

GCTS is committed to designing accurate testing systems by integrating innovative software engineering with advanced hardware. GCTS systems perform at the highest levels of reliability, providing efficient systems that satisfy customer needs and expectations.

► **RTR-1000**  
**Rapid Triaxial Rock Testing System**



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- **Static and dynamic closed-loop servo control**
- **Capable of performing strain or stress controlled & post failure behavior tests**
- **Axial load up to 1,500 kN**
- **140 MPa cell pressure capacity**
- **Frame stiffness up to 10 MN/mm**
- **Easy and safe operation--ideal for production testing**
- **Automated cell assembly...no fasteners used!**
- **Meets all the specifications of the ISRM and ASTM for triaxial testing of rock samples**
- **Optional Temperature control to 150 °C.**

**DESCRIPTION**

The GCTS Rapid Triaxial Rock Test System is a closed-loop digitally servo controlled apparatus developed for accurately performing easy and quick triaxial and unconfined tests on rock specimens. In addition, the system is also capable of performing permeability, hydraulic fracturing, indirect tension, and many other advanced rock tests. GCTS state-of-the-art control package that includes Windows XP testing software and digital signal conditioning increments testing reliability and eliminates advanced technical knowledge requirements for its operation.

Rapid, easy, and safe operation makes the RTR-1000 system ideal for production test facilities and research laboratories. The system can be designed to meet customer specifications and accommodates different specimen sizes. This system meets all applicable ISRM and ASTM testing standards.



Internal load and deformation measurements

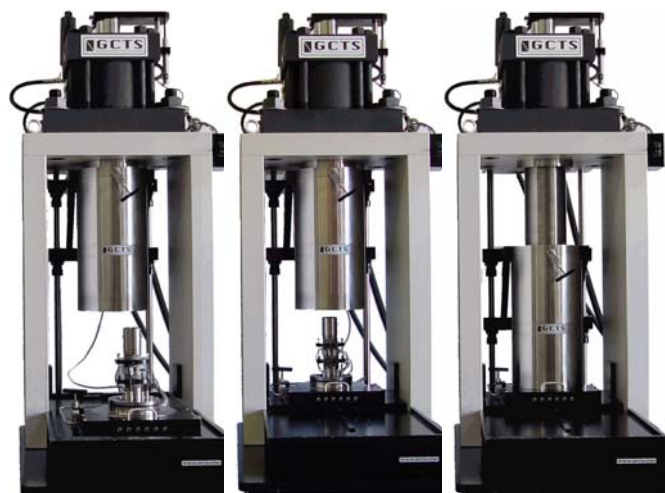
An automatic hydraulic lift and a sliding base for the triaxial cell are included with this system for fast and easy specimen setup as compared to conventional triaxial cells. Fast assembly/disassembly of the cell is achieved with the push of a single button. No bolts or other fasteners are used to assemble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

The triaxial cell is constructed of stainless steel and accommodates cylindrical specimens of up to 75-mm in diameter. The standard unit features a stiff loading

piston and low friction graphite seal. The advantages of the self-contained cell wall are that after the specimen is completely ready for a test, the cell wall is conveniently lowered and is automatically locked into place. An internal load cell can be provided as an option, although the piston friction is typically negligible. Other options include the internal instrumentation and stiff frame upgrades for precise measurement of the deformation modulus and post-failure behavior studies.

The standard RTR-1000 includes two pressure intensifiers for controlling the cell and pore pressures. Each pressure intensifier is housed inside a metal cabinet with casters that also include a 20 liter fluid reservoir, precise analog gages, high pressure valves, flow indicators, etc. making them very convenient and easy to operate. Pressure gauges provide a visual verification of confining and pore pressures. Convenient "quick-connect" fittings allow for easy connection of pressure lines and filling/draining the fluid reservoirs. Sight tubes are also available to show the available amount of fluid in each fluid circuit. Each pressure intensifier has a pressure transducer and LVDT connected to them allowing for the servo control as a function of pressure, fluid volume control, or any other measured or calculated test parameter. With both pressure intensifiers, advance tests such as stress/strain path,  $K_0$ , permeability, hydraulic fracturing (requires special platens) can be easily performed.

