

2021

GDS

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LABORATORY SYSTEMS  
**FOR ROCK**

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GDS INSTRUMENTS ROCK CATALOGUE 2021



# ROCK MECHANICS

GDS HAS MANUFACTURED HIGH PRESSURE AUTOMATED TRIAXIAL TESTING SYSTEMS FOR ROCK FOR OVER 25 YEARS, WITH SYSTEMS INSTALLED AT LEADING RESEARCH AND COMMERCIAL INSTITUTES AROUND THE WORLD.

To assess the deformation and failure characteristics of rocks in the laboratory, test equipment must be stiff to avoid tremendous backlash and spring effects at failure, as well as robustly designed and manufactured to ensure consistent results year on year. The GDS rock mechanics range is therefore built to meet these requirements, providing high load and pressure test systems with options to include advanced transducers, such as acoustic velocity and acoustic emission.

**STATIC TRIAXIAL ROCK TESTING SYSTEM (ST-RTS)** is a triaxial system which enables load application up to 2MN using a passive triaxial cell and stiff load frame. Triaxial confining pressures of up to 100MPa are common when using this system.

**ACTIVE CELL (AT-RTS).** The high pressure active triaxial cell is capable of reaching axial loads up to 2MN, applying load via its own hydraulic piston pressurised using a GDS pressure/volume controller. The system comes with its own lifting frame, with a in-built winch to remove the specimen and top section of the cell.

**ACOUSTIC EMISSION (AE) AND ACOUSTIC VELOCITY (AV)** transducers can typically be included with the GDS Instrumented Hoek Cell, or GDS high pressure triaxial cells.

**INSTRUMENTED HOEK CELL (GDSHC)** is a highly sophisticated version of the traditional Hoek cell, which can be fully instrumented with acoustic velocity and/or acoustic emission transducers.

**DYNAMIC HYDRAULIC LOAD FRAMES (HLF)** are cyclic triaxial systems designed to apply loads up to 1500kN, at loading frequencies of up to 5Hz, 10Hz, or 20Hz. Triaxial confining pressures of up to 70MPa may be reached with this system using either a static pressure controller or a dynamic pressure intensifier to ensure cell pressures are accurately and consistently controlled.

**LARGE AUTOMATED DIRECT SHEAR SYSTEM (GDSLADS)** is an electro-mechanical direct shear testing system designed for specimens up to 305mm square or circular. GDS also offers a rock mechanics specimen set to enable solid rock testing within the device.

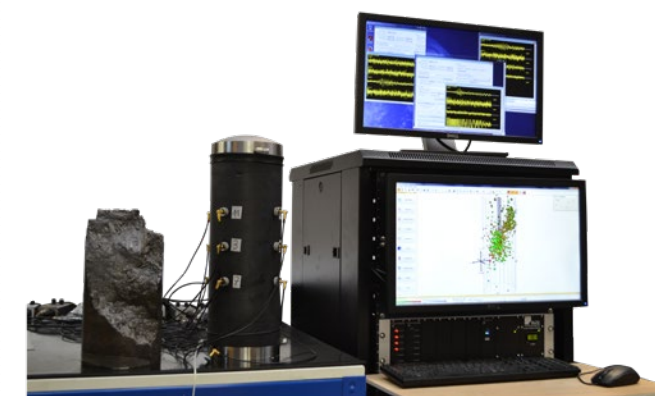
**HIGH PRESSURE BACK PRESSURE SHEARBOX (HPBPS)** is a high pressure version of the GDS back pressured shearbox, which has the unique feature of being able to perform direct shear tests with precise back pressure control for realistic modelling of slope failures. The system can load specimens to 100kN in the normal and shear directions, with a back pressure of up to 10MPa being maintained during testing.



250kN Hydraulic Loading Frames (HLF)



Instrumented Hoek Cell, shown with heat pads (GDSIHC)



Acoustic Emission System (AE)

## KEY FEATURES

Systems are configured to the customers' test specifications and budgets.

Automated system control and data acquisition via GDSLAB software.

Stiff load frames to avoid backlash and spring effects.

Triaxial and Hoek cells available for specimen confinement.

Options to install Acoustic Velocity and Acoustic Emission transducers.

Load frames with electro-mechanical or hydraulic actuation available.

