

## Company Vision

GCTS is internationally renowned for its high quality testing systems and client care. The design approach GCTS has utilized, emphasizes the importance of the customer needs. It is this approach that dictated the level of success we have achieved to this date.

GCTS does not just offer testing equipment, instead we provide complete solutions for advanced material characterization.

Our systems are designed to maximize client productivity by acquiring and processing testing data, then presenting the results in a simple and coherent format.

## GCTS Global Presence



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# Digital Point Load Testing System

## PLT-100

- 100 kN (22 kips) load capacity, larger capacities available
- Compact, light design (< 15 kg)
- Output display in SI or English units
- Digital output with 10 N (or 1 lb) resolution
- Dual signal outputs to a computer or data recorder
- Software for fast and automatic testing
- Increase test production and minimizes operational errors
- 110/220 VAC or 12 VDC operation
- Optional ultrasonic velocity point load platens
- Platens and frames are available to perform Uniaxial, Brazilian, Hardness, and Ultrasonic tests



## Specifications

Load Capacity	100 kN
Shipping Volume	0.11 m <sup>3</sup>
Shipping Mass	27 kg
Stroke	54 mm
Vertical Opening	125 mm
Horizontal Opening	100 mm

## Accessories

1. Watertight, airtight, crushproof carrying case.
2. Automatic size gauging & deformation transducer.
3. Automatic data acquisition system.
4. Unconfined compression load platens.
5. Ultrasonic velocity measurement system.

For more accessories please contact GCTS.

## Description

The GCTS Point Load Tester is an apparatus made of high strength anodized aluminum that incorporates digital technology to increase precision and ease of use while reducing its size and mass. The introduction of a pressure sensor to measure load provides a better accuracy at any load level eliminating the imprecision of the traditional pressure gauges at low load ranges.

The system has a digital display that continuously monitors the applied load. The maximum load is automatically stored and easily obtainable by pressing a button.

An advanced option for this system are the ultrasonic platens for the measurement of P-wave (compressional wave) velocity. The P-wave velocity is a more rational method and gives a better correlation to strength than the point load index. The major advantage of the ultrasonic velocity option is that, as with the point load test, it does not require expensive specimen preparation. The P-wave velocity is measured during the point load test.

Other options include: platens, triaxial cells, and frames for performing uniaxial and triaxial tests on small specimens. These options include software that captures the complete stress-strain curve and automatically calculates the parameters.



Indirect tension Brazilian test jig.



Weatherproof carrying case.

# Digital Point Load Testing System

## PLT-110

- 100 kN (22 kips) load capacity, larger capacities available
- Compact, light design (< 14 kg)
- Output display in SI units
- Digital output with 10 N (or 1 lb) resolution
- Dual signal outputs to a computer or data recorder
- Software for fast and automatic testing
- Increase test production and minimizes operational errors
- Internal battery operation
- Optional ultrasonic velocity point load platens
- Platens and cells are available to perform Triaxial, Uniaxial, Brazilian tests



## Specifications

Load Capacity	100 kN
Shipping Volume	0.13 m <sup>3</sup>
Shipping Mass	26 kg
Stroke	54 mm
Vertical Opening	125 mm
Horizontal Opening	100 mm

## Accessories

1. Watertight, airtight, crushproof carrying case.
2. Automatic size gauging & deformation transducer.
3. Automatic data acquisition system.
4. Unconfined compression load platens.
5. Ultrasonic velocity measurement system.

For more accessories please contact GCTS.

## Description

The GCTS Point Load Tester is an apparatus made of high strength anodized aluminum that incorporates digital technology to increase precision and ease of use while reducing its size and mass. The introduction of a pressure sensor to measure load provides a better accuracy at any load level eliminating the imprecision of the traditional pressure gauges at low load ranges.

The system has a digital display that continuously monitors the applied load. An optional second display provides specimen size in millimeters (or inches). The maximum load is automatically stored and easily obtainable by pressing a button. An advanced option for this system are the ultrasonic platens for the measurement of P-wave (compressional wave) velocity. The P-wave velocity is a more rational method and gives a better correlation to strength than the point load index. The major advantage of the ultrasonic velocity option is that, as with the point load test, it does not require expensive specimen preparation. The P-wave velocity is measured during the point load test.

Other options include: platens, triaxial cells, and frames for performing uniaxial and triaxial tests on small specimens. These options include software that captures the complete stress-strain curve and automatically calculates the parameters.



PLT software.

# Digital Rock Direct Shear System

## RDS-100

- Manual control of double acting (push/pull) 100 kN shear load actuator with 25 mm stroke & 50 kN normal load capacity with 25 mm stroke
- Normal load stiff reaction frame mounted on sliding bearings to minimize horizontal friction while keeping the normal load vertical throughout the full shear displacement
- 150 mm (6 inch) inside diameter sample rings for specimens up to 150 mm high
- Precise digital display with peak value memory
- A/D automatic data acquisition with USB interface
- Windows XP/Vista/7 software for automatic data logging and reporting of direct shear tests with real time graphical display of test progress
- Economically priced



## Specifications

Load Capacity	100 kN shear, 50 kN normal
Shipping Volume	1.4 m <sup>3</sup>
Shipping Mass	600 kg
Stroke	25 mm shear & normal
Specimen diameter	150 mm
Specimen height	150 mm

## Accessories

1. 150 mm diameter specimen rings.
2. 100 mm diameter specimen rings.
3. Specimen ring holder for 150 mm diameter.
4. Specimen ring holder for 100 mm diameter.
5. Grouting compound for specimen preparation.

For more accessories please contact GCTS.

## Description

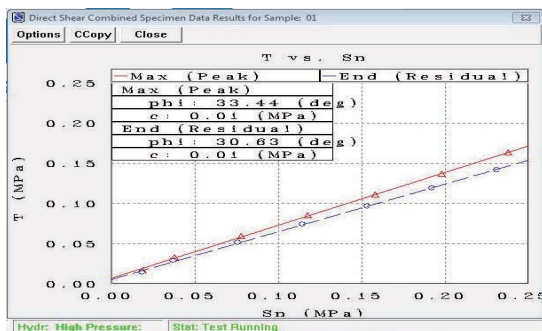
The GCTS Direct Shear System for testing rocks is a simple and inexpensive device for testing a wide range of rock specimen configurations. Cylindrical cores, cubes, prisms, and rock fragments of irregular shape can be used to determine the shear strength.

The system features electronic sensors and digital displays to monitor the loads and deformations. A standard A/D automatic data acquisition with USB interface is included with the system to automatically log and reduce the test data. The included software program accepts inputs from the shear and normal load sensors, the shear deformation, and up to four normal deformation sensors (the software calculates automatically the average normal deformation).

Two air/oil booster pumps operating from 800 kPa (100 psi) compressed air allow the user to easily set and maintain the normal load and shear displacement rate. Pressure sensors are used to monitor the loads but load cells are also offered as an option. The shear pump includes a 4-way valve to easily reverse the loading direction. The air/oil booster pumps, digital displays and all the control valves are set on an easy-to-use front panel housed in a metal cabinet.

Specimens are cured within removable specimen rings and then dropped inside the shear box allowing the preparation of multiple specimens using additional rings, increasing test production.

GCTS also offers a fully computer controlled servo-hydraulic direct shear machine (see RDS-200).

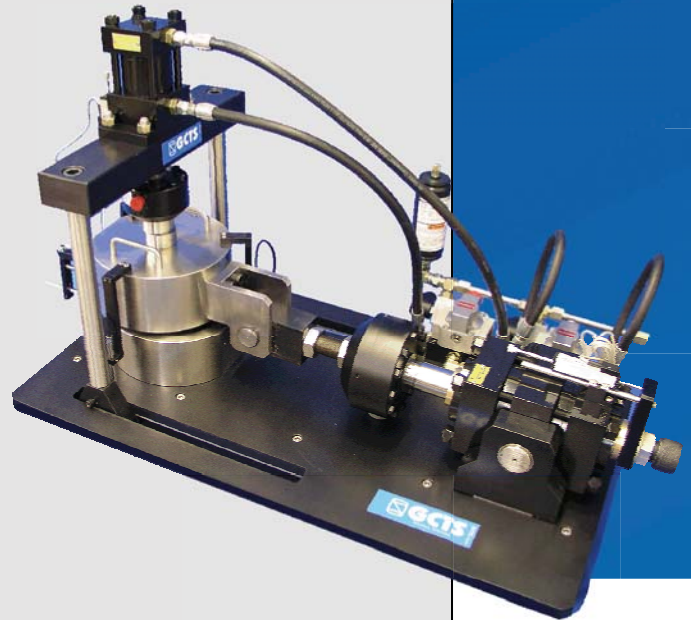


CATS Direct Shear Software.

# Servo Controlled Rock Direct Shear System

## RDS-200

- Closed loop servo control of double acting (push/pull) 100 kN shear load actuator with 25 mm stroke and 50 kN normal load capacity with 25 mm stroke
- Normal load stiff reaction frame mounted on sliding bearings to minimize horizontal friction while keeping the normal load vertical throughout the full shear displacement
- 150 mm (6 inch) inside diameter sample rings for specimens up to 150 mm high
- Software for automatic performance of direct shear tests with constant normal stress or normal stiffness
- Real time graphical display of test progress
- Other load capacities and specimen sizes are available, including large-scale test systems for shear loads of up to 1,000 kN and specimen sizes up to 300 mm diameter or side



## Specifications

Load Capacity	100 kN shear, 50 kN normal
Shipping Volume	2.7 m <sup>3</sup>
Shipping Mass	1,100 kg
Stroke	25 mm shear & normal
Specimen diameter	150 mm
Specimen height	150 mm

## Accessories

1. 150 mm diameter specimen rings.
2. 100 mm diameter specimen rings.
3. Specimen ring holder for 150 mm diameter.
4. Specimen ring holder for 100 mm diameter.
5. Grouting compound for specimen preparation.

For more accessories please contact GCTS.



Specimen rings with ring holder / shear gap spacer.

## Description

The GCTS Rock Direct Shear system is a computer controlled, easy to use device for testing a wide range of rock specimen configurations. Cylindrical cores, cubes, prisms, and rock fragments of irregular shape can be used to determine the shear strength. This system features electro-hydraulic closed loop digital servo control of the shear and normal loads for test automation. The included software program accepts inputs from the normal load sensor and up to four normal deformation sensors (software calculates automatically the average normal deformation). Loads or deformations for both the shear and normal actuators can be prescribed for automatically performing advanced tests such as the constant or calculated normal stiffness direct shear test.

Specimens are cured within removable specimen rings and then dropped inside the shear box allowing the preparation of multiple specimens using additional rings, increasing the test production.

Also available, as an alternative, is an economical Digital Direct Shear system (RDS-100) driven with manual pumps.

