular spreadsheet program available today, and as such is seen as a simple interface, that many computer users can already easily manipulate. This also allows your reports to be distributed in electronic format without the need for specific software.

PC Specification

- **Operating System:** Win95, 98, NT, 2000, XP, Vista.
- **Office Suite:** Compatible with Office XP (2002) and above.
- **Hardware:** 233 MHz Pentium or similar, 32 Megabytes Ram (minimum), 64 Mb recommended, CD Rom.
- **Microsoft Excel v8 or higher** must also be installed on the PC (Office XP needed when using Windows XP)
What is it?

The GDS Enterprise Level Pressure/Volume Controller (ELDPC) is a general-purpose water pressure source and volume change gauge. With a maximum pressure of 1000kPa and a volumetric capacity of 200cm$^3$, the ELDPC fits neatly in the GDS range of pressure controllers below the premiere product namely the Advanced Pressure Controller (ADVDPC) and the mid-range Standard Pressure Controller (STDDPC). Table 1 shows a comparison between devices (see page 2).

What are its uses?

The ELDPC provides an extremely cost-effective replacement for conventional soil mechanics laboratory pressure sources and volume change gauges. It is ideal as a back pressure or cell pressure source where it can also measure the change in volume of the test specimen.

In line with existing GDS pressure controllers the ELDPC does not require a supply of compressed air to function. Configured both with or without the optional keypad, the device can be controlled directly from a computer using its own full speed USB 2.0 interface.

With the addition of the optional Smart Keypad the ELDPC can be configured as a completely stand-alone device. In this stand-alone mode, the instrument is a constant pressure source which can replace traditional laboratory pressure sources such as mercury column, compressed air, pumped oil and dead weight devices. It is also a volume change gauge resolving to 1 cu mm.

The reduced size of the ELDPC compared to any other controller in the GDS range makes it ideally suited for life in a commercial testing laboratory where bench space is usually at a premium. The ELDPC automatically protects itself from pressure and volume over-ranges.

Intuitive PC based software supplied allows full controller functionality to be accessed by means of the full speed USB 2.0 interface. The instrument may also be controlled via the optional Smart Keypad without the need of a PC.

The ELDPC is fully RoHS Compliant.

### Technical specification

- **Pressure range**: 1 MPa
- **Volumetric capacity (nominal)**: 200cc for all pressure ranges
- **Resolution of measurement**: pressure = 1kPa, volume = 1cu mm
- **Accuracy of measurement**: pressure: <0.25% full range, Volume: < 0.4% measured value with <+/- 50mm$^3$ backlash
- **Closed-loop microprocessor control of pressure**: regulated to +/- 1kPa
- **Closed-loop microprocessor control of volume**: regulated to +/- 1cu mm
- **Size**: 550mm x 100mm x 125mm
- **Weight**: 5.5kg (empty)
- **Power**: Supply: 100-240V AC, 50-60Hz, 0.7A. Max Consumption: 20W. Typical Consumption: <12W.
- **Ambient temperature range**: 10°C to 30°C
- **Relative humidity**: 20% to 80% non condensing
- **User interface**: PC based software or Optional Smart Keypad featuring state-of-the-art Organic LED display technology with 180 degree viewing angle and 16 key input with audio feedback
- **Computer interface**: Full speed USB 2.0 compatible interface
- **Maximum operational speed**: Ultra high speed Fill/Empty up to 1500 cu mm/sec
- **Onboard processing**: 40 MIPS 16 bit DSC
What is it?

The GDS Standard Pressure/Volume Controller (STDDPC) is a general-purpose water pressure source and volume change gauge. It is designed for use in commercial and teaching soil mechanics laboratories. A stepping motor and screw-drive actuate a piston which directly pressurizes water. The pressure is regulated under closed-loop control. The change in volume is measured to 1 cu mm (0.001 cc) by counting the steps to the stepping motor.

What are its uses?

The STDDPC, typically operating at 3 MPa/200 cc, provides a cost-effective direct replacement for conventional soil mechanics laboratory pressure sources and volume change gauges. Above all, the device has its own computer interface and so can be controlled directly from a computer. It is ideal as a back pressure source where it can also measure the change in volume of the test specimen. Also, it automatically protects itself from pressure and volume over-ranges.

In stand-alone mode, the instrument is a constant pressure source which can replace traditional laboratory pressure sources such as mercury column, compressed air, pumped oil and dead weight devices. It is also a volume change gauge resolving to 1 cu mm.

In addition, the instrument can be programmed through its own control panel to RAMP and CYCLE pressure or volume change linearly with respect to time. This means the device is also ideal for permeability testing by constant rate of flow or constant head.

A data logger can be connected to an analogue interface option which provides output readings of pressure and volume change.

Compressed air is not used with the STDDPC.

Options available for STDDPC

<table>
<thead>
<tr>
<th>Pressure ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MPa ✔️</td>
</tr>
<tr>
<td>2 MPa ✔️</td>
</tr>
<tr>
<td>3 MPa ✔️</td>
</tr>
<tr>
<td>4 MPa ✔️</td>
</tr>
</tbody>
</table>

NB The most commonly-used pressure is 3 MPa

<table>
<thead>
<tr>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 cc ✔️</td>
</tr>
</tbody>
</table>

Technical specification

- Pressure ranges: 1, 2, 3, 4 MPa
- Volumetric capacity (nominal): 200 cc for all pressure ranges
- Resolution of measurement: pressure = 1 kPa, volume = 1 cu mm
- Accuracy of measurement: pressure = <0.15% full range, Volume =< 0.25% measured value with +/- 30 mm\(^3\) backlash
- Closed-loop microprocessor control of pressure: regulated to 1 kPa
- Closed-loop microprocessor control of volume: regulated to 1 cu mm
- Size: 600 mm x 230 mm x 220 mm
- Weight: 12 kg
- Power: 92-265 V, A.C. 48-440 Hz, 65 W maximum, single phase three wire earthed supply, 2 A fuse x 2
- Ambient temperature range: 10°C to 30°C
- Relative humidity: 20% to 80% non condensing
- Control panel: 16 keypad membrane touch panel with audio feedback. Functions include zero pressure, target pressure, zero volume, target volume, fill, empty, test, ramp, stop, continue, reset, enter, +, -, >, <, yes, no
- User interface: 32 character, 2-line liquid crystal display
- Computer interface: optional RS232 serial computer interface for computer control and logging of pressure and volume
- Maximum operational speed: Fill/empty speed = 500 cu mm/sec
What is it?