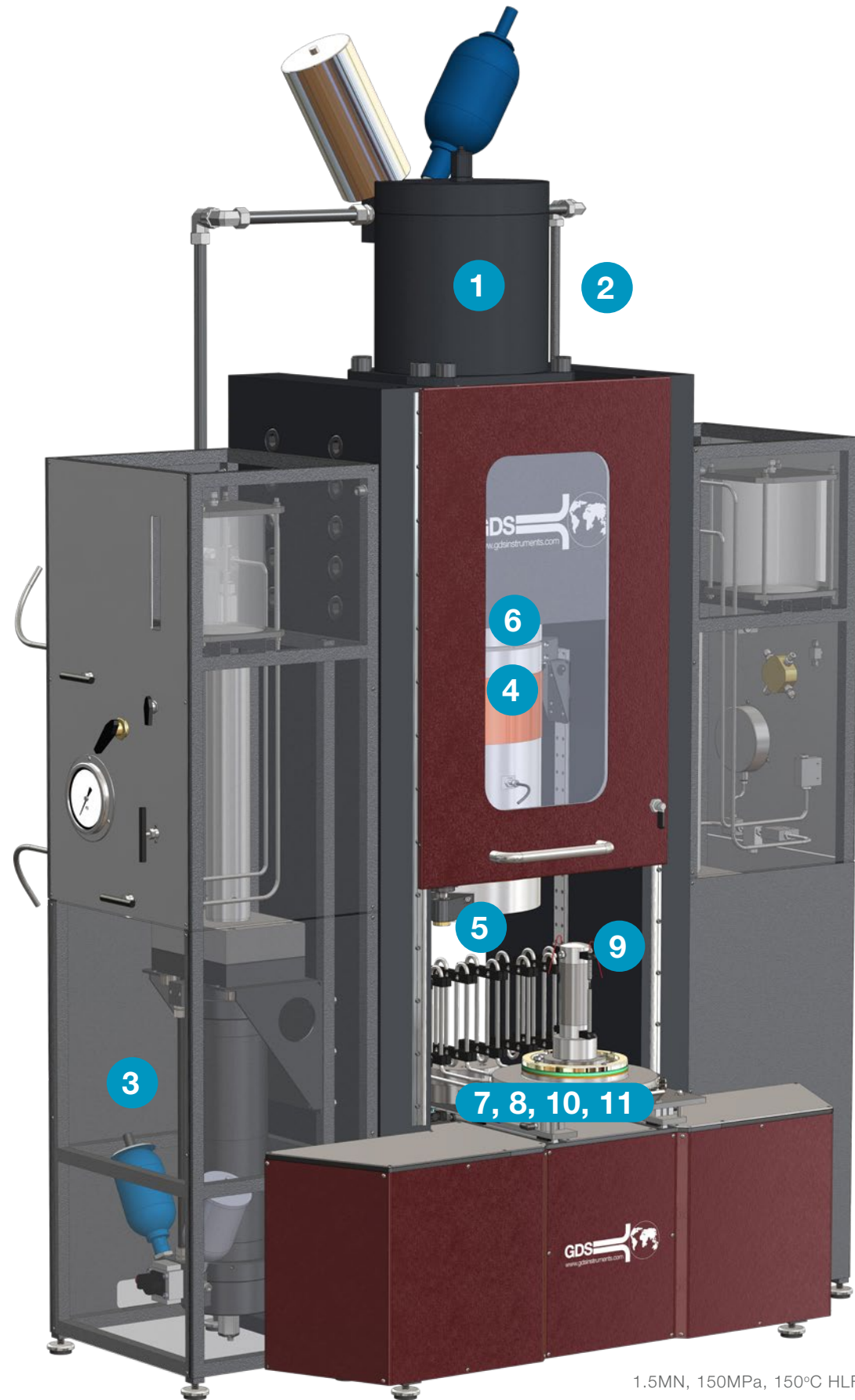
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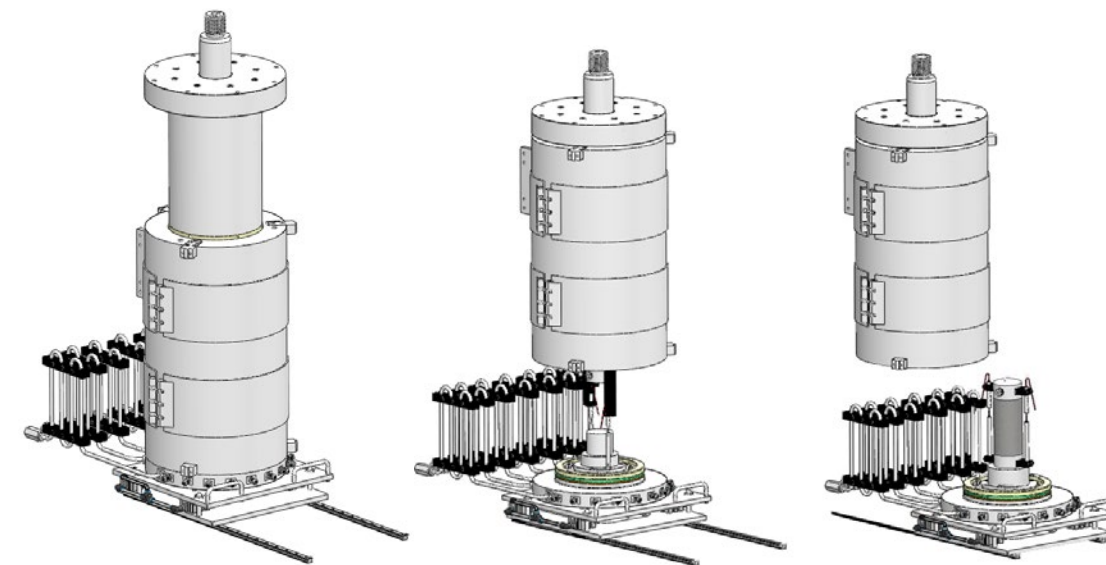
# 1.5MN / 150MPa / 150°C ROCK TRIAXIAL SYSTEM