# Servo Controlled Rock Direct Shear System

## RDS-300

- Closed loop servo control of double acting (push/pull) 300 kN shear load actuator with  $\pm 50$  mm stroke and 300 kN normal load capacity with 100 mm stroke
- Includes adjustable locking mechanism to prevent rotation of the top box in any one direction, two directions, or none (fixed so that no shear plane rotations are allowed)
- Accepts 150 mm (6 inch) diameter samples as well as 100 mm x 100 mm cubical specimens up to 150 mm high
- Software for automatic performance of direct shear tests with constant normal stress or normal stiffness
- Other load capacities and specimen sizes are available, including large-scale test systems for shear loads of up to 1,000 kN and specimen sizes up to 300 mm diameter or side



## Specifications

Load Capacity	300 kN shear, 300 kN normal
Shipping Volume	2.7 m <sup>3</sup>
Shipping Mass	1,100 kg
Stroke	$\pm 50$ mm shear, 100 mm normal
Specimen diameter	150 mm
Specimen height	150 mm

## Accessories

1. 150 mm diameter specimen rings.
2. 100 mm diameter specimen rings.
3. Specimen ring holder for 150 mm diameter.
4. Specimen ring holder for 100 mm diameter.
5. Grouting compound for specimen preparation.

For more accessories please contact GCTS.

## Description

The GCTS Rock Direct Shear system is a versatile device for testing a wide range of rock specimen configurations. Cylindrical cores, cubes, prisms, and rock fragments of irregular shape can be used for determine the shear strength. This system features electro-hydraulic closed loop digital servo control of the shear and normal loads for test automation. The included software program accepts inputs from the normal load sensor and up to four normal deformation sensors (software calculates automatically the average normal deformation). Loads or deformations for both the shear and normal actuators can be prescribed for automatically performing advanced tests such as the constant or calculated normal stiffness direct shear test.

The GCTS software calculates automatically the corrected specimen area, the normal and shear stresses, shear deformation, and the average normal deformation. Loads, stresses or deformations for both the shear and normal actuators can be directly prescribed to perform advanced tests. The hydraulic servo control of the normal load has a very low compliance that enables the precise performance of tests such as normal stiffness control test, where the normal deformation is a function of a prescribed stiffness to simulate actual compressibility of a ground shear plane.

Also available, as an alternative, is an economical Digital Direct Shear system (RDS-100) driven with manual pumps.

# Servo Controlled Rock Direct Shear System

## RDS-500

- Closed loop servo control of double acting (push/pull) 300 kN shear load actuator with  $\pm 50$  mm stroke
- 1,500 kN normal load capacity with 100 mm stroke
- Includes adjustable locking mechanism to prevent rotation of the top box in any one direction, two directions, or none (fixed so that no shear plane rotations are allowed)
- Accepts 150 mm (6 inch) diameter samples as well as 100 mm x 100 mm cubical specimens up to 150 mm high
- Software for automatic performance of direct shear tests with constant normal stress or normal stiffness
- Capable of performing unconfined uniaxial or triaxial tests with optional hardware



## Specifications

Load Capacity	300 kN shear, 1,500 kN normal
Shipping Volume	7.0 m <sup>3</sup>
Shipping Mass	2,100 kg
Stroke	$\pm 50$ mm shear, 100 mm normal
Specimen diameter	150 mm
Specimen height	150 mm

## Accessories

1. 150 mm diameter specimen rings.
2. 100 mm diameter specimen rings.
3. Specimen ring holder for 150 mm diameter.
4. Specimen ring holder for 100 mm diameter.
5. Grouting compound for specimen preparation.

For more accessories please contact GCTS.

## Description

The GCTS RDS-500 Rock Direct Shear and Triaxial system is a versatile device for testing a wide range of rock specimen configurations. Cylindrical cores, cubes, prisms, and rock fragments of irregular shape can be used for determine the shear strength.

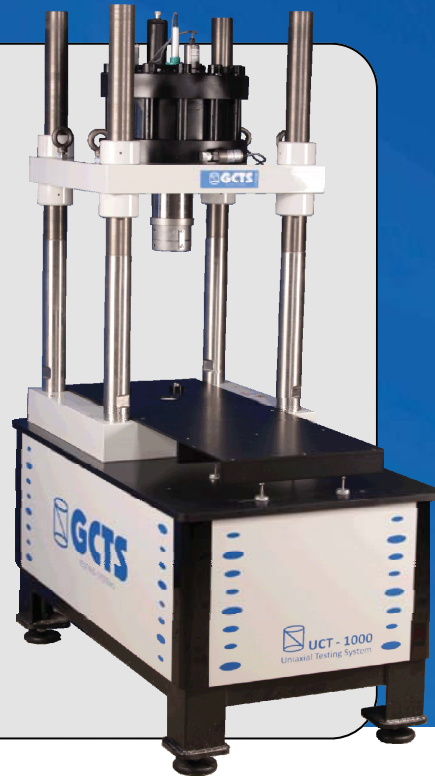
This system features electro-hydraulic closed loop digital servo control of the shear and normal loads for test automation. The included software program accepts inputs from the normal load sensor and up to four normal deformation sensors (software calculates automatically the average normal deformation). Loads or deformations for both the shear and normal actuators can be prescribed for automatically performing advanced tests such as the constant or calculated normal stiffness direct shear test.

This system can be upgraded with a triaxial cell, pressure intensifiers, unconfined loading platens, indirect tension (Brazilian) platens, and other fixtures to perform most of the laboratory mechanical tests required for rocks.

# Uniaxial Testing System

## UCT-1000

- Compression and tension loading system with electro-hydraulic closed loop digital servo control
- Static and dynamic loading capabilities
- Adjustable crosshead design
- Accepts GCTS high pressure triaxial cell & other testing components
- Ideal for performing unconfined compression, bending, indirect tension, fracture, creep, and other material tests
- Available systems with load capacities up to 4,500 kN (1,000 kip) and stiffness up to 10,000 kN/mm
- Economical “turn key” systems built to customer specifications



## Specifications

Compression load capacity	1,000 kN
Tension load capacity	800 kN
Stiffness	700 kN/mm
Stroke	100 mm
Distance between columns	400 mm
Distance between platens	600 mm
Shipping Volume	4.8 m <sup>3</sup>
Shipping Mass	1,700 kg

## Accessories

1. Platens for uniaxial rock and concrete testing.
2. Brazilian indirect tension test.
3. On-specimen axial and radial measurements.
4. Flexural bending fixture.
5. Rock triaxial cell.

For more accessories please contact GCTS.

## Description

GCTS Uniaxial Testing Systems include our state of the art SCON-1500 Digital Signal Conditioning & Servo Controller CATS software. The system is capable of performing static and dynamic closed loop load, deformation, strain or any other measured or calculated parameter. Automatic “bumpless” or smooth control transfer can be programmed at any test stage. The true 32 bit Windows software allows sending directly your test data to any computer connected to your local network. Using a Windows network system in your laboratory facilities the transferring of your test data directly into other Windows programs such as Word or Excel for report generation as well as to easily backup your important test results.

GCTS offers load frames with load capacities up to 4,500 kN. Accessories for unconfined testing as well as bending and indirect tension fixtures are available.



Brazilian indirect tension fixture.

# Rapid Triaxial Rock Testing System

## RTR-1000

- GCTS high pressure triaxial cell with hydraulic lift
- Ideal for production tests facilities
- Load capacities up to 1,500 kN (340 kips) & stiffness up to 10,000 kN/mm
- Larger load capacities available upon request
- Closed loop digital servo control
- Integrated confining & pore pressure panel with dual intensifiers
- Pressures up to 210 MPa (30,000 psi)
- 24 electrical feed through lines ( 6 connectors) for internal instrumentation such as load cells, LVDT's, thermocouples, ultrasonic velocity & acoustic emission sensors
- Economical turn-key systems built to customer specifications



## Specifications

Compression load capacity	1,000 kN
Tension load capacity	800 kN
Stiffness	1,750 kN/mm
Stroke	50 mm
Distance between columns	380 mm
Distance between platens	850 mm
Shipping Volume	8.0 m <sup>3</sup>
Shipping Mass	3,800 kg

## Accessories

1. Ultrasonic velocity measurement apparatus.
2. High temperature upgrade up to 200 °C.
3. Confining and pore pressure upgrade to 210 MPa.
4. Hydraulic fracturing platens.
5. Silent flow hydraulic power supply.

For more accessories please contact GCTS.

## Description

GCTS Rapid Triaxial Rock testing systems are typically operated with our new digital servo control and data acquisition package that includes Windows (XP, Vista, 7) testing software and digital signal conditioning system.

An automatic hydraulic lift and a sliding base for the triaxial cell are included with this system for fast and easy specimen setup. Fast assembly/disassembly of the cell is achieved with the push of a single button. No bolts or other fasteners are used to assemble the triaxial cell, resulting in more time dedicated to testing.

The RTR-1000 is operated with our fully integrated SCON-2000 digital signal conditioning and control unit with the state of the art CATS Triaxial Rock software. Conducting triaxial tests has been greatly simplified by the incorporation of direct user programming of test calculated parameters in the units of interest (stress, strain, etc.) based on the specimen dimensions. Up to 20 test parameters are automatically defined and corrected taking into account such things as piston uplift force from confining pressure application and changes in specimen area during the test. Using calculated test parameters directly eliminates complex and lengthy pre-calculations to design test programs. This allows the user to concentrate on the material behavior rather than on the electronics and equipment operation.

# Stiff Rapid Triaxial Rock Testing System

## RTR-1500

- GCTS high pressure triaxial cell with hydraulic lift
- Ideal for production tests facilities
- Load capacities up to 1,500 kN (340 kips) & stiffness up to 10,000 kN/mm
- Larger load capacities available upon request
- Closed loop digital servo control
- Integrated confining & pore pressure panel with dual intensifiers
- Pressures up to 210 MPa (30,000 psi)
- 24 electrical feed through lines ( 6 connectors) for internal instrumentation such as load cells, LVDT's, thermocouples, ultrasonic velocity & acoustic emission sensors
- Economical turn-key systems built to customer specifications



## Specifications

Compression load capacity	1,500 kN
Tension load capacity	820 kN
Stiffness	10,000 kN/mm
Stroke	50 mm
Distance between columns	380 mm
Distance between platens	850 mm
Shipping Volume	9.0 m <sup>3</sup>
Shipping Mass	4,500 kg

## Accessories

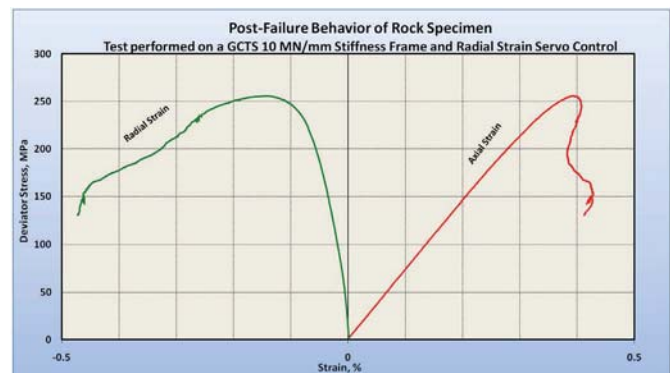
1. Ultrasonic velocity measurement apparatus.
2. High temperature upgrade up to 200 °C.
3. Confining and pore pressure upgrade to 210 MPa.
4. Hydraulic fracturing platens.
5. Silent flow hydraulic power supply.