The GDS Advanced Pressure/Volume Controller (ADVDPC) is a microprocessor-controlled screw pump for the precise regulation and measurement of fluid pressure and volume change. As a standard research device in commercial and teaching soil mechanics laboratories, it offers the highest level of accuracy, resolution and control. The ADVDPC may be used with water, oil or air.

What are its uses?

In stand-alone mode, the ADVDPC is a constant pressure source which can replace traditional laboratory pressure sources such as mercury column, compressed air, pumped oil and dead weight devices. It is also a volume change gauge resolving to 1 cu mm. Accordingly, the ADVDPC can be used in the geotechnical laboratory as a general-purpose source of water pressure as well as a volume change gauge. For example, the device is ideal as a back pressure source where it can also measure the change in volume of the test specimen.

For unsaturated soil testing, the fluid in the cylinder is air. Air pressure is precisely regulated under closed-loop control. In addition, air volume change is measured to 1 cu mm.

In addition, the instrument can be programmed through its own control panel to RAMP and CYCLE pressure or volume change linearly with respect to time. This means the device is also ideal for permeability testing by constant rate of flow or constant head.

Above all, the device has its own computer interface and can be controlled directly from a computer. Thus, the ADVDPC is the essential link between computer and test cell in GDS computer-controlled testing systems as well as in computer-controlled testing systems of your own devising.

Options available for ADVDPC

### Pressure ranges

- 500kPa ✓ 16MPa ✓
- 1000kPa ✓ 20MPa ✓
- 2000kPa ✓ 32MPa ✓
- 3000kPa ✓ 64MPa ✓
- 4000kPa ✓ 128MPa ✓
- 8000kPa ✓ 150MPa ✓

### Volume ranges

- 200cc ✓
- 1000cc ✓ (up to 2MPa only)
- 1000cc option for dedicated air pressure device up to 2MPa

**Technical specification**

- **Pressure ranges:** 0.05, 0.1, 0.2, 0.4, 0.8, 1, 2, 3, 4, 8, 16, 20, 32, 64, 128, 150MPa
- **Volumetric capacity (nominal):** 200 cc for all pressure ranges. Optional 1000cc for pressure ranges < 2MPa
- **Resolution of measurement and control:** pressure = <0.1% full range, volume = 0.5cu mm (<8MPa) or 1cu mm (8MPa or higher)
- **Accuracy of measurement:** pressure = <0.1% full range, volume = < 0.1% measured value, or <0.25% for 1000cc (with +/-12mm³ backlash up to 16MPa and +/-5mm³ above16MPa)
- **Size:** 860mm x 230mm x 220mm
- **Weight:** 20kg
- **Power:** 92-265v, A.C. 48-440Hz, 65w maximum, single phase three wire earthed supply, 2A fuse x 2
- **Ambient temperature range:** 10°C to 30°C
- **Relative humidity:** 20% to 80% non condensing
- **Control panel:** 16 keypad membrane touch panel with audio feedback. Functions include zero pressure, target pressure, zero volume, target volume, fill, empty, test, ramp, stop, continue, reset, enter, +, -, >, <, yes, no
- **User interface:** 40 character, 1-line liquid crystal display
- **Computer interface:** IEEE-488 Standard, Talker/Listener or optional serial RS232 (IEEE only with RFM)
What is it?

The GDS Consolidation Testing System (GDSCTS) is a state-of-the-art, fully-automated consolidation testing system designed for soil. GDSCTS can run classic tests such as step loading to more advanced tests such as automated testing rate by controlled hydraulic gradient or cyclic loading, all under PC control. In fact, using the flexibility of GDSLAB software, almost any user-defined test may be performed. Due to the extensive GDS range of pressure controllers and consolidation cells, each system may be configured exactly to the customer’s specification and budget.

Overview

The system is based on the Rowe and Barden type consolidation cell using GDS pressure/volume controllers. Two of these pressure controllers link the computer to the test cell as follows:

- one for axial stress and axial displacement control.
- one for setting back pressure and measuring volume change.

Options available for GDSCTS

Rowe and Barden cell sample sizes

- 50mm ✔
- 63.5mm ✔
- 70mm ✔
- 76.2mm ✔
- 100mm ✔

Cell or back pressure ranges

- 500kPa ✔
- 2000kPa ✔
- 1000kPa ✔
- 4000kPa ✔

Unsaturated testing upgrade ✔

Technical specification

- accuracy of pressure measurement = <0.1% full range (ADVCTS) or <0.15% full range (STDCTS)
- resolution of pressure measurement = 0.5kPa (ADVCTS) or 1kPa (STDCTS).
- accuracy of volume measurement = <0.1% measured value (ADVCTS) or <0.25% measured value (STDCTS)
- resolution of volume measurement = 0.5mm³ (ADVCTS) or 1mm³ (STDCTS)
- transducer resolution = 16bit
- computer-automated control of testing - not just data logging
- MS Windows® software (GDSLAB) for test control and post-test processing
- fully expandable ‘future-proof’ software to allow multiple test stations or additional hardware to be incorporated at any time.