1.5MN, 150MPa, 150°C HLF

## KEY FEATURES (See datasheet for full specification)

1. Double acting servo hydraulic actuator, maximum static load of +1500kN and maximum dynamic load of  $\pm 1200$ kN with frequencies up to 20Hz.
2. Full stroke in bore non-contact position sensor with 0.2% non linearity. Includes piston anti-rotation feature and mechanical feed back servo valve.
3. Optional 150MPa cell and back pressure controllers, 600cc volume with better than 0.25% pressure accuracy and 0.006cc volume resolution.
4. The cell is based on a cowl-type triaxial cell, where the cell wall is able to be lifted without the need for removing clamps. The cell is capable of heating the internal volume of oil up to 150°C whilst under the working pressure of 150MPa.
5. In order to ease sample and instrumentation preparation and setup, a lifting trolley has been added. The trolley slides out of the load frame to bring the cell base closer to the operator.
6. High wear-resistance, low friction rod seals for 20Hz/0.2mm performance or 10Hz/1mm or 5Hz/5mm. Static monotonic velocity range: 0.0001mm/sec to 1mm/sec.
7. 150MPa Hardened Stainless Steel cell construction. For samples up to 70mm diameter x 140mm height (with top bolting pedestals for easy handling).
8. Optional Acoustic Velocity Transducers in the top cap and pedestal, axial and radial local displacement with LVDTs and acoustic emission measurements are also available.
9. Access ports for high pressure connections.
10. The cell base has ten off 5 pin glass-to-metal feedthroughs capable of operating at pressures up to 150MPa.
11. High stiffness load frame construction using high modulus of elasticity materials achieving overall stiffness in excess of 10MN/mm.



Sliding / lifting mechanism ensures easier and safer sample preparation.

## TEMPERATURE CONTROLLED TRIAXIAL SYSTEMS

### HEATING & COOLING OPTIONS:

Fluid Recirculating Coils

- -10°C to +60°C
- -20°C to +85°C
- -30°C to +100°C\*

\*Not available on all cells, as depends on pressure seal used.

### HEATING ONLY OPTIONS:

External Heat Pads

- Ambient to 150°C

### PRESSURE / SAMPLE DIAMETER OPTIONS:

- 14MPa / 76mm or 150mm
- 20MPa / 100mm
- 32MPa / 54mm
- 64MPa / 100mm
- 70MPa / 70mm
- 100MPa / 50mm
- 150MPa / 70mm

### APPLICATIONS:

- High Pressure Testing
- High & Low Temperature Testing

Hydraulically actuated dynamic load frame with temperature controlled cell. 100kN, 4MPa, -20°C to +65°C shown below.



### TEMPERATURE CONTROLLED TESTING

GDS have a large range of temperature controlled rock testing systems. Our temperature controlled systems are offered in two variants; heating & cooling or heating only. Combined heating and cooling systems use coiled tube heat exchangers inside the cell for thermal fluid circulation; these are connected through ports in the cell base or cell top to a temperature control unit allowing temperature regulation close to the specimen. The heating only options uses external heat pads.



Cell base with heating and cooling coil.



Cell with external heat pads.

## LOADFRAMES

The GDS hydraulic dynamic load frames are designed to perform dynamic cyclic testing from static up to 20Hz. The load frames range from maximum loads of 100kN up to 1500kN. Combined with either high pressure triaxial cells (specimens up to 150mm diameter) or standard triaxial cells (specimens up to 300mm diameter) they can be used to run advanced tests on rock or soil. The GDS VIS load frames allow static advanced testing. Ranges from 100kN to 2MN are available. Ranges up to 500kN are available as electromechanically controlled systems, above 500kN all frames are hydraulically actuated.



100kN (Dynamic)



250kN (Dynamic)



1.5MN (Dynamic)



2MN (Static)



500kN Static (Extra Tall)