For more accessories please contact GCTS.

## Description

The GCTS RTR-1500 is very high stiffness test system capable of obtaining post-failure behavior of most rocks. This system includes not only a stiff frame but also stiff components to eliminate soft links in the system. Every element from the actuator, loading shaft, to the load cell have been designed to maintain the maximum stiffness of the complete test system.

An automatic hydraulic lift and a sliding base for the triaxial cell are included with this system for fast and easy specimen setup. Fast assembly/disassembly of the cell is achieved with the push of a single button. No bolts or other fasteners are used to assemble



Post failure behavior of rock specimen.

# Triaxial Rock Testing System

## RTX-1000

- 1,000 kN axial load and 70 MPa (10,000 psi) confining pressure capacity
- Direct closed loop digital servo control of axial stress, axial strain, radial strain, and several other calculated triaxial variables
- GCTS high pressure triaxial cell with internal instrumentation to measure local axial & radial strains
- Ideal for performing unconfined compression, triaxial, bending, direct and indirect tension, fracture, creep, post failure behavior & other compression tests.
- Integrated confining & pore pressure panel with dual intensifiers
- Pressures up to 210 MPa (30,000 psi)
- Economical turn-key systems built to customer specifications



## Specifications

Compression load capacity	1,000 kN
Tension load capacity	800 kN
Stiffness	1,750 kN/mm
Stroke	50 mm
Distance between columns	380 mm
Distance between platens	850 mm
Shipping Volume	8.0 m <sup>3</sup>
Shipping Mass	3,800 kg

## Accessories

1. Ultrasonic velocity measurement apparatus.
2. High temperature upgrade up to 200 °C.
3. Confining and pore pressure upgrade to 210 MPa.
4. Hydraulic fracturing platens.
5. Silent flow hydraulic power supply.

For more accessories please contact GCTS.

## Description

GCTS triaxial rock testing systems are manufactured according to your design specifications as load capacity and system stiffness, sample size, confining and pore pressures, internal instrumentation, temperature upgrade, and ultrasonic velocity measurements are all options available for system customization. The top cross-head height can be adjusted to accommodate a wide variety of test specimens and triaxial cells. The RTX-1000 meets the specifications of the International Society of Rock Mechanics (ISRM) for triaxial testing of rock samples.

The system is capable of performing static and dynamic closed loop strain or stress controlled as well as post failure behavior tests. Included with this system is our Windows software. It allows sending directly your test data to any computer connected to your local network. Our new software includes database system to keep track of all the data generated at your lab with any of our testing systems. Using a Windows network system in your lab facilities the transferring of your test data directly into other Windows programs such as Word or Excel for report generation as well as to easily backup important test results.

The system manages all the instrumentation and continuously monitors sensor outputs to accurately account for uplift pressures acting on the loading piston, area changes, deformation and volume change sensors setup and repositioning.

# Triaxial Rock Testing System

## RTX-1500

- Direct closed loop digital servo control of axial stress, axial strain, radial strain, and several other calculated triaxial variables
- Standard 1,500 kN axial load capacity and 1,750 kN/mm stiffness
- GCTS high pressure triaxial cell with internal instrumentation to measure local axial & radial strains
- 140 MPa servo controlled pressure intensifier system for cell and pore pressure
- Available options: axial & circumferential deformation measurement system, platens with ultrasonic transducers, and high temperature control system
- Pressures up to 210 MPa (30,000 psi)
- Economical turn-key systems built to customer specifications



## Specifications

Compression load capacity	1,500 kN
Tension load capacity	820 kN
Stiffness	1,750 kN/mm
Stroke	50 mm
Distance between columns	400 mm
Distance between platens	800 mm
Shipping Volume	8.0 m <sup>3</sup>
Shipping Mass	3,900 kg

## Accessories

1. Ultrasonic velocity measurement apparatus.
2. High temperature upgrade up to 200 °C.
3. Confining and pore pressure upgrade to 210 MPa.
4. Hydraulic fracturing platens.
5. Silent flow hydraulic power supply.

For more accessories please contact GCTS.

## Description

GCTS triaxial rock testing systems are manufactured according to your design specifications as load capacity and system stiffness, sample size, confining and pore pressures, internal instrumentation, temperature upgrade, and ultrasonic velocity measurements are all options available for system customization. The top cross-head height can be adjusted to accommodate a wide variety of test specimens and triaxial cells. The RTX-1500 meets the specifications of the International Society of Rock Mechanics (ISRM) for triaxial testing of rock samples.

The system is capable of performing static and dynamic closed loop strain or stress controlled as well as post failure behavior tests. Included with this system is our Windows software. It allows sending directly your test data to any computer connected to your local network. Our new software includes database system to keep track of all the data generated at your lab with any of our testing systems. Using a Windows network system in your lab facilities the transferring of your test data directly into other Windows programs such as Word or Excel for report generation as well as to easily backup important test results.

The system manages all the instrumentation and continuously monitors sensor outputs to accurately account for uplift pressures acting on the loading piston, area changes, deformation and volume change sensors setup and repositioning.

# Triaxial Rock Testing System

## RTX-3000

- 3,000 kN axial load and 70 MPa (10,000 psi) confining pressure capacity
- Direct closed loop digital servo control of axial stress, axial strain, radial strain, and several other calculated triaxial variables
- GCTS high pressure triaxial cell with internal instrumentation to measure local axial & radial strains
- Ideal for performing unconfined compression, triaxial, bending, direct and indirect tension, fracture, creep, post failure behavior & other compression tests.
- Integrated confining & pore pressure panel with dual intensifiers
- Pressures up to 210 MPa (30,000 psi)
- Economical turn-key systems built to customer specifications



## Specifications

Compression load capacity	3,000 kN
Tension load capacity	1,000 kN
Stiffness	500 kN/mm
Stroke	50 mm
Distance between columns	410 mm
Distance between platens	600 mm
Shipping Volume	9.0 m <sup>3</sup>
Shipping Mass	4,500 kg

## Accessories

1. Ultrasonic velocity measurement apparatus.
2. High temperature upgrade up to 200 °C.
3. Confining and pore pressure upgrade to 210 MPa.
4. Hydraulic fracturing platens.
5. Silent flow hydraulic power supply.

For more accessories please contact GCTS.

## Description

GCTS triaxial rock testing systems are manufactured according to your design specifications as load capacity and system stiffness, sample size, confining and pore pressures, internal instrumentation, temperature upgrade, and ultrasonic velocity measurements are all options available for system customization. The top cross-head height can be adjusted to accommodate a wide variety of test specimens and triaxial cells. The RTX-3000 meets the specifications of the International Society of Rock Mechanics (ISRM) for triaxial testing of rock samples.

The system is capable of performing static and dynamic closed loop strain or stress controlled as well as post failure behavior tests. Included with this system is our Windows software. It allows sending directly your test data to any computer connected to your local network. Our new software includes database system to keep track of all the data generated at your lab with any of our testing systems. Using a Windows network system in your lab facilities the transferring of your test data directly into other Windows programs such as Word or Excel for report generation as well as to easily backup important test results.

The system manages all the instrumentation and continuously monitors sensor outputs to accurately account for uplift pressures acting on the loading piston, area changes, deformation and volume change sensors setup and repositioning.

# Pressure Intensifier System

## HPVC-070/140/210

- Closed loop digital servo control of pressure or flow (volume) with bump-less transfer
- 210 MPa (30,000 psi) pressure range
- 500 cm<sup>3</sup> stroke capacity
- Stainless steel construction
- Can be used as a volume change measurement device for triaxial and permeability testing
- Larger pressure and volume stroke capacities also available



## Specifications

Control precision	Better than $\pm 0.1$ MPa (15 psi)
Pressure transducer resolution	0.02 MPa
Volume transducer resolution	0.01 cc
Analog pressure test gauge accuracy	$\pm 0.25\%$
Fluid media compatibility	oil and water
Fluid reservoir capacity	19 liter (5 gallon)
Required pressure input	21 MPa (3,000 psi)

## Shipping

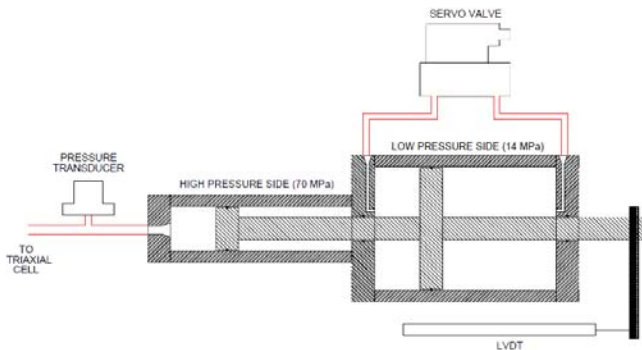
Mass:	285 kg
Dimensions:	0.85 m x 0.85 m x 2.0 m (WxDxH)

## Description

GCTS pressure intensifiers are ideal for the servo control of the cell pressure in triaxial tests, head pressure in permeability tests, or fluid pressure in hydro-fracture tests. This intensifier can also be used to measure flow in permeability tests and volume change in triaxial tests while applying prescribed pressures. Together with GCTS digital servo controller and the triaxial software, it allows the performance of more advanced tests such as stress/strain path.

The HPVC system is mounted in a metal cabinet on casters to house the confining pressure/volume servo controlled intensifier, fluid reservoir, sight level gage, and venturi vacuum pump. All valves are mounted on the front panel for easy intensifier operation and filling or draining the cell.

GCTS makes a dual piston intensifier model for tests where continuous flow is required and pressure spikes cannot be tolerated. These models include two intensifiers and two servo valves together with the necessary check valves, plumbing, and special control software for automatic operation. Also available, as an alternative, is an economical air/oil pressure booster. These units operate with 700 kPa (100 psi) air pressure input for a 70 MPa (10,000 psi) output. GCTS pressure boosters offer a low cost, trouble free operation and are ideal for use in creep and sustained loading in long term tests.