Consolidation Testing Systems (GDSCTS) including STDCTS and ADVCTS

System elements

The fundamental system hardware elements are shown in Fig. 1 on the following page. In fact, the hardware used may be chosen to suit your testing and budgetary requirements. Common arrangements are as follows:

- Standard Consolidation Testing System (STDCTS) which is based on 2 x 3MPa Standard Pressure/Volume Controllers (STDDPC)
- Advanced Consolidation Testing System (ADVCTS) which is based on 2 x 2MPa Advanced Pressure/Volume Controllers (ADVDP)

In particular, all elements of the ADVCTS system are biased towards achieving the greatest resolution and accuracy, for the highest quality tests achievable in a research environment. The STDCTS system is a low cost version of ADVCTS.

The GDS consolidation system can become a GDS stress path triaxial testing system by changing the test cell and adding a further 200cc pressure/volume controller.
What is it?

The GDS Triaxial Testing System (GDSTTS) is a fully automated advanced triaxial testing system designed principally for stress path testing due to the direct actuation of axial stress through the hydraulically controlled ram in the base of each cell. GDSTTS can run advanced tests such as stress paths, slow cyclic and K0, all under PC control. In fact, using the flexibility of GDSLAB software, almost any user-defined test may be performed. Due to the extensive GDS range of pressure controllers and triaxial cells, each system may be configured exactly to the customers specification and budget.

Overview

The system is based on the classic Bishop & Wesley-type stress path triaxial cell, and the GDS pressure/volume controller. Three of these pressure controllers link the computer to the test cell as follows:

- one for axial stress and axial displacement control.
- one for cell pressure control.
- one for setting back pressure and measuring volume change.

System elements

The fundamental system hardware elements are shown in Fig. 1 on the following page. The actual hardware used may be chosen to suit your testing and budgetary requirements. Common arrangements are as follows:

- Standard Triaxial Testing System (STDTTS) which is based on 3 x 3MPa Standard Pressure/Volume Controllers (STDDPC)
- Advanced Triaxial Testing System (ADVTTS) which is based on 3 x 2MPa Advanced Pressure/Volume Controllers (ADVDPC)
- High Pressure Triaxial Testing System (HPTTS) which is based on 3 x High Pressure Controllers

All elements of the ADVTTS system in particular are biased towards achieving the greatest resolution and accuracy, for the highest quality tests achievable in a research environment. The STDTTS system is a low cost version of ADVTTS.

Technical specification

- Accuracy of Pressure measurement = <0.1% full range (ADVTTS) or <0.15% full range (STDTTS)
- Resolution of Pressure measurement = 0.5kPa (ADVTTS) or 1kPa (STDTTS). For >8MPa see individual specs.
- Accuracy of Volume measurement = <0.1% measured value (ADVTTS) or <0.25% measured value (STDTTS)
- Resolution of Volume measurement = 0.5mm³ (ADVTTS) or 1mm³ (STDTTS and ADVTTS > 8MPa)
- Transducer Resolution = 16bit
- computer-automated control of testing - not just data logging
- MS Windows® software (GDSLAB) for test control and post-test processing
- Fully expandable software to allow additional testing or hardware to be incorporated at any time
What is it?

The GDS Triaxial Automated System (GDSTAS) is a load frame-based triaxial testing system which may be configured exactly to the customer's specification and budget. Using the GDS range of load frames, triaxial cells, pressure systems and the GDSLAB software, the basic system can be configured for low cost multi-station commercial testing right through to high range rock testing at research level. Using GDSLAB with optional software modules, GDSTAS can run advanced tests such as stress paths, slow cyclic and K0, all under PC control.

This system can be configured using any GDS devices, from a 10kN to 1000kN load frame and from a 500kPa to 150MPa pressure controller.

Overview

The GDS Triaxial Automated System, GDSTAS, has been designed to comply with international standards of test execution and data presentation, and to qualify for national laboratory accreditation schemes.

The system is controlled by the user's PC running MS Windows® and GDSLAB software.

The operator chooses the type of test from a test menu (e.g., U-U, C-U, multi-stage, stress path etc) and then enters the test parameters (of cell pressure, back pressure, testing rate and so on) and test termination conditions.

The test then proceeds automatically with all test data being saved to a file. On-line graphics are presented with up to three graphs displayed together with a block of current live test data. Tests can proceed overnight and during weekends and holidays. To enable spot-verification, all electronic measurements may be duplicated by mechanical gauges.

The computer directly controls the cell pressure, back pressure and testing rate. In addition to logging these parameters to the PC hard drive, the computer also logs axial displacement, axial load, pore pressure and volume change. Of course, additional transducers may be easily configured and logged during the test.

<table>
<thead>
<tr>
<th>Options available for GDSTAS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Load ranges</strong></td>
</tr>
<tr>
<td>10kN ✓ 500kN ✓</td>
</tr>
<tr>
<td>50kN ✓ 750kN ✓</td>
</tr>
<tr>
<td>100kN ✓ 1000kN ✓</td>
</tr>
<tr>
<td>250kN ✓</td>
</tr>
<tr>
<td><strong>Cell or back pressure ranges</strong></td>
</tr>
<tr>
<td>500kPa ✓ 16MPa ✓</td>
</tr>
<tr>
<td>1000kPa ✓ 20MPa ✓</td>
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<tr>
<td>2000kPa ✓ 32MPa ✓</td>
</tr>
<tr>
<td>3000kPa ✓ 64MPa ✓</td>
</tr>
<tr>
<td>4000kPa ✓ 128MPa ✓</td>
</tr>
<tr>
<td>8000kPa ✓ 150MPa ✓</td>
</tr>
<tr>
<td><strong>Triaxial cells</strong></td>
</tr>
<tr>
<td>from:</td>
</tr>
<tr>
<td>1700kPa ✓ to 128MPa ✓</td>
</tr>
<tr>
<td>for sizes:</td>
</tr>
<tr>
<td>38mm ✓ to 300mm ✓</td>
</tr>
</tbody>
</table>
The GDS Virtual Infinite Stiffness Loading System (GDSVIS) is the loading frame/compression machine that you would expect from GDS. It has feedback control and continuous displays of axial load and platen displacement, IEEE or serial computer interface and, exclusive to GDS, Virtual Infinite Stiffness (VIS).