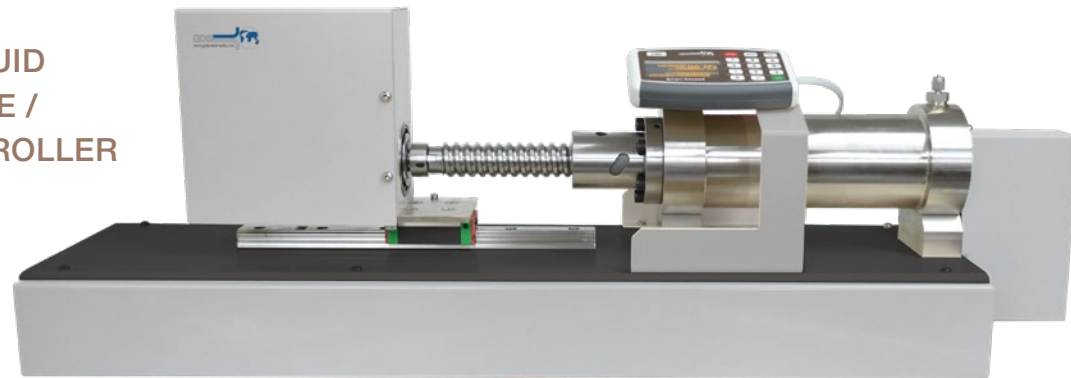
## HIGH PRESSURE / VOLUME CONTROLLERS



The GDS Advanced High Pressure Digital Pressure Controller (HPDPC) is a general-purpose device for the precise regulation and measurement of fluid pressure and volume change. The advanced controller offers the highest level of accuracy, resolution and control and is the defacto standard for research. The high pressure version is available in pressure ranges from 0-8MPa to 0-100MPa with a volumetric capacity of 200cc. Manufactured from stainless steel, they can be used with water, oil or air.

Key features of GDS controllers:	Benefits to the user:
Single connection to electrical power:	GDS pressure controllers do not rely on lab air supplies.
USB and Smart Keypad user interfaces:	The GDS pressure controllers can be controlled directly from a computer using the USB 2.0 interface or the Smart Keypad. Using the Smart Keypad, the controller can be configured as a completely stand-alone device.
Pressure is measured by an integral pressure transducer. Volume change is measured by counting the steps of the incremental motor:	Accurate measurements of pressure and volume as both are measured locally to the controller.
Self-protecting and can be programmed to protect any attached equipment:	Full confidence that the equipment is inherently safe and can never be over-ranged.
Measurement of change in volume with no requirement for a separate volume change device:	Controllers are an ideal back-pressure source.
All controllers are designed to run using liquids. GDS have an ADVDP (1000cc) specifically designed for use with Air:	Controllers can be used with a large range of media.

## CORROSIVE FLUID HIGH PRESSURE / VOLUME CONTROLLER



The GDS High Pressure Syringe Pumps are positive displacement pumps that have been developed from the proven pressure controller range that GDS Instruments have been making for over 40 years. The HPDPC-H version has been enhanced with features that are ideal for core testing and reservoir analysis. These include flow rate control, enhanced resolution (0.01mm<sup>3</sup>) and the use of high corrosion resistance

Hastelloy wetted parts. With the ability to operate in pressure, volume or flow control modes, either directly from the keypad or remotely via software, the HPDPC-H is a versatile and simple to use pump.

Suitable for a wide range of applications in varied fields like petrochemical applications, EOR, reaction feed, alternative fuels, biomass, etc

## TRIAXIAL CELLS

### HIGH PRESSURE PASSIVE TRIAXIAL CELLS WITH BALANCED RAM (>4MPa)

The balanced ram ensures that there is no axial deviator load caused by the cell pressure pushing on the ram, no matter how much cell pressure is being applied. The main advantage being that the full capacity of the load frame can be used to apply load to the sample without needing to also overcome ram upthrust.

What is a Balanced Ram?

The balanced ram is a system that compensates for the up thrust on the ram exerted by the cell pressure. A secondary chamber around the ram balances the pressure in the cell against a second piston seal such that the cell pressure force is not exerted onto the load frame (i.e. the ram is "balanced" no matter what pressure is inside the cell).



32MPa triaxial cell with balanced ram 54mm max sample diameter



64MPa triaxial cell with balanced ram 100mm max sample diameter

### HIGH PRESSURE PASSIVE TRIAXIAL CELLS WITHOUT BALANCED RAM (>4MPa)

For triaxial cells that do not have balanced rams, accommodation needs to be made for the potential maximum ram upthrust, which can be considerable for high load and pressure triaxial cells. The load frame used must be capable of overcoming the maximum ram upthrust as well as the required sample load. If this is not the case, a balanced ram solution can be considered. Porting is provided for

local instrumentation. All high pressure triaxial cells have the following common functions:

- Temperature versions available.
- Minimum of 5 x feed through ports (Cell, back, pore pressure, top cap and extension).
- Made from Stainless Steel.



14MPa triaxial cell with 76mm max sample diameter



20MPa triaxial cell with heating pads 100mm max sample diameter



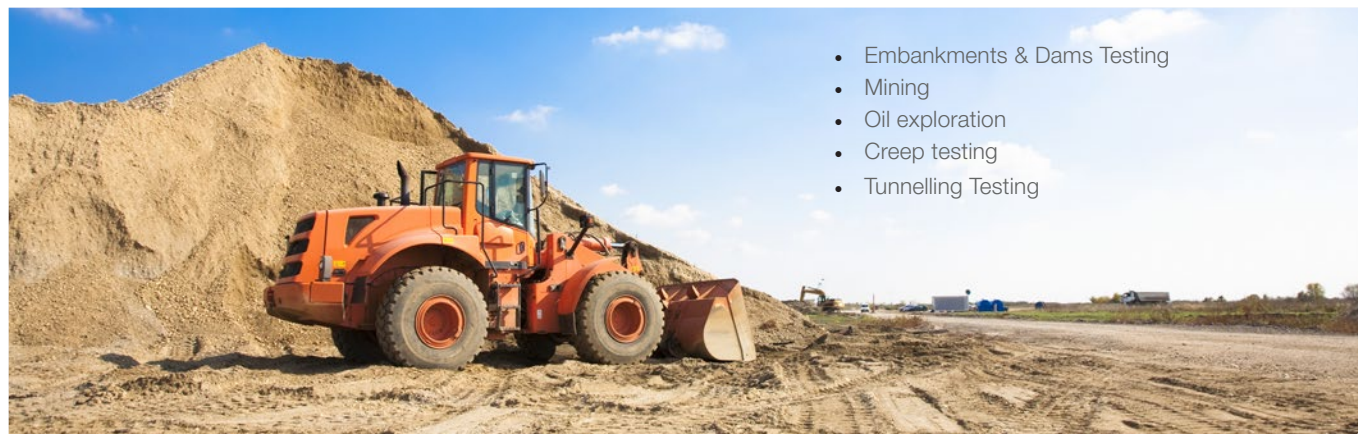
100MPa triaxial cell with 50mm max sample diameter