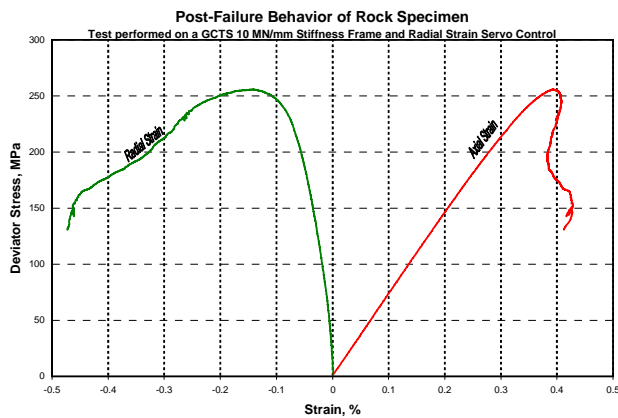
The RTR-1000 is operated with our fully integrated SCON-2000 digital signal conditioning/controller and the state-of-the-art CATS-TRX-ROCKS software. Conducting Triaxial tests have been greatly simplified by the incorporation of direct user programming of test calculated parameters in the units of interest (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. These parameters are calculated in real time and are available for display, graph and/or control. In addition, CATS software allows you to define user defined parameters to obtain multiple sensor averages or corrections as a function of other inputs. 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. GCTS offers compatibility with network systems that allows monitoring or sending your test data directly to any computer connected to your network. Any desired unit can be used for display or report test parameters even allowing to combine different unit systems.



Sample Mounted      Cell Base Inserted into Load Frame      Cell Wall Lowered Ready for Testing

Specimen Mounting

The embedded microprocessor is capable of performing all test functions even if the Windows computer crashes. It provides automatic dynamic control mode switching between ant connected transducer or



Typical Test Results

calculated parameter (“bump-less transfer”). This controller also conditions all transducers used for triaxial testing and provides real time linearization of any input using high-order polynomials. This digital controller is capable of updating the control loop at up to 6 kHz required to control the loads for brittle specimens. The SCON-2000 has several adaptive compensation techniques to improve the control precision without user intervention.

Together with GCTS excellent support from our highly qualified and experienced staff, we are sure to provide the best option and price-performance value.

## SPECIFICATIONS

### 1.1) FRMB-1000-5

Stiff loading frame with the following specifications:

- 1,750 kN/mm (10,000,000 lbs/inch) stiffness
- 50 mm (2 inch) stroke.
- 1000 kN (225 kips) Static load capacity.
- 800 kN Dynamic load capacity.
- 20 Hertz maximum frequency.
- 700 mm/minute maximum velocity.
- 100 mm swivel platen with HRC 45 hardness.
- High-Frequency Two-Stage Electro-hydraulic servo valve rated to 19 l/min (5 GPM)
- Manifold including on/high pressure control solenoid and accumulator to minimize pressure ripples.
- SR-DF-750-1000AC Deformation sensor.
- Hydraulic lift to raise triaxial cell automatically
- Clearance between columns: 380 mm (15 inches). Clearance between plates: 850 mm (34 inches).
- Mounted on heavy duty steel table.

### 1.2) RTRX-140A

Stainless steel construction triaxial cell with AutoLock open/close mechanism for automatic cell assembly. 140 MPa (20,000 psi) confining pressure capacity and 1,000 kN axial load capacity. Includes loading piston with spherical seating, low-friction spring-loaded graphite seals, cell and pore fluid connectors, and one set of spare seals. Also includes six sealed feed-through connectors (4-pins each) for in-vessel instrumentation to accommodate different type of sensors like load cells, LVDT's, ultrasonic transducers, etc. Accepts samples having a diameter of up to 75 mm (3 inch) with a length of 2.0 times the diameter. Supplied with valves, fittings and nylon tubing. Accepts GCTS axial and circumferential measurement device.

### 1.3) SR-LCI-1000

1,000 kN (225 kip) Internal compression load cell. 0.05 kN resolution. Operates inside Rock Triaxial cell at pressures up to 140 MPa (20,000 psi).

### 1.4) HTRX-ACC-NX PLATENS FOR NX DIAMETER

- 1 Top platen for NX diameter specimens with pore pressure port and spherical loading seat. Made of hardened 17 4 stainless steel.
- 1 Bottom platen for NX diameter specimens with pore pressure port. Made of hardened 17 4 stainless steel.
- 7.5 m of Heat Shrink Tubing for NX Diameter Specimens.
- Set of O-rings for sealing jacket to platens for NX specimens.
- Platens for EX, AX, BX, or HQ diameter specimen diameters also available at same cost

### 1.5) DEF-R5100-A

Axial & circumferential measurement device for high pressure triaxial cell (35 to 54 mm diameter specimens). For the measurement of axial and radial strains inside the triaxial cell at pressures up to 170 MPa.