These outstanding features, coupled with GDSLAB software, GDS digital pressure controllers, and the GDS Data Acquisition System, give you unlimited possibilities in conventional and advanced PC-controlled triaxial testing of soil and rock.

**What is VIS?**

VIS (Virtual Infinite Stiffness) is a unique GDS development. To the observer, and in terms of the test specimen, it allows the axial loading system to operate as though to have infinite stiffness.

**Technical specification**

- **Load ranges**: 100kN (10ton), 250kN (25ton) and 400kN (40ton). Custom ranges available on request.
- **Load resolution**: +/- 1 in 10,000
- **Load cell accuracy**: non-linearity +/- 0.03%, hysteresis and non-repeatability +/- 0.05%
- **Displacement range**: 100mm
- **Displacement resolution**: 0.1micrometre
- **Displacement accuracy**: 0.05% of full range
- **Max displacement rate**: TARGET: 3.75mm/min, RAMP: 1.20mm/mm, UP/DOWN: 6mm/min, RAMPTARGET LOAD control: 1.0mm/min
- **Max displacement rate**: there is no minimum rate
- **Max displacement rate**: platen diameter: 100kN = 140mm, 250kN = 145mm, 400kN = 145mm
- **Weight**: approx. 800 kgf to 2000 kgf (depending on model)
- **Nominal Size**: 2.3m x 1.0m x 0.96m
- **Resolution of measurement and control**: pressure = <0.1% full range, displacement = 0.1micrometre
- **Power**: 92-265v, A.C. 48-440Hz, 65v maximum, single phase three wire earthed supply, 2A fuse x 2
- **Control panel**: 16 keypad membrane touch panel with audio feedback. Functions include zero pressure, target pressure, zero volume, target volume, fill, empty, test, ramp, stop, continue, reset, enter, +, -, >, <, yes, no
- **User interface**: 40 character, 1-line liquid crystal display
- **Computer interface**: IEEE-488 Standard, Talker/Listener or optional serial RS232 (IEEE only with RFM)
What is it?

GDS Unsaturated Triaxial Testing of Soil (UNSAT) is an extension to traditional triaxial testing in that soils from above the water table may be tested under conditions approaching the in-situ stress state and degree of saturation or partial saturation. All features and methods described in this datasheet can be used to upgrade GDS triaxial testing systems to enable the testing of unsaturated soil, or existing triaxial equipment from other manufacturers may be modified.

The required changes to upgrade a typical GDS triaxial testing system consists of software and hardware elements. Some of the hardware elements are optional. These optional elements are made available to add further rigour to the test procedures if this is required (for example mid-plane suction probe, atmospheric pressure transducer and local measurement of strain).

How is it configured?

The GDS UNSAT provides a number of state-of-the-art methods to allow flexibility in the method used to perform unsaturated testing.

The 4 main methods that GDS uses are as follows:

- **method A**: direct volume measurement using a GDS pore air pressure/volume controller
- **method B**: HKUST inner cell
- **method C**: double cell
- **method D**: on-sample strain transducers

Each of these methods is described in detail over the following pages.

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**Technical specification**

**Method A**
- Resolution of measurement of pore pressure/volumes (air & water): pressure = 0.2kPa, volume = 1cu mm
- Accuracy of measurement of pore pressure/volumes (air & water): pressure = <0.1% full range, volume = 0.25%

**Method B**
- Resolution of volume change measurement using 16 bit resolution: <2cu mm
- Accuracy of volume change measurement: estimated at 32cu mm or 0.04% volumetric strain for a triaxial specimen 38mm in diameter, 76mm in height.

**Method C**
- Resolution of measurement of cell volume: 1cu mm
- Accuracy of measurement of cell volume: 0.25%

**Method D**
- Resolution of on-sample displacement measurement using 16 bit data acquisition +/- 3.0mm = <0.1µm
- Accuracy: Hall Effect = 0.8% FRO, LVDT = 0.1% FRO
What is it?

The GDS Enterprise level Dynamic triaxial testing system has been designed to fulfill the demand within the geotechnical laboratory testing industry for a lower cost, more basic dynamic triaxial testing system. ELDyn provides a simple route to allow cyclic loading of triaxial samples under either load or strain control while monitoring the effects on the specimen pore pressure.

Features

The ELDyn triaxial testing system builds on over 15 years of GDS experience in designing, manufacturing, controlling and supporting electro-mechanical dynamic systems.

Based on an axially-stiff load frame with a beam mounted electro-mechanical actuator which has a full stroke capability of 100 mm and a maximum axial load capability of +/- 5 kN at 5Hz (upgradable to +/-10 kN).

Actuator System:
- Electro-mechanical
- 5Hz Frequency

Available Load ranges:
- 5kN
- 10kN (optional)

Optional Cell Sizes:
- 76mm
- 100mm
- 150mm

Software
- Fully automated

Available options
- Bender Elements
- Unsaturated

Technical Specifications

- Maximum Operating Frequency: 5Hz
- Minimum Operating Frequency: Static tests, i.e. < 0.001Hz
- Highly accurate dynamic, electro-mechanical actuator
- Standard Triaxial cells can be used (upgraded to dynamic seals and bearings)
- Available sample sizes (depending on cell selection):
  - Φ38 x 76mm (or Φ39.1 x 78.2mm)
  - Φ50 x 100mm
  - Φ70 x 140mm (or Φ61.8 x 123.6mm)
  - Φ100 x 200mm (or Φ101 x 202)mm
  - Φ150 x 300mm
- 16-Bit dynamic data logging
- 16 Bit dynamic actuator control channel
- Cell pressure range to 2MPa (dependent of cell choice)
- Small laboratory footprint
- No hydraulic power pack required

The ELDCS, Dynamic Control System, provides a 4-channel dynamic data logger with 16 bit data acquisition for an Internal Submersible Load Cell and a Pore Pressure Transducer. An optional displacement transducer can be fitted and logged on one of the spare channels, although not entirely necessary due to the encoder on the axial actuator.