## INSTRUMENTED HOEK CELLS



The GDS Instrumented Hoek Cell (GDSIHC) brings together the traditional high pressure Hoek Cell, with the functionality of advanced testing capabilities for Acoustic Emission (AE) and Acoustic Velocity (AV) testing. Below are some features and benefits of the cell.

- Max pressure: 70MPa.
- Sizes sizes available: 38.1mm and 50.8mm diameter.
- The confining pressure of up to 70MPa is applied using a GDS high pressure controller which provides accurate control and acquisition of both the pressure and volume change.
- Special membranes allow for AE, AV and local radial strain transducers to quick connect via dedicated connections.
- Vertical Acoustic Velocity transducers are mounted in the topcap and pedestal.
- Up to 12 Acoustic Emission transducers, 1 set of vertical AV transducer, up to 2 sets of horizontal AV transducers can be installed in each cell.
- Access to the inner chamber and membrane is via screw threaded end caps. A specially designed base plate allows the entire internals of the cell to be fitted for easy maintenance.
- Dimensions: Cell wall 310mm diameter x 305mm high. Weight = approximately 180kg.
- Approximately 400mm diameter outside of cowling when used with heating option.

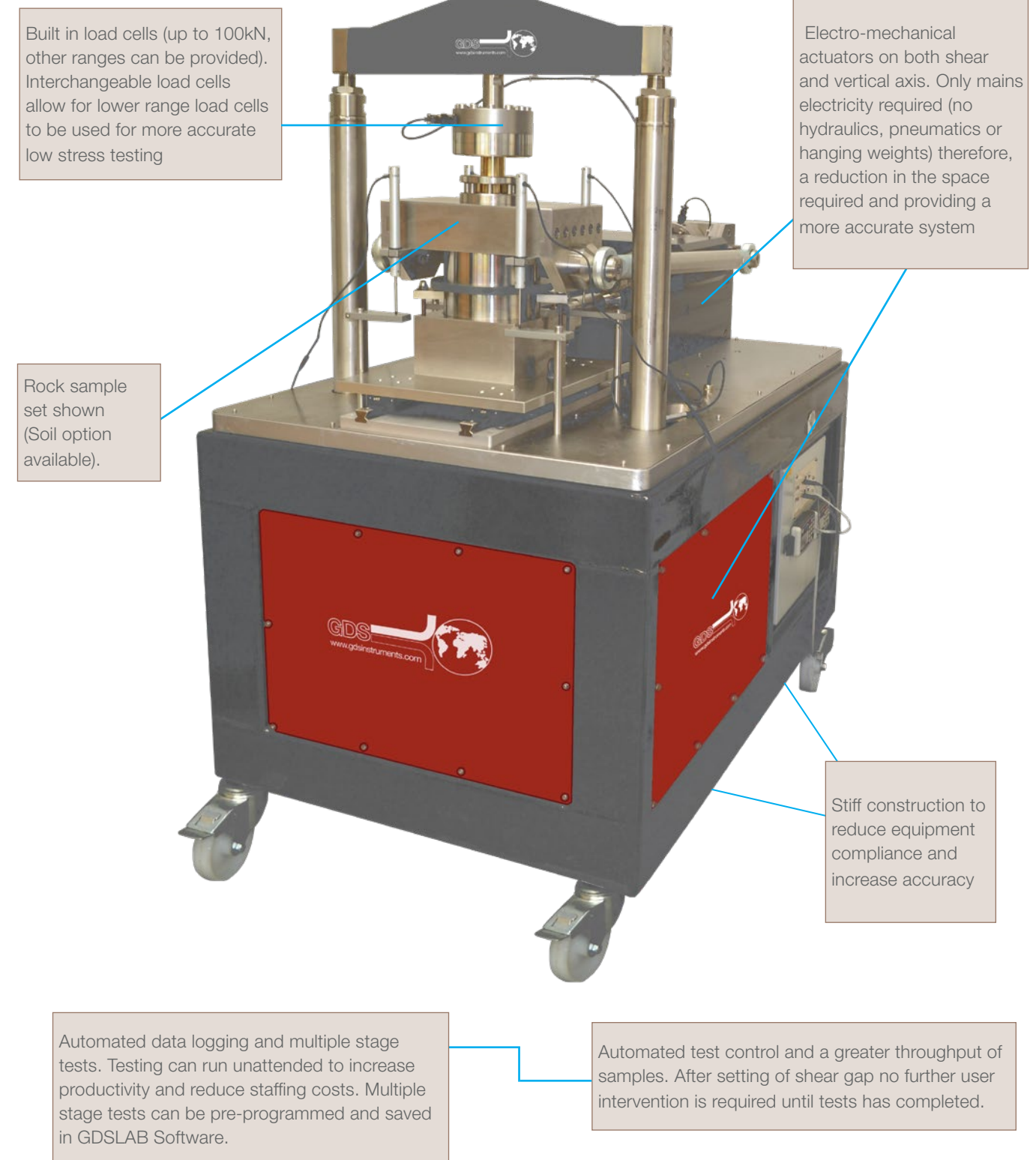


- Embankments & Dams Testing
- Mining
- Oil exploration
- Creep testing
- Tunnelling Testing

## LARGE SHEARBOX

GDS Large Automated Direct Shear System (GDSDLADS) is an electro-mechanical direct shear testing device for rock specimens up to 150mm in diameter. Different sample sets can be used to achieve the following types of testing in one system.

- Rock Mechanics cylindrical sample set up to 150mm diameter.
- Geomembrane Shear test.
- Soil sample sets for up to 300x300mm.