- (1) Set of upper and lower LVDT holder rings for two deformation sensors positioned at 180 degrees to measure average axial strain. Accommodates specimens with a diameter from 35 mm to 54 mm.
- (1) Circumferential roller assembly and LVDT holder to measure arc changes. Accommodates specimens with initial diameter from 35 mm to 54 mm.
- (3) LVDT's with 5 mm range.

### 1.6) HPVC-140C Cell Pressure Intensifier

Stainless steel Pressure/volume servo controlled intensifier for direct control and/or measurement of cell pressure and volume

- 140 MPa (20,000 psi) service pressure and transducer with 0.005 MPa resolution
  - 560 cc volume capacity and transducer with 0.01 cc resolution
  - High-Frequency Two-Stage Electro-hydraulic servo valve rated to 11 liter/min (3 GPM)
  - Manifold including on/high pressure control solenoid and accumulator to minimize pressure ripples.
  - Pressure panel with high pressure valves, test gauge with 0.25% accuracy and flow controls.
  - 19 liter (5 gallon) fluid reservoir with pressure/vacuum/vent port and panel mounted level and flow indicators for filling/emptying triaxial cell
  - Mounted on metal cabinet with casters
- \*\* Requires 700 kPa (100 psi) air pressure supplies.

### 1.7) HPVC-140P Pore Pressure Intensifier

Stainless steel Pressure/volume servo controlled intensifier for direct control and/or measurement of pore pressure and volume

- 140 MPa (20,000 psi) service pressure and transducer with 0.005 MPa resolution
  - 280 cc volume capacity and transducer with 0.005 cc resolution
  - High-Frequency Two-Stage Electro-hydraulic servo valve rated to 11 liter/min (3 GPM)
  - Manifold including on/high pressure control solenoid and accumulator to minimize pressure ripples.
  - Pressure panel with high pressure valves, test gauge with 0.25% accuracy and flow controls.
  - 19 liter (5 gallon) fluid reservoir with pressure/vacuum/vent port and panel mounted level and flow indicators for filling/emptying triaxial cell
  - Mounted on metal cabinet with casters
- \*\* Requires 700 kPa (100 psi) air pressure supplies.

### 1.8) HPS-10-5 Hydraulic Power Unit

19 LPM, 10 HP, 21 MPa variable volume constant pressure pump. 150 liter reservoir, oil temperature indicator, pressure and return filters, pressure gage, valves, thermal and low fluid level shut off protection, heat exchanger, hydraulic hoses (10 m. long), accumulator, filler strainer, drain port and motor starter. Includes computer low/high/off remote pressure controls and oil temperature and level sensors for computer diagnostics and interlocks. Voltage:

208, 230, 380 or 460 V / 50 or 60 Hz / 3 phase (please specify electrical power and hydraulic hoses length at time of ordering).

### 1.9) SCON-2000 DIGITAL SERVO CONTROLLER AND ACQUISITION SYSTEM

Microprocessor based digital servo controller, function generator, signal conditioning, data acquisition, and digital I/O unit. Advanced servo control from any system sensor with "on-the-fly bump-less" transfer switching between any connected transducer or calculated input. Can be configured to read up to 28 transducers or inputs and control up to 8 outputs. Includes 9 DSB-111 Universal Signal Conditioning boards and 3 DSB-122 Servo Amplifier Boards plus all necessary cables (see SCON-2000 brochure for full specifications).

#### 1.10) WIN-CATS-ADV

32-bit Windows 98/2000/NT/XP software for advanced digital servo control from any system sensor or calculated channel with "on-the-fly" bump-less transfer. Includes calculated channels for stress, strain, etc. and user defined equations with the following specifications:

- Third degree polynomial sensor linearization in real time.
- Ability to define user defined inputs as a function of other inputs and correct by another input via a third degree polynomial to view or control in real time.
- Configurable unit library to automatically perform unit conversions.
- Linear, log, and semi-log plotting capability with user specified plot parameters.
- Unlimited user configurable view tools (graphs, meters, gages, bars, etc.)
- User defined procedures with up to 100 stages.
- Timed, Level Crossing, and Peak/Valley data acquisition modes.