HPVC pressure intensifier

# Fast Pulse Decay Permeability Apparatus

## HPPD-20

- Apparatus for measurement of rock permeability using the Fast Pulse Decay method
- Two (2) 2,000 cc volume stainless steel reservoirs
- Two (2) 500 cc volume stainless steel reservoirs
- Nine (9) zero volume change ball valves
- Two (2) pressure transducers
- 20 MPa pressure capacity
- Integrated temperature control system inside the cabinet



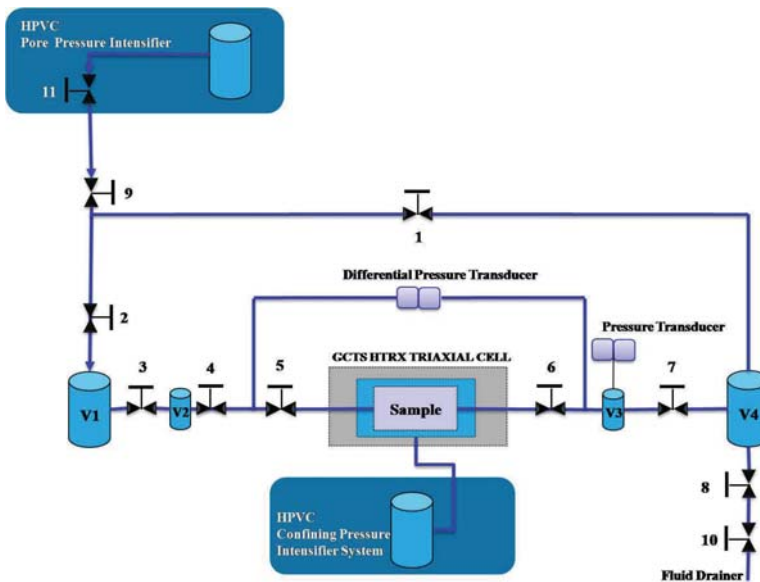
## Description

The GCTS Fast Pulse Decay Permeability Apparatus (HPPD-20) is designed for measurement of permeability in micro-porous material such as a gas shale and other reservoir rock, in order to determine the capacity and flow characteristics of the rock matrix. HPPD-20 is capable of measuring rock permeability less than  $1 \mu\text{D}$  (microdarcy).

HPPD-20 includes two large stainless steel reservoirs with 2,000 cc volume capacity each and two smaller stainless steel reservoirs each with 500 cc volume capacity. Also included are nine zero volume change ball valves and one needle valve for precise flow control.

The system components are secured in an insulated meal cabinet with front panel mounted valves and controls. The system also features precise temperature control inside the cabinet for elimination of any errors from temperature induced volume expansion or contraction of the fluid and gas inside the reservoirs.

HPPD-20 includes all necessary valves and fluid lines to perform the Fast Pulse Decay permeability tests when used with any of the GCTS triaxial systems.



HPPD-20 system schematic

# High Pressure Triaxial Cells

## HTRX-010 / 070/ 140 /210

- Pressure capacity: 10, 70 , 140 and 210 MPa
- Stainless steel construction
- Accepts samples with a diameter from 25 mm to 100 mm with length of 2 times the diameter
- Upper platen provided with a spherical seat to compensate for non-parallel specimen ends
- Top & bottom pore pressure plumbing provided for effective stress and permeability measurements
- Electrical feed through connectors for GCTS axial and circumferential deformation measurement devices, ultrasonic sensors, and other special transducers
- Built to customer specifications
- Hydraulic balance option available for each cell



## Specifications

Pressure capacity	Up to 210 MPa
Specimen diameter	Up to 100 mm
Material	Stainless steel
Temperature Rating	200 °C

## Accessories

1. Ultrasonic velocity measurement platens.
2. Axial and circumferential deformation package.
3. High & low temperature control subsystem.
4. Hydraulic lift and locking.



Automatic cell assembly

## Description

The GCTS high pressure triaxial cells were designed for testing rock specimens with diameter up to 100 mm (4 inch) and 200 mm (8 inch) lengths at confining pressures of up to 210 MPa and axial loads of up to 4,500 kN. Other specimen diameters can also be tested with the use of optional platens.

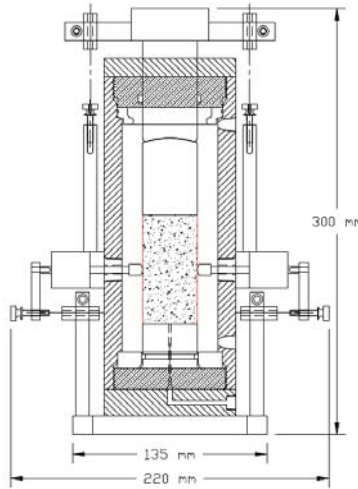
The 150 mm inside diameter of the cell wall and the electrical feed through connectors installed at the cell base allow the use of in-vessel instrumentation for precise measurements of deformation modulus and Poisson's ratio. The standard specimen platens have o-ring grooves for sealing the specimen jacket and an upper spherical seat to minimize stress concentrations due to non-parallel specimen ends. Pore fluid lines and ports for both, upper and lower platens, are also standard for effective stress and permeability measurements.

Cell and pore fluid connectors are provided at the cell base for easy interface with either the GCTS computer servo controlled pressure intensifier or the GCTS air/oil pressure booster system. A loading piston with spherical seating is also provided with this triaxial cell.

The typical triaxial cell includes 4 electrical feed through connectors with 4 lines each (16 electrical lines total) to connect a variety of internal sensors such as deformation gauges, P & S wave velocity transducers and acoustic emission sensors. Additional feed throughs can be supplied.

# GCTS Rock Triaxial Cells

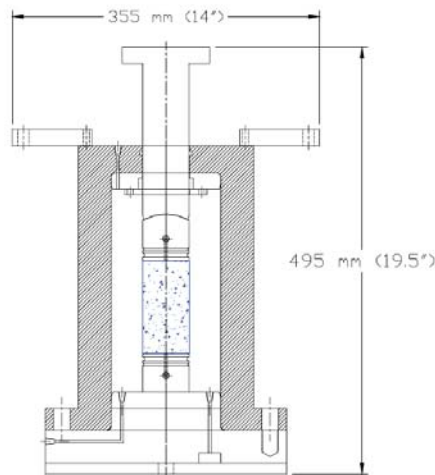
## HTRX-010



### Specifications

<b>Pressure capacity:</b>	70 MPa (10,000 psi)
<b>Internal diameter (ID):</b>	67 mm (2.5 in)
<b>Overall width:</b>	220 mm (8.7 in)
<b>Overall height:</b>	300 mm (11.8 in)
<b>Mass:</b>	18 kg (40 lbf)
<b>Max. specimen size with internal instrumentation:</b>	
<b>Diameter:</b>	54.7 mm (2.125 in)
<b>Height:</b>	108 mm (4.25 in)

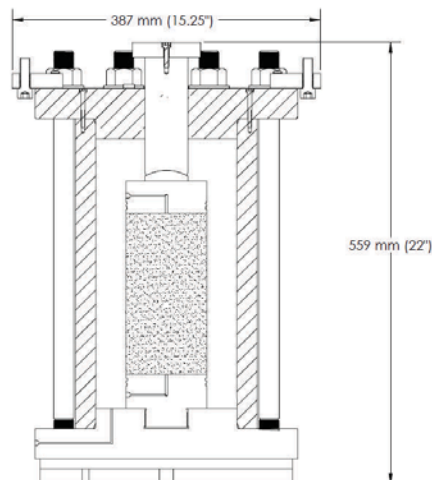
## HTRX-070



### Specifications

<b>Pressure capacity:</b>	70 MPa (10,000 psi)
<b>Internal diameter (ID):</b>	127 mm (5 in)
<b>Overall width:</b>	355 mm (14 in)
<b>Overall height:</b>	495 mm (19.5 in)
<b>Mass:</b>	111 kg (245 lbf)
<b>Max. specimen size with internal instrumentation:</b>	
<b>Diameter:</b>	54.7 mm (2.125 in)
<b>Height:</b>	108 mm (4.25 in)

## HTRX-070L



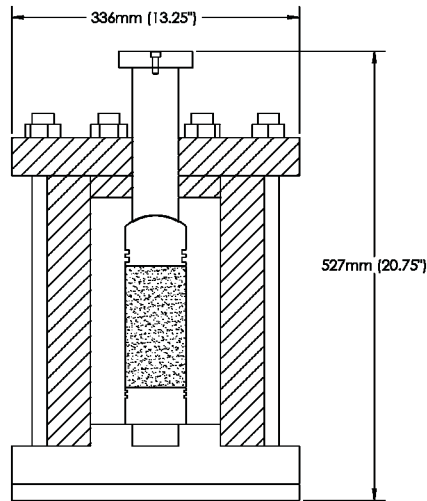
### Specifications

<b>Pressure capacity:</b>	70 MPa (10,000 psi)
<b>Internal diameter (ID):</b>	178 mm (7 in)
<b>Overall width:</b>	387 mm (15.25 in)
<b>Overall height:</b>	559 mm (22 in)
<b>Mass:</b>	135 kg (298 lbf)
<b>Max. specimen size with internal instrumentation:</b>	
<b>Diameter:</b>	100 mm (4 in)
<b>Height:</b>	200 mm (8 in)

# GCTS Rock Triaxial Cells



## HTRX-140

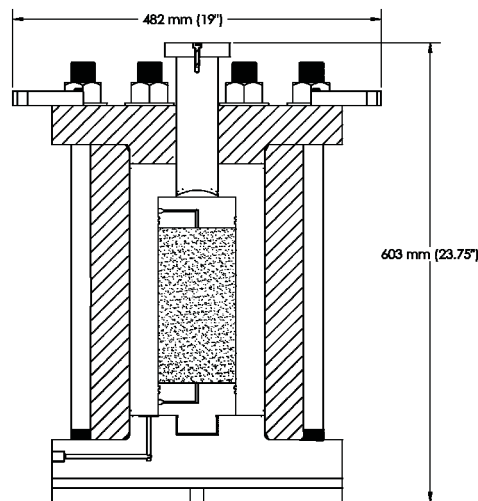


### Specifications

<b>Pressure capacity:</b>	140 MPa (20,000 psi)
<b>Internal diameter (ID):</b>	152 mm (6 in)
<b>Overall width:</b>	381 mm (15 in)
<b>Overall height:</b>	635 mm (25 in)
<b>Mass:</b>	119 kg (262 lbf)
<b>Max. specimen size with internal instrumentation:</b>	
<b>Diameter:</b>	76 mm (3 in)
<b>Height:</b>	152 mm (6 in)