Built in load cells (up to 100kN, other ranges can be provided). Interchangeable load cells allow for lower range load cells to be used for more accurate low stress testing

Electro-mechanical actuators on both shear and vertical axis. Only mains electricity required (no hydraulics, pneumatics or hanging weights) therefore, a reduction in the space required and providing a more accurate system

Rock sample set shown (Soil option available).

Stiff construction to reduce equipment compliance and increase accuracy

Automated data logging and multiple stage tests. Testing can run unattended to increase productivity and reduce staffing costs. Multiple stage tests can be pre-programmed and saved in GDSLAB Software.

Automated test control and a greater throughput of samples. After setting of shear gap no further user intervention is required until tests has completed.



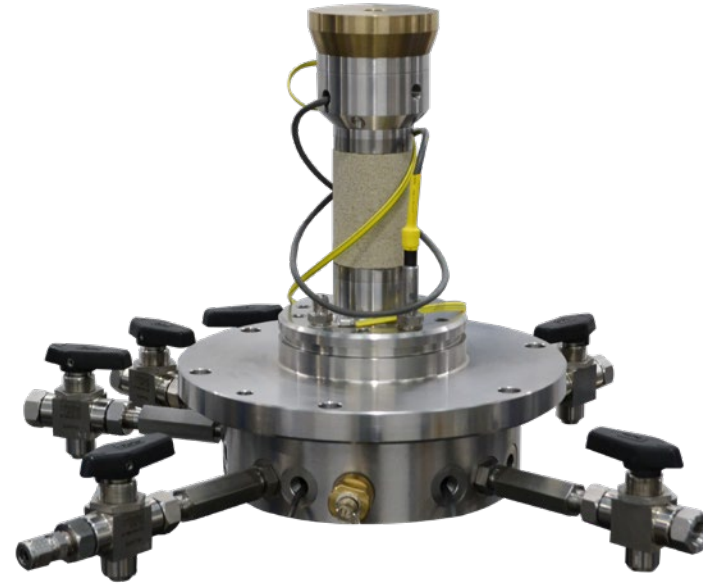
# ACOUSTIC VELOCITY

## Acoustic Velocity Transducers (AV):

The AV system is used to measure the P and S Wave velocity within a sample. AV sensors are generally used where pressures and load exceed those where bender elements can be used, and where velocities are higher.

AV sensors are based on the same principle as bender elements. Using piezo ceramic elements they can be used at pressures up to 100MPa and axial forces up to 2MN. Sensors are most commonly mounted in the pedestal and topcap for vertical measurements, or to the sides of the sample for horizontal measurement.

Each sensor package contains a Compressional wave (P-Wave) element and two shear wave (S-Wave) elements. The shear wave elements are set in orthogonal directions to allow two shear waves to be generated with different polarisation which, is important where samples may be cross-anisotropic or fully anisotropic.