\*\* See WIN-CATS-ADV brochure for full specifications \*\*

#### 1.11) WIN-TRX-ROCK

Triaxial test module to automatically perform conventional triaxial static tests as well as other advanced tests such as Stress-Path, Ko-loading, etc. Includes procedures to servo control the radial strain rate for post failure behavior tests (see brochure for full specifications).

#### 1.12) Computer

Windows computer to control and execute the test automatically with the following specifications: Windows XP Operating System, Pentium processor, 1 GB RAM, 80 GB Hard, Ethernet port, CD ROM drive, 17" SVGA flat panel monitor, and mouse.

## OPTIONS

### 2) FRMB-1000SU3 Upgrade Frame Stiffness to 3,500 kN/mm

Includes upgrade of loading frame stiffness to 3,500 kN/mm (20 million lbs/inch), electro-hydraulic pump and dual frame servo valve to 40 LPM (10 GPM) total.

### 3) FRMB-1000SU9 Upgrade Frame Stiffness to 10,000 kN/mm

Includes upgrade of loading frame stiffness to 10,000 kN/mm (57 million lbs/inch) and electro-hydraulic pump to 60 LPM (15 GPM) and dual frame servo valve to 76 LPM (20 GPM) total.

### 4) FRMB-1500SU Upgrade Axial Load Capacity To 1,500 kN

Frame upgrade to FRMB-1500S-20 with 1,500 kN (340,000 lbs) load capacity, 10,000 kN/mm (57 million lbs/inch) stiffness and internal load sensor to 1,500 kN,(340,000 lbs) load range.

### 5) SR-LCI-500

500 kN (112 kip) Internal compression load cell. 0.02 kN resolution. Operates inside Rock Triaxial cell at pressures up to 140 MPa (20,000 psi). Recommended for testing weak rocks.

### 6) SR-LC-LPS-1500 Stiff (9 MN/mm) Compression Load Cell 1,500 kN (340 kips) Capacity

Ultra high stiffness Compression Load Cell, 1,500 kN (340 kips) range with 9 MN/mm stiffness for unconfined testing. Recommended for obtaining the post failure behavior of rocks on unconfined tests.

### 7) Platens for EX, AX, BX, NX, HQ, or HX Diameter Specimens

Set of platens for triaxial and unconfined testing made of hardened stainless steel with a Rockwell hardness of no less than HRC58 and grounded surface with flatness better than 0.005 mm. Meets ISRM specifications.

### 8) Spare LVDT Set for Triaxial and Unconfined Testing

Three (3) High pressure, high temperature LVDTs with 5 mm range and connectors for deformation device inside triaxial cell. Other ranges available.

### 9) DCD-25 Deformation Sensor Calibrator.

LVDT and Deformation Sensor calibrator device with six digit digital micrometer head and 25 mm travel. Includes non-rotation block mounted with linear bearing guide. Resolution of 0.00005" (0.001mm). Output in mm or inches.

### 10) ULT-100 P & S Ultrasonic Velocity Measurement System

Ultrasonic Velocity test system for automatic measurements of P & S wave velocities through soils, rocks or concrete specimens. Includes digital signal processing and signal enhancement controller with software for automatic ultrasonic velocity measurements including wave form stacking, filtering, and spectral analysis.

### 11) HTRX-HTEMP

Temperature control for heating rock triaxial cell. Internal and external thermocouples for cascade temperature control to minimize overshoot and control gradients within the test chamber. Includes internal cell wall heaters, thermocouples, and upgrade of triaxial cell, seals and internal deformation sensors for 150 °C service. Consult factory for higher temperature systems.

### 12) RIT-B-NX Indirect Tension Testing Fixture for Rocks

Apparatus for determining indirect tensile strength by the Brazil test according to the ISRM standard.

**Other options such as acoustics emissions and hydraulic fracturing are also available. In addition, GCTS offers a full line of laboratory sample preparation devices such as core drills, saws, grinders, etc. Consult the factory for a custom made system to meet all of your specifications.**

## WARRANTY

One (1) year parts and labor.

## SHIPPING

Standard shipping weight: 3,800 kg

Standard shipping volume: 8 m<sup>3</sup>