Further data acquisition channels may be added using a synchronized data bus connection.

As well as dynamic triaxial tests, the ELDyn system can be utilised to carry out traditional triaxial tests such as UU, CU and CD as well as more advanced tests such as stress paths, K0 and Resilient Modulus tests.

Due to the high precision electro-mechanical actuator the ELDyn system supersedes most systems using pneumatic actuators in terms of life costs and overall useable performance.
What is it?

The Electromechanical Dynamic Triaxial Testing System (DYNTTS) is a combined triaxial cell and dynamic actuator, the axial force and axial deformation being applied through the base of the cell. The cell itself is screw-driven from an integral base unit housing the motor drive. Where an optional dynamic radial actuator is not chosen, the cell is provided with a balanced ram to eliminate disturbance to constant cell pressure during dynamic testing. This software-based system is controlled from a PC running GDSLAB in MS Windows. Data is saved and displayed in real-time for any number of cycles.

Useful Helpsheets/further information

- "GDS software-based dynamic and seismic laboratory soil testing systems". A technical review of GDS dynamic systems including a section entitled "Electromagnetic, hydraulic or pneumatic control - which is best?"
- Helpsheet 86: Why Choose a GDS System?

Technical Specification

- Displacement range = 100mm
- Displacement accuracy = ±0.3% in 50mm (i.e. 0.07%)
- Displacement resolution = 0.208 mm
- Axial force accuracy = ±0.1% of load cell range (i.e. 1N for 10kN load cell)
- Axial force resolution = 16bit (i.e., <0.4N for 10kN load cell, <1.5N for 40kN load cell)
- Control data points = 10,000 points/sec
- Maximum saved data points = 100 points/cycle
What is it?

The GDS Large Diameter Cyclic Triaxial Testing System (LDCTTS) is hydraulically actuated with a large diameter triaxial cell suitable for testing samples with large particle sizes such as railway ballast. The system is capable of both monotonic (static) and dynamic triaxial tests as well as other advanced triaxial tests usually expected from a GDS system.

Using GDSLAB software with optional test control modules, GDSLDCT can run tests such as stress paths, slow cyclic, dynamic cyclic and K0, all under PC control.

Overview

The basic system consists of the following major components:

- GDS 10Hz hydraulic load frame (100kN/200kN)
- Hydraulic power pack to supply the load frame
- GDSDCS (dynamic control system) for data acquisition and control
- GDS single channel pneumatic regulator for cell pressure
- Optional GDS dual channel pneumatic regulator for both cell pressure and back pressure (in this case, single channel device above is not required)
- GDSLAB data acquisition and control software

The system is controlled by the user's PC running MS Windows® and GDSLAB software.

The operator chooses the type of test from a test menu (e.g., U-U, C-U, multi-stage, dynamic cyclic, stress path etc) and then enters the test parameters (of cell pressure, back pressure, testing rate and so on) and test termination conditions.

The test then proceeds automatically with all test data being saved to a file. On-line graphics are presented with up to three graphs displayed together with a block of current live test data.

The computer directly controls all parameters for the test in addition to logging these parameters to the PC hard drive. Of course, additional transducers may be configured easily and logged during the test.

Technical specification

- Displacement range = 100mm
- Displacement resolution = 16bit (i.e., <2µm)
- Displacement accuracy = <0.15% (i.e., <0.15mm)
- Axial force resolution = 16bit (i.e., <0.4N for 10kN load cell, <1.5N for 40kN load cell)
- Axial force accuracy = <0.1% of load cell range (i.e., 10N for 100kN load cell)
- Control data points = 10,000 points/sec
- Maximum saved data points = 100 points/cycle
- Compliance with international standards
- MS Windows® software = GDSLAB for automated test control and data collection
- Future proof fully expandable software to allow additional testing or hardware to be incorporated at any time
What is it?

The GDS Resonant Column Apparatus (RCA) is used to excite one end of a confined solid or hollow cylindrical soil specimen. The specimen is excited in torsion or flexure (bending) by means of an electromagnetic drive system. Once the fundamental resonant frequency is established from measuring the motion of the free end, the velocity of the propagating wave and the degree of material damping are derived. The shear modulus (torsion) or Young’s modulus (flexure) is then obtained from the derived velocity and the density of the sample.

Features

GDS RCA software (see Fig. 1) is used for control and data acquisition of the RCA apparatus. The software allows testing to occur via a simple, user-friendly interface. The tests that may be performed using the GDS RCA software are as follows:

- Resonance in torsion.
- Resonance in flexure.
- Damping Ratio in torsion.
- Damping Ratio in flexure.
- Slow speed (<2Hz) torsional shear.

Technical Specifications

- Standard cell capable of 1MPa gaseous cell pressure (other cells available up to 25MPa)
- Electromagnetic drive system incorporating precision wound coils and composite sintered neodymium iron boron (NdReB) “rare-earth” magnets
- Transconductance current driven amplifier
- Inner cell for silicon oil (to aid membrane sealing)
- Energisation mode of coils is switchable by software to provide torsional and bending (longitudinal) tests
- Internal LVDT for measurement of sample deformation
- Internally mounted, counter-balanced accelerometer
- 1 off transconductance current driven drive amplifier
- 1 off high-speed 16-bit data acquisition/control card with associated GDS RCA control box/interface panel
- 3 off calibration weights and calibration bars provided of differing stiffness to enable calibration of system Io value
- 1 off computer controlled proportional gas valve to control cell pressure from software
- Back pressure by GDS Standard pressure/volume controller (STDDPC)
- Options for environmental temperature chamber (-20 degs C to +40 degs C) and an axial loading actuator and frame
- Standard specimen sizes: 50mm x 100mm and 70mm x 140mm (diameter x height) - other sizes available on request
What is it?