Screenshots from the GDS Acoustic Velocity software

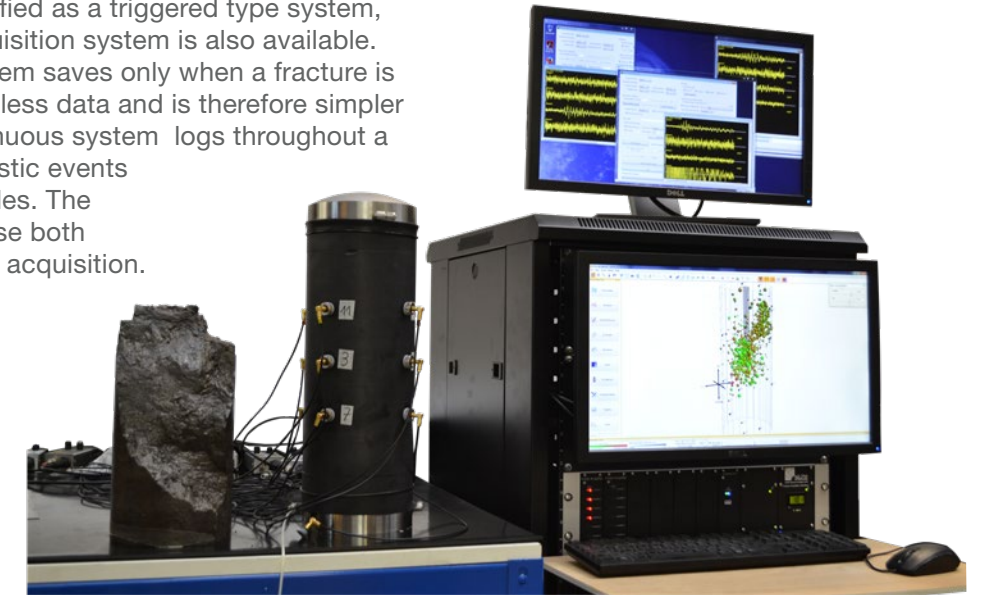
# ACOUSTIC EMISSION

## Acoustic Emission Transducers (AE):

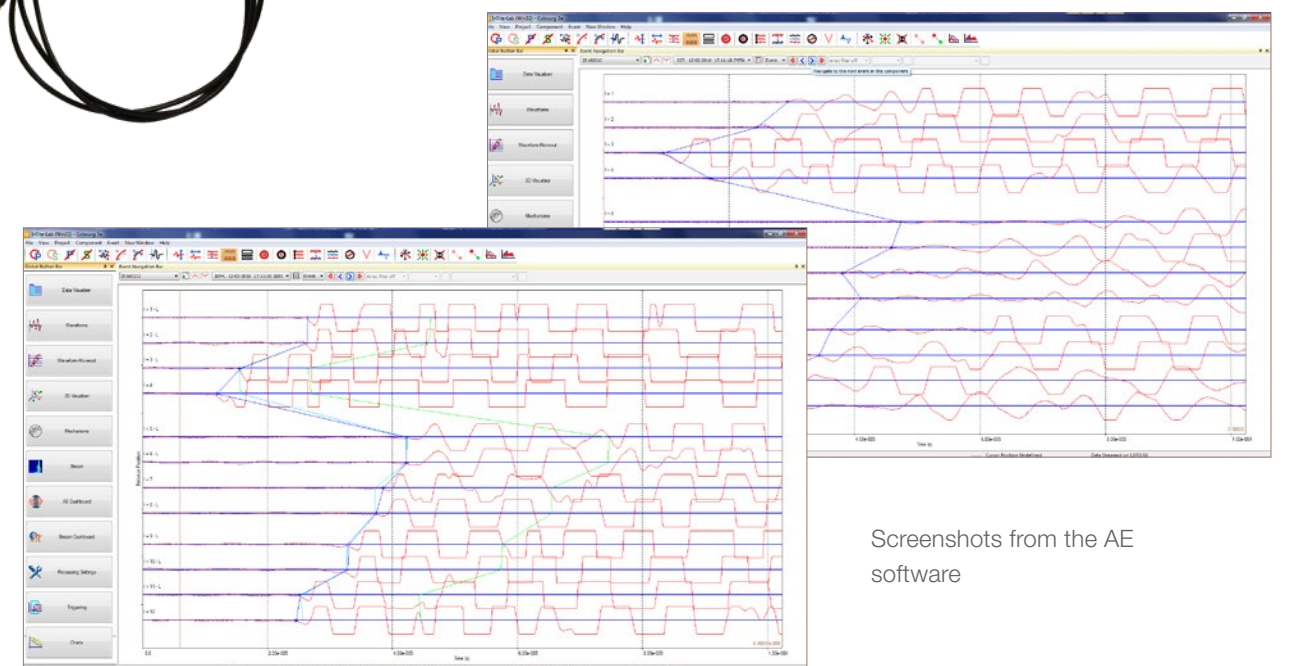
The AE transducers enable micro-fractures occurring within a rock specimen during testing to be recorded and analysed for intensity and location. Analysis of rock micro fractures can give information as to the failure mechanisms of a sample under test as well as better determining the onset of failure.

The AE system is usually specified as a triggered type system, alternatively a continuous acquisition system is also available. The triggered 'hit counter' system saves only when a fracture is detected, yielding significantly less data and is therefore simpler to process the data. The continuous system logs throughout a test, picking up even tiny acoustic events but produces very large data files. The system can be configured to use both triggered and continuous data acquisition.

The AE system is available in three different configurations, 4, 8 or 12 channels. The AE is suitable for both unconfined and confined tests at high pressures.