## HTRX-140XL

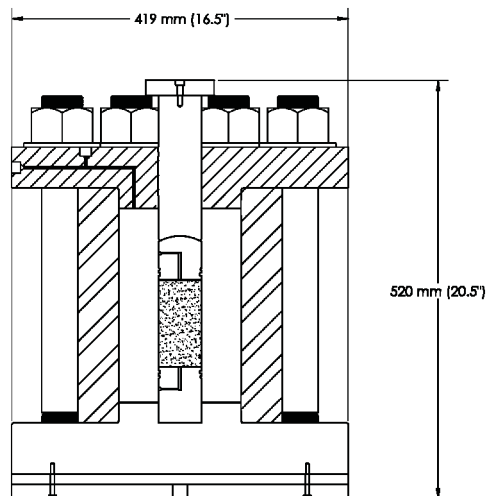


### Specifications

<b>Pressure capacity:</b>	140 MPa (20,000 psi)
<b>Internal diameter (ID):</b>	178 mm (7 in)
<b>Overall width:</b>	482 mm (19 in)
<b>Overall height:</b>	603 mm (23.75 in)
<b>Mass:</b>	248 kg (546 lbf)
<b>Max. specimen size with internal instrumentation:</b>	
<b>Diameter:</b>	100 mm (4 in)
<b>Height:</b>	200 mm (8 in)



## HTRX-210



### Specifications

<b>Pressure capacity:</b>	210 MPa (30,000 psi)
<b>Internal diameter (ID):</b>	152 mm (6 in)
<b>Overall width:</b>	419 mm (16.5 in)
<b>Overall height:</b>	520 mm (20.5 in)
<b>Mass:</b>	278 kg (612 lbf)
<b>Max. specimen size with internal instrumentation:</b>	
<b>Diameter:</b>	76 mm (3 in)
<b>Height:</b>	152 mm (6 in)

# Rock Deformation Device

## DEF-5000

- Available sizes for specimen diameter from 25 mm to 150 mm
- Measures axial and lateral strains directly on the test specimen
- Two axial sensors & one circumferential sensor
- Uses LVDTs for ease of operation
- Models available for up to 210 MPa pressure and up to 200 °C temperature testing
- Very easy to setup and use



## Specifications

Model #	Specimen diameter (mm)	LVDT range (mm)
DEF-5100	25 to 55	5
DEF-5200	50 to 75	5
DEF-5300	70 to 100	10

## Shipping

Mass: 4 kg  
 Dimensions: 0.3 m x 0.3 m x 0.3m (WxDxH)

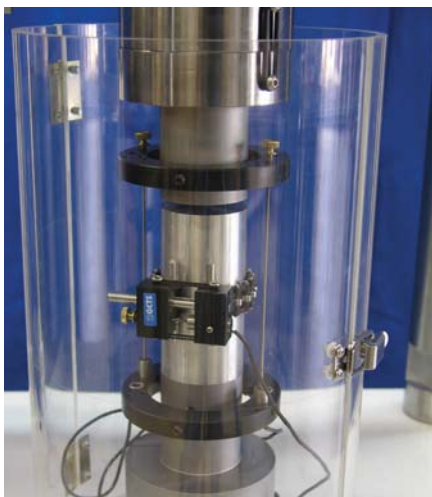
## Description

The GCTS rock deformation device measures axial and lateral strains directly on the specimen providing accurate results. The device consists of an upper and lower support ring machined with a low weight, high strength design. The rings include spring loaded set screws to allow for specimen expansion during loading. A set of perforated rods with preset lengths are included to position the axial rings at predefined gage lengths without difficulty.

The circumferential device is built with small, high precision rollers and stiff linkages for high accuracy strain measurements. Thumb screws are also provided to easily null the LVDT sensors.

The GCTS rock deformation device is available in standard sizes as well as in custom sizes with LVDT deformation ranges from 2 to 10 mm.

This device can be used within our high pressure triaxial cell and also used for elevated or cold temperature testing. Elastic constants such as Young's modulus and Poisson's ratio can be determined as well as inelastic strains that occur after sample failure (post failure behavior). Direct servo control of axial or radial strains can be performed with this device.



Unconfined testing setup.

# Differential Strain Curve Analysis Measurement Device

## DSA-12

- Measurement device for Differential Strain Curve Analysis (DSCA)
- Includes twelve (12) high pressure LVDT sensors for strain measurement
- Support base and LVDT holders with anodized high-quality aluminum construction
- Stainless steel sliding rail for fast and precise positioning of sensors onto the samples with different dimensions
- Interchangeable flat or pointed LVDT ends for suitable contact with the specimen
- Accommodates cubical rock samples with maximum dimensions of 50 mm x 50 mm x 50 mm
- Optional hydrostatic high pressure triaxial cell with pressure capacity of 140 MPa (20,000 psi)
- Requires signal conditioning and data acquisition unit for the sensors



## Specifications

Pressure capacity	Up to 140 MPa
Specimen dimensions	50 x 50 x 50 (mm) cube
Number of LVDTs	12
Material	Anodized aluminum
Shipping mass	2 kg

## Accessories

1. HTRX-DSA high pressure hydrostatic/triaxial cell.
2. Signal conditioning and data acquisition unit.

## Description

The GCTS differential strain curve measurement device (DSA-12) is designed for testing cubical rock specimens under hydrostatic conditions in order to determine the in-situ stress state. The results obtained using the DSA-12 allow for characterization of the distribution of crack porosity with crack closure pressure as well as the crack orientation as a function of crack closure pressure amongst other parameters.

The DSA-12 comes with twelve high precision LVDTs vented for pressures up to 140 MPa with cables to connect to electrical feed throughs inside the triaxial cell.

GCTS offers the hydrostatic triaxial cell (HTRX-DSA) with 140 MPa pressure capacity. HTRX-DSA features stainless steel construction with 16 feed through lines, 4 clusters of 4 lines, for in-vessel instrumentation, 3 fluid pressure connectors (cell, drainage and bleed ports), 100 mm (4 inch) inside diameter. HTRX-DSA accommodates DSA-12 device with the 12 LVDTs and 50 mm x 50 mm x 50 mm cubical rock specimens.

For pricing information please contact us at [sales@gcts.com](mailto:sales@gcts.com).

# Rock Abrasiveness Apparatus

## RAA-100

- Measurement apparatus for determination of rock abrasiveness as specified by the Cerchar test
- Meets ASTM D7625 specifications
- Precision slide for smooth movement with graduated knob for accurate scratch distance control with 0.01 mm precision
- Includes one hundred (100) sharp steel indenters with hardness of  $200 \text{ kg/mm}^2$  and  $90^\circ$  cone angle according to Cerchar test
- Aluminum mass crosshead with stainless steel linear ball bearings for easy application of required 70 N force
- Accepts specimens with maximum width of 76 mm (3 in) and 150 mm height (6 in)
- Rock holding vice with anodized aluminum jaws for firm no-slip grip during the test



## Specifications

Specimen diameter	Up to 100 mm (4 inch)
Apparatus material	Anodized aluminum
Shipping mass	20 kg

## Accessories

1. Microscope
2. Steel indenters

## Description

The GCTS Rock Abrasiveness Apparatus (RAA-100) is used for measurement of rock abrasiveness under the standards specified by the Cerchar test. The test consists of measuring the wear flat on the standard steel indenter with  $200 \text{ kg/mm}^2$  hardness loaded with 70 N force, after it has scratched 10 mm distance on the rock surface. The indenter is examined under the microscope and the amount of wear is correlated to the Cerchar Abrasiveness Index (CAI).

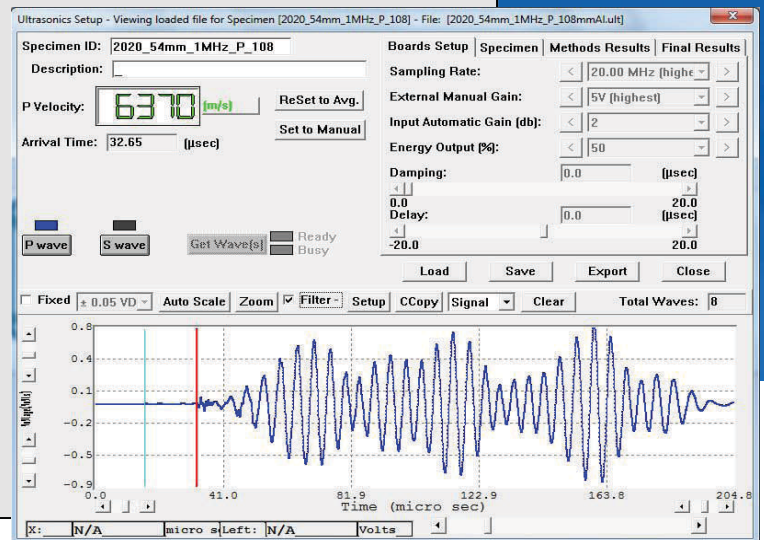
RAA-100 features precision slide for smooth movement of the rock specimen over the required scratch distance. It also comes with graduated knob for accurate scratch distance control with 0.01 mm precision. The slide movement is controlled with precision threaded acme rod with 1 mm pitch (1 mm horizontal movement per knob revolution).

Included in the RAA-100 package are one hundred (100) sharp steel indenters with  $200 \text{ kg/mm}^2$  hardness and  $90^\circ$  cone angle, rock holding vise and anodized aluminum and stainless steel construction loading frame.

# Ultrasonic Velocity Measurement System

## ULT-100

- Ultrasonic velocity measurement of compression and shear waves in asphalt, soil, rock & concrete specimens
- Digitally controlled pulser and receiver including a switch to automatically select P or S wave transducers
- 20 MHz sampling rate with 12 bit resolution
- State of the art software for data acquisition, analysis, storage, plotting & reporting
- Available transducer platens for use inside soil and rock triaxial cells
- Easy to setup and use



## Description

The GCTS Ultrasonic Velocity test system is a turn-key system including everything required to perform ultrasonic velocity measurements on laboratory specimens. The system can be programmed to obtain a single measurement or several measurements at prescribed times or any other test parameters available.

The ULT-100 system uses a fast acting pulser that provides excitation to the ultrasonic sensor and an ultra high speed analog to digital converter for storing the resulting waveform signals. The sampling rate can be selected from 20 MHz to a sampling rate as low as 156 Hz allowing the user to capture a wide range of ultrasonic signals. With the automatic gain selection, which can be set from -22 dB to 20 dB, and the energy output, damping and delay selections that can be manipulated, the user is able to generate ultrasonic waveform in many different scenarios.