A cylindrical soil specimen is laterally confined by Teflon coated low friction retaining rings, ensuring a constant cross sectional area. Vertical displacement may be prevented whilst shear force loading is applied (Fig. 1), therefore constant volume conditions are enforced, i.e. Simple Shear.

The GDS Electromechanical Dynamic Cyclic Simple Shear (EMDCSS) apparatus is a preferred device for research into dynamic soil behaviour because of its simplicity for the user and its ability to model many types of field loading conditions that are difficult to achieve with other laboratory equipment. The EMDCSS apparatus allows for a smooth and continuous rotation through 90 degrees of the principal stress directions. The ability to simulate principle stress rotation is common to many geotechnical problems, including earthquake loading. The simple shear device allows direct investigation of the shear stress v. shear strain in drained and undrained situations (see graph Fig. 1). The simple shear test is used for routine work for undersea structures, landslips and earthquake performance studies. In addition, the dynamic cyclic capability allows investigation of damping ratio and liquefaction, also under the conditions of simple shear.

Optional frequency ranges
- Static to 0.5Hz
- Static to 5Hz

Testing Options
- Simple shear testing
- Direct shear testing

Load capacity options
- 5kN
- 10kN

Available specimen diameter
- 50mm
- 70mm
- custom

Specimen height
- 20mm (25mm max)

Technical specification
- Overall dimensions and weight = 1200mm (H) x 500mm (L) x 770mm (W), Weight = 160kg
- Electrical specification = 240V or 110V 50/60Hz 1 ph
- Data acquisition = integrated with control module with 8 (+/- 10V range) input channels, 16 bit A/D converters.
- Control module = closed-loop control feedback system integrated with data acquisition module. Twin feedback 16bit control channels, dedicated USB communication interface.
- Displacement range: axial = +/- 25mm, shear = +/- 15mm; Accuracy = <0.1% FSO (in practice, axial range is +/-50mm to aid sample placement, however measured stroke is +/- 25mm).
- Measured Displacement for test (low range LVDT’s): axial = +/- 2.5mm, shear = +/- 2.5mm; Accuracy = <0.1% FSO
- Displacement resolution = 16 bit (i.e. +/- 20mm = 0.8µm, +/- 15mm = +/- 0.5µm, +/- 2.5mm = <0.1µm)
- Force accuracy = <0.1% of load cell range on both axial and shear (i.e. 5N for 5kN load cell, 10N for 10kN load cell)
- Force resolution = 16 bit (i.e. <0.2N for 5kN load cell, <0.4N for 10kN load cell)
- Control data points per cycle = 5,000@1Hz, 1,000@5Hz

Fig. 1 Typical Graph shear stress (kPa) v shear Strain (%) and sample schematic during simple shear
What is it?
The GDS Back Pressured Shearbox (GDSBPS) is used for direct shear testing on soil specimens with varying degrees of saturation by controlling the pore water and pore air pressures of the specimen. The GDSBPS is based on a standard direct shear device, modified to allow the measurement and control of matric suction (the difference between the pore air and water pressures). The complete system runs using GDSLAB control and data acquisition software. This allows standard direct shear tests to be carried out as well as advanced unsaturated tests under computer control. Control parameters include:

- Shear force and displacement
- Effective stress control
- Total stress control
- Pore air and water pressures
- Axial (normal) force and displacement (with optional axial actuator)

Features
- Low-cost version uses hanging weights for axial load
- Internal loadcells for both shear and normal force
- Closed-loop control of shear force/displacement and normal force/displacement (if axial actuator upgrade is ordered)
- Shear gap manually adjustable from outside the pressure vessel whilst under pressure
- Rigid aluminium cell body to reduce system compliance
- Optional bender elements

Control of matric suction
Matric suction is applied to the soil specimen by maintaining air pressure in the air pressure chamber and a water pressure below the high-air-entry porous disk (unsaturated version only). The measurement and control of matric suction during shearing is critical for simulating the behavior of partially saturated soils. As such the GDSBPS provides a realistic model of many real-world geotechnical problems, such as slope stability in semi-saturated conditions.

Technical specification
- Overall dimensions: L = 875mm x W = 350mm
- Standard specimen size = 75mm x 75mm (alternative sizes available on request)
- Displacement range: axial = +/- 15mm, shear = +/- 25mm
- Displacement accuracy = <0.1% FSO
- Displacement resolution of measurement = 16 bit with optional external transducers (± 25mm = ± 0.7µm(shear), ±10mm = ±0.3µm (axial))
- Force accuracy = <0.1% of load cell range on both axial and shear (i.e. 5N for 5kN load cell, 10N for 10kN load cell)
- Force resolution (control) = 1.25N for 5kN load cell
- Force resolution (measurement) = 0.5N for 5kN load cell
- Data acquisition = 8 channel, 16 bit with serial interface and 8 user definable gain ranges from 10mV to 10V input.
- Control modules = closed-loop control feedback system integrated with each independent actuator control unit (shear and axial).
- Electrical specification = 240V or 110V 50/60Hz single phase
What is it?

The GDS Bender Element system enables easy measurement of the maximum shear modulus of a soil at small strains in a triaxial cell. Measurement of soil stiffness at very small strains in the laboratory is difficult due to insufficient resolution and accuracy of load and displacement measuring devices. The capability exists to regularly carry out measurements of small strain stiffness in the triaxial apparatus using local strain transducers, but this can be expensive and is generally confined to research projects.

The addition of Bender Elements to a triaxial testing system makes the routine measurement of Gmax, maximum shear modulus, simple and cost effective.