Single transducer without casing



Screenshots from the AE software

# ROCK MECHANICS

## STATIC TRIAXIAL ROCK TESTING SYSTEM



Up to 2MN

### PRODUCT CODE: ST-RTS



The Static Triaxial Rock Testing System enables axial load application up to 2MN, with triaxial cells rated up to 100MPa used to confine test specimens of maximum 200mm diameter.

### KEY FEATURES

Axial loads generated by a GDS 64MPa pressure volume controller, or electro-mechanical load frame.

Stiff frame construction that exceeds ISRM recommendations, reducing equipment compliance and increasing measurement accuracy.

Clean and quiet system operation, designed for long term tests. Very low power consumption and no system cooling requirements.

## TRIAxIAL (ACTIVE CELL) ROCK TESTING SYSTEM



### PRODUCT CODE: AT-RTS



The Active Triaxial Rock Testing System allows axial load application up to 2MN via a hydraulically-actuated triaxial cell. Confining pressures up to 64MPa are available for a maximum 150mm test specimen diameter.

### KEY FEATURES

Axial loads generated by a GDS 64MPa pressure volume controller, with stress directly applied to the test specimen.

Options to include Acoustic Emission and Acoustic Velocity transducer measurement systems.

Upgrades available to provide local strain measurement, along with temperature control systems for specimen heating and cooling.

## DYNAMIC TRIAXIAL ROCK TESTING SYSTEM



### PRODUCT CODE: DT-RTS



The Dynamic Triaxial Rock Testing System can apply axial loads of up to 1.5MN at dynamic frequencies up to 20Hz. Dynamic loading is achieved using a servo-hydraulic actuator system. Cell and back pressure up to 150MPa. Temperature control up to 150°C.

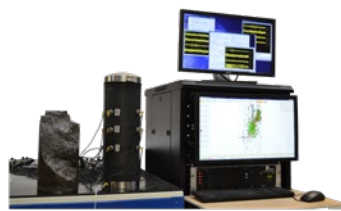
### KEY FEATURES

Different load, pressure and specimen sizes available to enable system configuration to specific user requirements.

Can be supplied with a cell top lifting system to provide ease of use when confining test specimens in a high pressure triaxial cell.

Options to include Acoustic Emission and Acoustic Velocity transducer measurement systems.

## ACOUSTIC EMISSION



### PRODUCT CODE: GDSAE



The Acoustic Emission transducers enable micro-fractures occurring within a rock specimen during testing to be recorded. The submersible transducers may monitor fractures continuously, or only when triggered.

### KEY FEATURES

High speed data acquisition systems (10MHz – 50MHz) available up to 16-bit for high resolution measurements.

Transducer systems range from simple fracture counters through to complete systems that locate the fracture origin within the specimen.

Option to include velocity tomographic surveys to map acoustic velocity variations within a rock specimen.

# ROCK MECHANICS

## ACOUSTIC VELOCITY



### PRODUCT CODE: GDSAV



The Acoustic Velocity transducers allow P- and S-wave velocities to be measured within a rock specimen. The transducers are mounted in the pedestal and top-cap, or in some cases the sides of the specimen.

### KEY FEATURES

Standard package includes hardware to measure P-wave velocity, along with S-wave velocities using two polarities.

High speed data acquisition system supplied to produce high resolution wave propagation data.

Transducer hardware designed to fit most GDS high pressure triaxial and Hoek cells.

## INSTRUMENTED HOEK CELL



### PRODUCT CODE: GDSIHC



The Instrumented Hoek Cell is a highly sophisticated version of the traditional Hoek cell, which can be fully instrumented with acoustic velocity and/or acoustic emission transducers.

### KEY FEATURES

Option to include up to 12 channels of Acoustic Emission transducers for monitoring micro-fractures.

Option to include vertically and horizontally propagating Acoustic Velocity transducers for P- and S-wave measurements.

Can be supplied as a standalone cell for use in an existing system or as a complete system with loadframe and pressure control.

## LARGE AUTOMATED DIRECT SHEAR SYSTEM (305mm)



### PRODUCT CODE: GDSLADS



The Large Automated Direct Shear system is an electro-mechanical direct shear testing device for specimens of up to 305mm square in size.

### KEY FEATURES

Only mains electricity required to run the system (no hydraulics or pneumatics), reducing space required and additional equipment requirements.

Flexibility to test different shaped specimens, including sets for testing rock cores.

Stiff shearbox construction reduces system compliance and increases accuracy of strain measurements.

## BACK PRESSURE SHEARBOX - HIGH PRESSURE



### PRODUCT CODE: HPBPS



The High Pressure Back Pressured Shearbox is a high pressure version of the GDSBPS. Normal and shear loads of up to 100kN may be applied to the test specimen, with a back pressure of up to 10MPa available.

### KEY FEATURES

Accurate application of loading conditions through electro-mechanical control of normal and shear forces.

Precise displacement measurements enable long-term creep tests to be performed.

Back pressure applied using GDS Advanced Pressure Volume Controller.



PREFER TO VIEW THE PRODUCTS ONLINE?

visit [www.gdsinstruments.com](http://www.gdsinstruments.com)



# LABORATORY SYSTEMS FOR ROCK TESTING

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