Ultrasonic software determines the shear and compression wave velocities and stores the waveforms digitally. The system utilizes a computer board for high speed data acquisition and a sophisticated computer software package for data analysis. The computer software is integrated within the GCTS CATS software environment. The pulse amplitude, sampling rate, input gain, and waveform enhancement are controlled by the software while the waveform is being viewed on the computer screen. The face to face platen corrections can be entered into software so that the shear and compression wave velocities can be calculated simultaneously. The data can then be to disk for further analysis using the software. The software allows the operator to view the original data and then frequency spectrum of the waveform. Waveform filters, degree of waveform filtration, band pass frequency selection (low/high), stop band rejection (dB) and transition band width (kHz) can

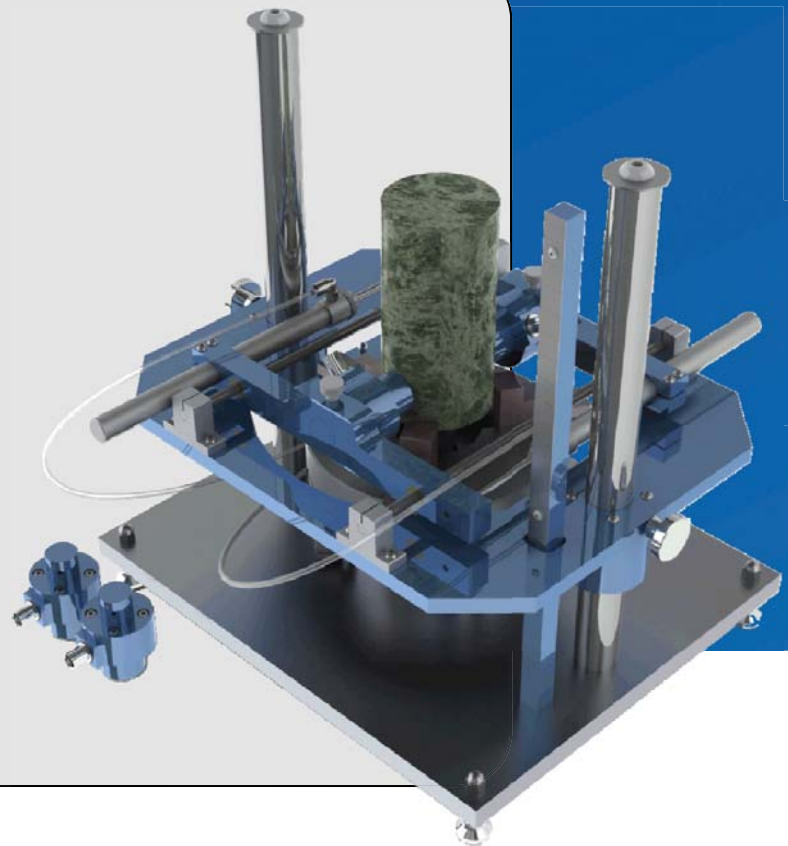
be applied to the original data to produce a filtered waveform which is very convenient when dealing with poor raw waveform. The GCTS ULT software can be used within a variety of laboratory test systems, which simulate the in-situ stress conditions or "bench" test (no additional stress applied to the specimen). Systems that simulate in-situ stress conditions include triaxial cells and polyaxial (true triaxial) cells as well as in-situ field tests.

Included with this system is a set of combination platens designed for both P and S wave velocity measurements. Available platens include models for unconfined loading, soil triaxial loading, and rock (high pressure) triaxial loading.

# Circumferential Velocity Apparatus

## CVA-100

- Measurement of P-wave and S-wave velocities with the included transducers
- Map of P-wave and S-wave velocities vs. orientation angle
- Includes turntable with vernier scale for precise measurement of angular orientation of the specimen
- Pneumatic actuators for automatic clamping of sensors onto specimen
- 200 kHz or 1 MHz frequency crystals, other frequencies available upon request
- 100 mm (4 inch) maximum specimen diameter
- Very easy to setup and use
- Requires GCTS ULT-100 ultrasonic velocity system or any other suitable ultrasonic measurement device



## Specifications

Specimen diameter	Up to 100 mm (4 inch)
Crystal frequency	200 kHz (other available)
Material	Anodized aluminum, steel
Shipping mass	20 kg
Shipping dimensions	40 x 32 x 30 (cm) HxWxL

## Accessories

1. ULT-100 ultrasonic velocity measurement system.
2. Ultrasonic velocity platens with 1 MHz crystals.

## Description

The GCTS Circumferential Velocity Anisotropy Apparatus (CVA-100) is used to determine the compression P-wave velocities and shear S-wave velocities of rock core specimens in different orientations. This apparatus when used with a GCTS ULT-100 or a suitable ultrasonic measurement device, can obtain the velocity versus angle and height data with relative ease and precision.

CVA-100 comes standard with set of 200 kHz P-wave and S-wave measurement platens (other crystal frequencies available upon request). The apparatus frame (base, columns and the transducer supports) is built using high quality anodized aluminum, which supports the steel turntable with a precision vernier scale and fasteners capable of accommodating 100 mm (4 inch) diameter specimens. Pneumatic actuators are included, with return toggle switch, for quick and easy positioning of the transducers on the specimen. The pneumatic actuators come with air lines and quick-connect fittings for a compressed air input.

# Rock Polyaxial Fixture

## RPX-150

- Stainless steel construction
- Perform polyaxial (true triaxial) tests within GCTS rock triaxial cells
- Independent control of  $\sigma_1$ ,  $\sigma_2$ ,  $\sigma_3$  (where  $\sigma_1 \neq \sigma_2 \neq \sigma_3$ ) or  $\epsilon_1$ ,  $\epsilon_2$ ,  $\epsilon_3$  or a combination of stress or strain control for each axis
- Measures strains in all three orthogonal directions
- Accommodates cubical or cylindrical rock specimens with maximum dimensions of 54 mm x 54 mm x 108 mm or 54 mm diameter by 108 mm height
- Stress control up to 140 MPa
- Available ultrasonic sensors to measure P and S wave velocities under different stress states
- Optional hydraulic fracturing platens available to perform wellbore stability tests
- Customized fixtures available to fit existing triaxial cells
- GCTS also offers stand-alone, large scale polyaxial systems built to customer specifications



## Specifications

Specimen diameter	54.7 mm (2.15 inch)
Pressure capacity	140 MPa (20,000 psi)
Material	Stainless steel
Shipping mass	25 kg
Shipping dimensions	40 x 32 x 30 (cm) HxWxL

## Accessories

1. ULT-100 ultrasonic velocity measurement system.
2. Hydraulic fracturing platens.

## Description

The GCTS RPX-150 Rock Polyaxial fixture can be used to study the intermediate principal stress effect on rock engineering behavior and describe adequately the strength of rock under a general system of polyaxial compressive stresses. The RPX-150 is a simple and economical fixture that enhances the capabilities of standard GCTS rock triaxial systems which include cell and pore pressure control. This fixture is designed to fit inside GCTS triaxial cells and use the load frame to (typically) apply  $\sigma_1$ , the cell pressure to apply  $\sigma_2$  and the pore pressure system to apply  $\sigma_3$  through the fixture's flat jacks.

GCTS also offers semi-circular platens to test cylindrical specimens together with GCTS hydraulic fracturing fixtures and approximate the effects of anisotropic stress state on borehole stability. Although the stress state applied with these semicircular loading jacks is not uniform, it is much easier to prepare and test cylindrical specimens.

Ultrasonic sensors can be provided to study the effects of anisotropic stress conditions on compression and shear wave velocities. Velocities for all three axis can easily be measured during polyaxial tests with this option.

# Hydraulic Fracture Test Fixture

## HTRX-HF

- Perform hydraulic fracture, wellbore stability and rock permeability tests within GCTS RTX rock triaxial systems
- Available fixtures for specimens from 25 mm (1 inch) up to 100 mm (4 inch) diameter
- Optional internal acoustic emission sensors
- Large scale hydraulic fracturing equipment available



## Specifications

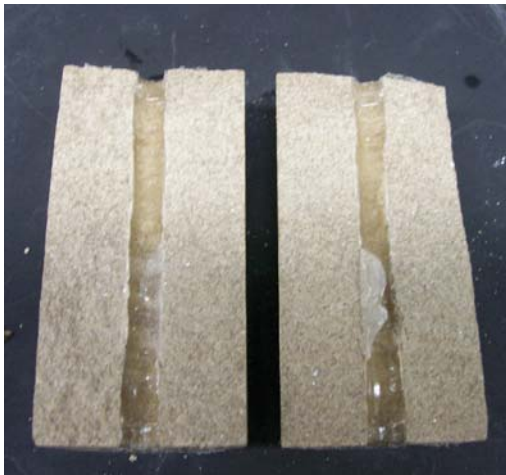
Model number	Specimen diameter
HTRX-HF-1.0	25 mm (1 inch)
HTRX-HF-1.5	38 mm (1.5 inch)
HTRX-HF-BX	42 mm (1.65 inch)
HTRX-HF-2.0	51 mm (2 inch)
HTRX-HF-NX	54 mm (2.125 inch)
HTRX-HF-3.0	76 mm (3 inch)
HTRX-HF-4.0	102 mm (4 inch)

## Description

The GCTS hydraulic fracture fixture allows for the performance of fracture tests within any of the standard GCTS rock triaxial cells and the use of a GCTS HPVC pressure intensifier. This fixture is typically used for hydraulic fracture, wellbore stability, and permeability tests. Tests can be performed with or without confining pressure.

Typically fracturing pressure is ramped up at a constant fluid injection rate while injection pressure and radial strain are measured to determine the fracture stress. When coupled with GCTS acoustic emissions system, it is possible to graph the AE versus the internal pressure to better detect the onset of fracturing.

Any of GCTS rock triaxial systems can be supplied or upgraded with hydraulic fracturing test fixture, further enhancing its capabilities with minimal cost. Each specimen diameter requires a specific fracturing fixture constructed for that specific sample diameter.



Fractured specimen after test.

# Digital Signal Conditioning and Control Unit

## SCON-1500 / 2000

- 16 bit A/D resolution and 100 kHz conversion rate with track-and-hold
- Adaptive digital servo control with Windows™ interface software
- Accepts Universal Digital Signal Conditioning modules for load cells, LVDTs (AC and DC), pressure sensors, or other analog input signals
- Automatic sensor recognition
- Internal and external temperature monitoring



### Specifications

#### SCON-1500

#### SCON-2000

Max. Analog Inputs	8	24
Max. Control Outputs	4	8
Maximum Loop Rate	4,000 Hz	6,000 Hz
Dimensions	430 x 380 x 270 mm (WxDxH)	560 x 540 x 580 mm (WxDxH)
Mass	17 kg	40 kg
Voltage	90-260 VAC, 50-60 Hz	90-260 VAC, 50-60 Hz
Power	0.4 kW max.	0.7 kW max.

### Description

The SCON-1500 features an integrated 850 MHz microprocessor based digital servo controller and includes the CATS Standard software. This is a complete and self-contained module featuring built in function generator, data acquisition, and digital I/O unit. Utilizing state-of-the-art Universal Signal Conditioning boards, this system can accept load cells, pressure transducers, LVDTs, thermocouples, or other analog input signals. Each channel features digital offset and gain, 16-bit resolution, and anti-alias filter. This system includes a 100,000 hertz A/D converter with "track-and-hold." Track-and-hold ensures that the converted values from all attached sensors (load cells, deformation, etc.) represent a single instant in time eliminating any data skew from delays in the A/D converter.