The GDS Bender Element System (BES)

- S and P -Wave velocity ✓
- Dedicated software ✓
- Sample sizes from 38mm ✓

**New Specification**

- 2 Million Samples/Sec ✓
- USB control box ✓

**Technical Specifications**

- Data acquisition speed = 2,000,000 samples/second, simultaneous sampling of both source and received signals
- Resolution of data acquisition (bits) = 16 bit
- Connectivity of control box = USB
- Available gain ranges for data acquisition = from x10 to x 500
- Titanium inserts for reduced weight (particularly important for the top-cap)

Developed in conjunction with GeoDelt

**The GDS encapsulated element and insert**

- The GDS Bender elements are bonded into a standard insert (see Fig.1). This method of manufacture has 2 advantages:
  - It makes the bender element insert a modular device that can then be easily fitted into a suitably modified pedestal/top-cap.
  - Should an element fail, it is simple and quick to replace the complete insert.

- Elements are manufactured to allow both S and P-wave testing to be performed (in opposing propagation directions).

- The length of the bender element that protrudes into the soil has been optimised without compromising the power transmitted by or received to the elements. This is achieved by fixing the element further down inside the insert and then filling the remaining volume with flexible material. This allows the element to achieve maximum flexure at its tip, whilst only protruding into the sample by a reasonable distance. Advantages of this include prolonged life by increased resilience to breakage and easier sample preparation, particularly on very stiff samples where only a small recess for the element is required.

**Fig. 1 GDS Titanium Bender Element and Insert**
What is it?

The GDS Hall Effect Local Strain Transducers provide on-sample small strain measurements of axial and radial strains. 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 for 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. Therefore, it is highly desirable 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.

### Options available

<table>
<thead>
<tr>
<th>Sample Sizes</th>
<th>38mm</th>
<th>50mm</th>
<th>70mm</th>
<th>76mm</th>
<th>100mm</th>
<th>150mm</th>
<th>Custom</th>
</tr>
</thead>
</table>

### Technical specification

- Range = +/- 3.0mm
- Resolution using 16 bit data acquisition: +/- 3.0mm = <0.1µm
- Accuracy = 0.8% FRO
- Radial Caliper Weight, 38mm caliper = 24g, 70mm caliper = 46g
- Axial Apparatus Weight (1 off) = 16g
- Transducer Weight (1 off encapsulated Hall Effect Chip) = 5g
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 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.

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).

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
What is it?

The GDS Mid Plane Pore Pressure probe provides a direct measurement of the specimen pore pressure at the mid height of the sample. The GDS Mid Plane Suction Probe is a similar device but uses a high air entry porous disk in the tip to enable suction measurements to be made for unsaturated soil testing.

Why use it?

Mid-plane pore pressure measurement is preferred to measurements made in the area of the base pedestal. The reason for this is due to the minimal volume change of pore fluid required to activate the transducer diaphragm compared to that in a base pedestal transducer.

Measurement of matric suction in unsaturated soil

One of the two stress state variables for unsaturated soils is matric suction. The GDS suction probe provides a direct measurement of pore water pressure for the measurement of matric suction. This type of direct measurement is preferred in unsaturated soil tests as measured values of pore water pressures are more rapidly reflected. When the tip is fully saturated, the response of the time of the suction probe is generally less than 3 seconds, even for relatively large changes in pore water pressure.

The principal of making suction measurements using a suction probe is based on the equilibrium between the pore water pressure in the soil and the pore water pressure in the water compartment of the transducer behind the porous tip. Before equilibrium is attained, water flows from the water compartment into the soil, or vice versa. In an unsaturated soil specimen, negative pore water pressure causes the flow of water from the water compartment into the soil. On the other hand, in a saturated soil specimen, positive pore water pressure causes the flow of water from the soil into the water compartment.

Technical specification

- Pressure ranges (standard): 700, 1500kPa,
- Pressure ranges (suction): -400 to 1500, -400 to 700kPa
- Combined Non-linearity and hysteresis: +/- 0.2% BSL
- Temperature range: -20 to +120 degrees C
- Thermal zero shift: +/-0.05% FS/degrees C
- Thermal sensitivity shift: +/-0.2% of reading/degrees C
- Output: linear DC volts output of approx. 0 to 200mV

Why buy a Mid Plane Probe?

- Response speed of pore pressure measurement.
- Measurement of pore pressures (and hence effective stress) in the middle third of the specimen where end effects are not present.
- Measurement of pore pressure distribution and equalization throughout the specimen length.
- Direct measurement of suction (suction probe only).
PNEUMATIC CONSOLIDATION LOAD FRAME
AASHTO T21, ASTM2435, D4546

This is a combination dead weight and pneumatic load frame for stress controlled consolidation testing. It was designed to apply loads instantaneously and to maintain any set load, regardless of sample compression occurring within the loading interval. They are available in three load ranges based on a 2.5" diameter sample: 16 tsf, 32 tsf and 64 tsf. Over 1500 CONBELS are in use worldwide and this series is a refinement of the original design and incorporates features that offer greater sensitivity and ease of operation.

A large pneumatic piston handles loads up to 16, 32 or 64 tsf depending on the model.

This model utilizes a Fairchild low-bleed type of pressure regulator to set and maintain the load on the specimen. Known for their precision, this regulator is sensitive to 1/8" variations in water column. It requires a source of compressed air for operation. The unit is self-contained with a built-in digital readout and pressure transducer with 0.1% linearity. Requires Dial Indicator, Digital Dial Indicator or Displacement Transducer.

CONSTRUCTION
Fabricated to survive harsh laboratory environments, the cabinets are steel and painted with a durable enamel. The load platform consists of 1" thick aluminum plate. Vertical rods are made from stainless steel.

The load platform features adjustable centering pads to aid in aligning the consolidometer. It will accept any consolidometer, regardless of manufacturer, up to a maximum diameter of 7.25" (184 mm).

NOTE: A wide range of consolidometer sizes are available, please inquire.