The signal conditioning electronics are fully digital with settings directly manipulated by the software. Different equipment configurations are saved making it very easy to change sensors like load cells or deformation transducers. At the same time, the digital settings are protected from inexperienced users to eliminate accidental modifications to sensor calibra-

tions and amplifications. In addition, the system incorporates automatic sensor recognition that will automatically load the correct sensor setup upon connecting or changing a transducer.

Included with this system is a true 32-bit Windows™ GCTS CATS Standard software (Win XP, Vista, 7) Graphical User Interface with a Universal Test module that allows you to create a variety of wave forms. The standard system also includes calculated inputs from one or several analog channels that can be directly servo controlled or monitored in real time.

Any system sensor can then be used to provide advanced servo control with "on-the-fly bump less" transfer switching between any connected transducer or calculated inputs.

GCTS offers SCON-2000 for more demanding testing systems that utilize more sensors inputs as well as the control outputs. SCON-2000 has a 6 kHz maximum loop rate with 300 kHz conversion rate between channels.

The SCON-2000 accepts up to 24 DSB-111 Universal Digital Signal Conditioning modules for

load cells , LVDTs (AC and DC), pressure sensors, or other analog input signals. It also supports up to 8 digital outputs, 8 digital inputs and 48 bit digital counter.

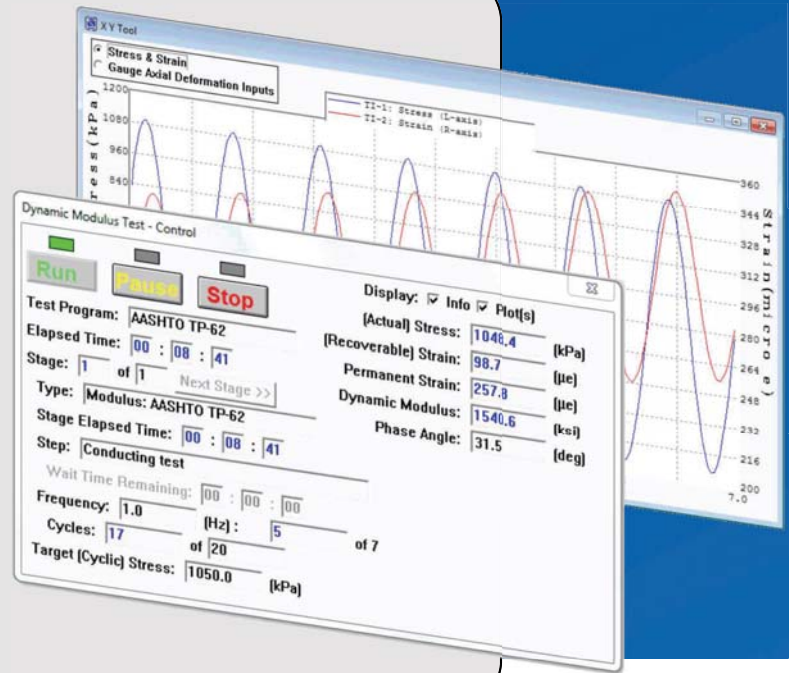


SCON-2000

# Computer Aided Testing Software

## CATS-ADV

- Advanced servo control from any system sensor or calculated variable
- “On-the-fly bump-less” transfer and adaptive compensation
- Advanced digital temperature control
- Automatic frequency sweeps
- Independent and synchronized control of up to 10 outputs including temperature
- Complete units library including SI, metric, English and user defined units
- Real time graphics of input channels
- Remote monitoring of test through networks



## Description

The GCTS Advanced Windows software, coupled with SCON electronics, is the most advanced testing software available today. This software has simplified the operation of our instruments allowing the user to directly program test calculated parameters in the units of interest (stress, strain, etc.) based on the specimen dimensions. These parameters are calculated in real time and are available for display, graph and/or control. Since our signal conditioning electronics are fully digital, optimization and calibration settings are software controlled. Alternate equipment configurations can be easily saved within the software so that when a sensor has been changed (such as a load cell or deformation transducer), the software can be quickly updated with the new settings. The system also utilizes automatic sensor recognition that will automatically load the correct sensor information when a new sensor has been connected. All the offset and gain settings are managed by our computer software, reducing the possibility of accidentally or inadvertently changing the sensor calibration. The CATS

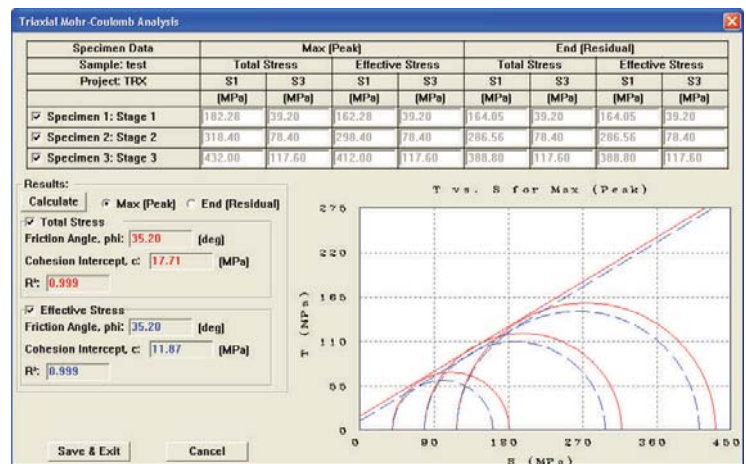
software includes a digital filter on the sensor inputs to help eliminate noise from the digital signal.

All of our testing systems have been designed to take full advantage of our software and electronics so that all test stages can be automatically performed from beginning to end with minimal user intervention. Another advantage that provides superior results is the advanced sensor calibration that can include nonlinear conversion factors and/or automatic corrections applied in real time.

The Universal test module of the CATS Advanced software is a very versatile and powerful module that allows the user to establish any test procedure that they wish. It allows the user to simultane-

ously control up to 10 outputs (synchronous or asynchronous) in any phase, and allows the user to run unlimited phases or test programs.

GCTS offers many application software modulus to perform specific test procedures (Direct Shear, Rock Triaxial, Point Load, Ultrasonic Velocity etc.), in addition CATS software includes the universal module to program any user-defined test procedures.

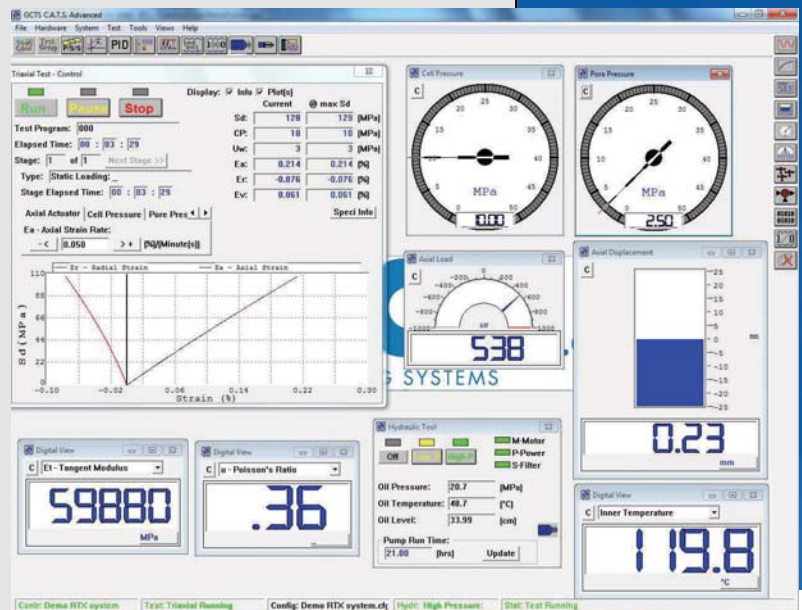


Automatic Mohr circle generation.

# Rock Triaxial Software Module

## CATS-TRX-ROCK

- Automatic Mohr-Coulomb model fitting (Mohr circles)
- Complete automatic procedures
- Isotropic and anisotropic consolidation
- Static and dynamic loading with stress/strain path control including  $K_0$  test
- Multi-stage testing
- Modification of stress or strain rates during testing
- Real time graphics of input channels
- Export data to Excel™ or other programs
- Easy to setup and conduct triaxial tests



## Description

The GCTS TRX-ROCK software is part of the CATS 32 bit Windows software, which coupled with our SCION electronics, is the most advanced geotechnical laboratory testing software available today. This software has simplified the operation of our triaxial instruments allowing the user to directly program test calculated parameters in the units of interest (stress, strain, etc.) based on the specimen dimensions. These parameters are calculated in real time and are available for control, display and/or graph.

Example of test calculated parameters include  $\sigma_d$ —deviator stress,  $\epsilon_a$ —axial strain,  $\epsilon_r$ —radial strain,  $\epsilon_v$ —volumetric strain, Poisson's ratio, tangent and secant modulus (TRX software modulus contains 20 test inputs). The strain can be calculated from direct deformation inputs, or can be calculated as functions of each other—the option is user selectable.

This software includes an automatic procedure for setting the initial ram contact

with the specimen. The ram is first moved in deformation control while monitoring the axial stress. As soon as the ram gets in contact with the specimen, the system automatically switches to axial stress control preventing premature sample failure. This program also calculates the force exerted on the ram by the confining pressure and automatically corrects the axial load required to maintain the deviator stress and thus preventing the ram from lifting while changing the cell pressure.

The Static Loading stage is easy to setup and allows the user to perform static loading on the specimen while allowing the user to change the stress and or strain rates for all of the controlled axis (axial, cell pressure and back pressure) during testing. The Dynamic Loading stage allows the user to easily setup a dynamic loading on the specimen. The Universal stage of the TRX software is a very versatile and powerful module that allows the user to establish any custom test procedure that they wish. It allows the user to simultane-

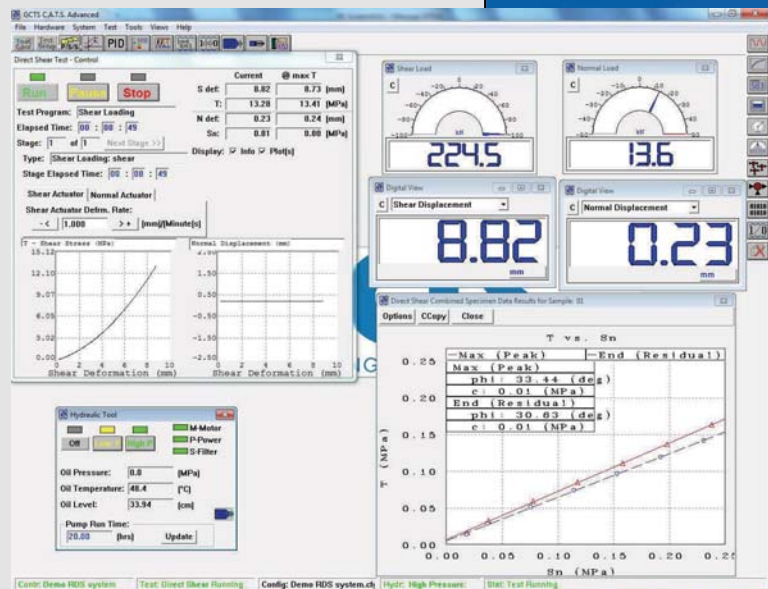
ously and independently control the three axis outputs in the test program.