ADVANTAGES
- Instantaneous loading without impact
- Complete flexibility in choice of loads
- Relatively insensitive to shock or inertia forces
- Compact size allows for table top operation

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum Load</th>
<th>Air Pressure Req.</th>
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</thead>
<tbody>
<tr>
<td>1016</td>
<td>16 tsf</td>
<td>62 psi</td>
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<tr>
<td>1032</td>
<td>32 tsf</td>
<td>123 psi</td>
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<tr>
<td>1064</td>
<td>64 tsf</td>
<td>188 psi</td>
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<table>
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<tr>
<th>ACCESSORIES</th>
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</thead>
<tbody>
<tr>
<td>1210</td>
</tr>
<tr>
<td>Floating Ring Consolidometer, 2.5&quot; Diameter with Cutting Ring</td>
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<tr>
<td>1220</td>
</tr>
<tr>
<td>Fixed Ring Consolidometer, 2.5&quot; Diameter with Cutting Ring</td>
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<tr>
<td>1230</td>
</tr>
<tr>
<td>Back Pressure Consolidometer, 2.5&quot; Diameter with Cutting Ring &amp; SS Piston</td>
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<tr>
<td>1214</td>
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<tr>
<td>Calibration Disc, 2.460&quot; Diameter x 1&quot; High</td>
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<tr>
<td>5102</td>
</tr>
<tr>
<td>Dial Indicator, 0.5&quot; Range x 0.0001&quot; Resolution</td>
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<tr>
<td>6820</td>
</tr>
<tr>
<td>Digital Dial Indicator, 0.6&quot; Range x 0.0001&quot; Resolution</td>
</tr>
<tr>
<td>6552</td>
</tr>
<tr>
<td>Digital Readout with 0.500&quot; range displacement transducer. Output is 0-10V and RS232 serial output to computer</td>
</tr>
</tbody>
</table>

Height: 20.5" (521 mm)
Width: 20.0" (508 mm)
Depth: 14.5" (368 mm)
Net Weight: 48 lbs. (21.8 kg)
Vertical Clearance: 8.25" (210 mm)
Horizontal Clearance: 7.75" (197 mm)
Maximum Piston Travel: 1.0" (27 mm)
PNEUMATIC DIRECT/RESIDUAL SHEAR
ASTM D-3080; AASHTO T-236

This latest direct shear utilizes the Karol-Warner "CONBEL" pneumatic loading concept for applying the vertical load to the sample. The self-contained tabletop model eliminates the need for numerous weights used in dead weight systems.

Sample loads are obtained by the use of two pneumatic pistons. This new concept increases the accuracy and sensitivity of light load settings. A small diameter rolling diaphragm piston is capable of applying loads from 4 lbs. up to 100 lbs., which is helpful when working with light vertical loads. A larger diameter piston applies loads up to 1500 lbs. Applying the vertical load is accomplished by setting the precision regulator to the required pressure per the calibration chart. Load settings are verified on a pressure readout that reads to two decimal places and is accurate to .25%.

All models have built-in readouts for pressure and load which are used for setting the vertical load and measuring shear forces. The basic direct shear Model 2001 frame is supplied with dial indicators to measure vertical and shear displacement.

The digital version features displays for viewing all test parameters including residual cycle count, strain rate and load setting. Displacement transducers are used for horizontal and vertical measurements. Data output to the computer is via an RS232 Serial Port in ASCII format to spreadsheet programs similar to Excel. A PC Computer 386 or higher is required. Viewing of displays are not dependent on computer hookup.

The direct shear includes 2.5” diameter shear rings, porous stones, drainage plates and water chamber. Other size shear rings are available. Maximum shear displacement is .8”. Travel is set with limit switches. The stepper motor drive controls the strain rate within 1% and is easily set with digital thumbwheels. Each digit represents .0001”/min. strain rate and can be controlled from .0001” to .3”/min.

CONSTRUCTION
The direct shear is designed for harsh lab environments. A 1-1/4” thick solid base for the vertical and horizontal loading and shear box assembly is mounted on a sturdy steel cabinet. The shear rings and water chamber are anodized aluminum for corrosion resistance.

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Strain Rate</th>
<th>.0001” to .3”/min</th>
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<tbody>
<tr>
<td>Horizontal Movement</td>
<td>0.8”</td>
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<tr>
<td>Overall Dimensions</td>
<td>14.5” deep x 30” long x 22” high</td>
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<td>Power</td>
<td>110 Volts 60 Hz</td>
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<td>Net Weight</td>
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<td>Shipping Weight</td>
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**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>VERTICAL LOAD LBS</th>
<th>AIR PRESS REQUIRED</th>
<th>HORIZONTAL SHEAR FORCE</th>
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<tr>
<td>2001/2001D</td>
<td>1500</td>
<td>90</td>
<td>1500</td>
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**SPECIFICATIONS**

<table>
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<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>2001</td>
<td>Standard version with:</td>
</tr>
<tr>
<td></td>
<td>- Load Cell and Readout for shear Load</td>
</tr>
<tr>
<td></td>
<td>- Dial Indicators for consolidation and shear displacement.</td>
</tr>
<tr>
<td>2001D</td>
<td>Digital version with displays for:</td>
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<tr>
<td></td>
<td>- Horizontal and Vertical Displacement Transducers</td>
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<tr>
<td></td>
<td>- Shear Load</td>
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<tr>
<td></td>
<td>- Pressure (Vertical Load)</td>
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<tr>
<td></td>
<td>- Strain Rate set with</td>
</tr>
<tr>
<td></td>
<td>- Cycle Counter with settings from 1 to 99</td>
</tr>
<tr>
<td></td>
<td>- Data Output RS 232 Serial Port with standard ASCII format</td>
</tr>
</tbody>
</table>
Hoskin Scientific Limited has been supplying testing and monitoring instruments since 1946. Although our range is broad, we focus on three major markets including:

Geotechnical & Materials Testing
Environmental Monitoring
Test & Measurement Instrumentation

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