The GCTS triaxial testing systems have been designed to take full advantage of our new software and electronics so that all test stages can be automatically performed from beginning to the end with minimal user intervention. For the full specifications regarding the TRX-ROCK software, please see the CATS-TRX-ROCK brochure.

# Direct Shear Software Module

## CATS-DSH

- Complete automatic test setup including multi-stage procedures
- Modification of stress or deformation rates during testing
- Automatic real time specimen area corrections
- Easy to setup and conduct direct shear tests
- Automatic calculations of friction angle and cohesion intercept for peak and residual values
- Compatible with most soil & rock direct shear test systems



## Description

The new GCTS DSH software is part of the CATS 32 bit Windows software, which coupled with our new SCON electronics, is the most advanced geotechnical software available today. This software has simplified the operation of direct shear systems allowing the user to directly program test calculated parameters in the units of interest based on the specimen dimensions. These parameters are calculated in real time and are available for display, graph and/or control. The test parameters include  $\sigma_n$ —normal stress,  $\tau$ —shear stress, and  $A_c$ —corrected area. The software is able to handle cylindrical specimens with circular, rectangular or elliptical cross-sections, and square and rectangular as well as irregular (user defined) specimens while being able to keep track of the specimen area changes automatically.

The Consolidation stage allows the user to consolidate a specimen. The Shear Loading stage is easy to setup and allows the user to perform shear loading on the

specimen while allowing the user to change the stress and/or deformation rates for all of the controlled axis (shear and normal axis) during testing. The user can perform normal stiffness controlled test with this stage, either keeping the normal stiffness constant or making it a function. If none of these stages fit the users need, the Universal stage of the DSH module of the CATS software allows the user to establish a custom test procedure. Direct Shear multi-stage test programs can be easily defined and automatically executed.

After testing is done, the DSH module allows the user to calculate the friction angle and cohesion intercept for user selected samples. The software calculates and graphs both, the peak and residual friction angles and cohesion intercepts.

The GCTS Direct Shear testing systems have been designed to take full advantage of our new software and electronics so

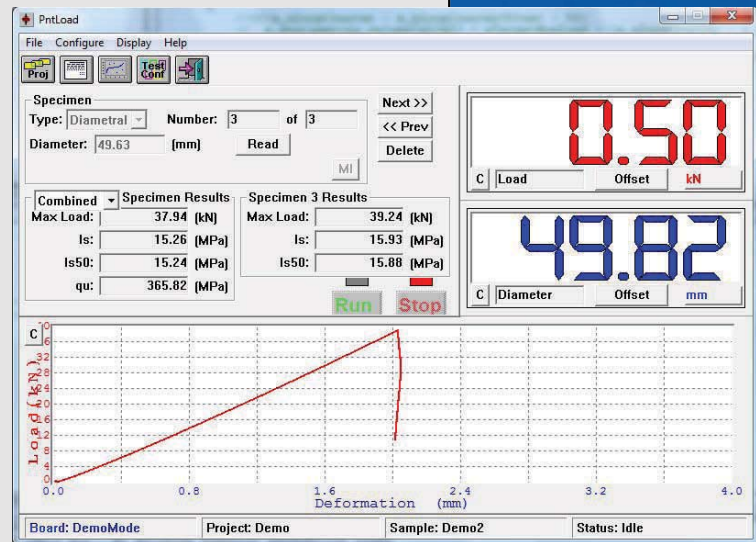
that all test stages can be automatically performed from beginning to end with minimal user intervention.

The full specifications regarding DSH software, please see the Direct Shear brochure.

# Point Load Test Software

## PntLoad

- Automatic test execution, data logging, data analysis, and test report
- Real time display of test results and statistical results
- Optimized for mass production of rock testing
- Automatic specimen size measurement to increase productivity and minimize errors
- Compatible with most laptop and desktop PC computers running Windows™ operating system



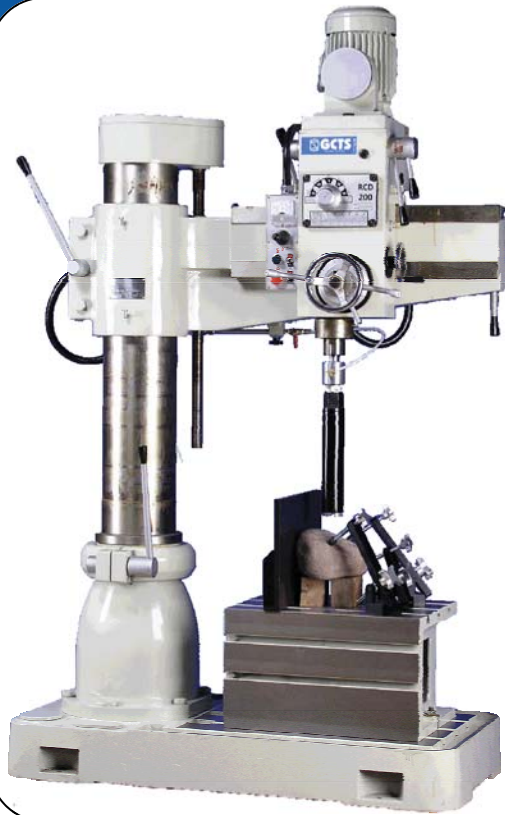
## Description

The specimens can be tested one after the other, in rapid succession, and the software program will automatically measure the specimen diameter and start/stop the test data logging based upon threshold load values. During the test, there is real time display of the parameters (time, load, deformation) and statistical results from all the previous specimens. Program is capable of deleting data based on comparison with previous data sets and the combined results from the results graph.

The GCTS Point Load test system is a convenient test system that has been designed for ease of transportation through its compact, lightweight aluminum construction. Included in the system is a precise digital display to monitor axial load and axial deformation in SI or English units. The system includes an optional easy to use Windows software package that interfaces to a laptop or desktop computer. The software was designed to provide fast, automated testing. The soft-

ware is able to automatically log test data and statistical data analysis. Some options that are available include Ultrasonic Velocity package (including platens and ultrasonic software). This allows for automatic collection of ultrasonic velocity data. An additional option provided includes unconfined compression plates for uniaxial testing.

# GCTS Rock Preparation Equipment



## RCD-200 Heavy Duty Laboratory Coring Machine

- 150 to 1500 rpm spindle speed
- 2 HP motor
- Automatic down feed mechanism with 170 mm travel
- Stiff frame for true cylindrical, ridge free samples with automatic down feed
- Built in sample hold
- Wide variety of coring barrels to choose

The GCTS laboratory coring machine is capable of achieving a large range of spindle speeds to provide optimum performance when preparing test specimens, regardless of the properties of the material being sampled. All accessories are included (water swivel, drip pan, sample holder, and custom specified core barrels). Optional force/stroke control is available to optimize feeding rates for superior performance when coring material, which is not homogeneous.



## RCD-250 Pressure Controlled Coring Machine

- 1.5 HP electric motor with 12 adjustable spindle speeds from 150 through 4,200 rpm
- Drilling rate controlled by both pressure and speed and automatic down feed mechanics with 250 mm travel
- Rigid multi column drill support frame to eliminate ridges on specimen
- Wide variety of coring barrels available

The main feature that sets this coring machine above any other is the force/stroke control to optimize feeding rates for superior performance when coring material, which is not homogeneous. Diamond coring barrels available for different diameter and length specimens, and type of cored material.

The machine operates on 208/240 Volt, 50-60 Hz, single phase power.

# GCTS Rock Preparation Equipment



## RSG-200 Rock Specimen Grinder

- Fast grinder with a single-pass full specimen coverage to make core loading faces parallel and flat according to ASTM and ISRM specifications.
- 2 HP motor
- Includes diamond grinding cup wheel, coolant system with 45 liters of biodegradable rock oil
- Custom made specimen holder

The GCTS specimen grinder provides the final step to preparing test specimens with parallel and flat ends according to ASTM and ISRM specifications. The grinder is driven by a heavy duty 2 HP electric motor for durability. A diamond grinding cup wheel is provided along with a custom stainless steel sample holder. GCTS offers sample holders for specimen diameters from 25 mm to 150 mm. The system has a built-in cooling circulator that cools the grinding cup wheel when preparing a specimen.



## RLS-100 Specimen Lab Saw

- 3 speed advancing rate (feed rate of specimen being prepared)
- Accepts up to 170 mm diameter core specimen
- 1 horsepower electric motor (3 HP available)
- Stainless steel upgrade available
- Metal hood with viewing window

RLS-100 has a power feed feature, which automatically pushes the specimen into the saw blade for an even, smooth cut. The lab saw can accommodate up to 170 mm diameter specimen. The blade speed is approximately 800 rpm and it is cooled either by water or biodegradable cutting oil.

The machine operates on 208/240 Volt, 50-60 Hz, single phase power.

# GCTS Rock Testing Accessories

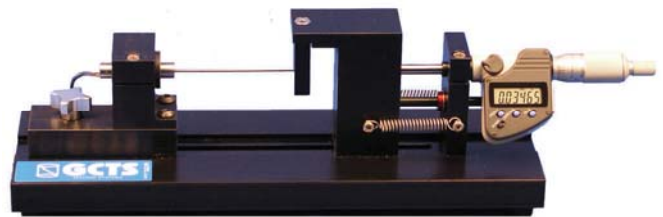
## RFG-100 Specimen Flatness Gauge

200 mm x 300 mm x 50 mm thick granite base (grade A,  $\pm 0.0001$  inch accuracy) with dial gage support for measuring flatness of specimens up to 200 mm in height. Includes electrical dial gage 0.01 mm (0.0005 inch) resolution.



## DCD-25 LVDT Calibration Device

The GCTS LVDT calibration device provides a very simple and easy to use technique to accurately calibrate a wide variety of LVDTs. The DCD-25 features spring loaded linear displacement to prevent system compliance when reversing directions. The readout is available in both SI and English units. The device has an adjustable mounting bracket that can accommodate LVDTs of most sizes. It provides a calibration range of 25 mm (1 inch) with 0.001 mm (0.00005 inch) resolution.



## Installation & Training

GCTS has highly knowledgeable and professional staff who are capable to train your system operators regardless of the operator's level of familiarity with the systems.

Our training staff has decades of experience ranging from commercial to high-level research. They will guide your operators step-by-step to ensure they are fully confident throughout the testing process. Our team is also available to help with system installation and maintenance. Short courses are also periodically offered at GCTS facilities. Please contact GCTS to schedule an appointment.



