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.

**STX-050**

**Pneumatic Soil Triaxial System**

- Closed-loop digital servo control
- Automatic multi-stage testing
- Static & dynamic loading
- Stress/strain path
- Frequencies up to 5 Hertz
- Unsaturated soil testing upgrade
- Complete test automation including saturation, consolidation, & shear
- Affordably priced

**DESCRIPTION**

The GCTS Electro-pneumatic Cyclic Triaxial Test System is a closed-loop digitally servo controlled apparatus developed for performing static and dynamic triaxial tests. This system is capable of performing isotropic and anisotropic consolidation; UU, CD, and CU triaxial tests with volume change or pore pressure measurements; stress/strain path; Ko-consolidation; cyclic loading including cyclic stress path; dynamic shear strength and deformation, Resilient Modulus, liquefaction potential, shear modulus and damping ratio, and other user designed procedures for frequencies at up to 5 Hz with significant amplitudes. The system is also capable of performing flexible-wall permeability tests. The axial loader, cell pressure, and back pressure are servo controlled using any system sensor as feedback. The drain ball valve is also automated. Meets ASTM D-3999 and D 5311 specifications.
The triaxial cell is constructed of stainless steel and accommodates cylindrical specimens of up to 75-mm in diameter with a length of 2 to 2.5 times the diameter. The standard unit features a see-through Plexiglas external cell wall, a stiff loading piston, and low friction graphite seal. The advantages of the external cell wall are that after the specimen is completely ready for a test, the cell wall is lowered over the cell and fastened into place with a minimum of disturbance to the test sample. An internal load cell and LVDT can be provided as an option, although the piston friction is typically negligible.

The pressure control panel contains all valves, gages, sensors, and air/water interfaces for control of cell pressure and both top and bottom pore water pressures. This unit also includes the internal Venturi vacuum pump. The pressure settings on the cell pressure, back pressure (bottom), and top pressure regulators can be directed to the pressure gage at upper left via the selector valve under it. The use of a single gauge enhances the precision for the manual effective stress settings and pressure gradients.

For permeability testing of high hydraulic conductivity soils, the air pressure on the top of the specimen top and bottom tubes can be made the same by opening the bypass valve on the panel. For higher gradients, the top air pressure can be set different from the bottom air pressure. Water flow through the specimen can be directed up or down and can be reversed without a restart of the test. Back pressure saturation of permeability specimens can be employed, if desired.

The three pressure transducers mounted inside the pressure control panel have very low-compliance and bleeding screws to de-air them. These transducers measure cell (chamber) pressure, back/pore pressure, and volume change. The pressure panel also allows the user to visually monitor the triaxial pressures and specimen volume changes during all test stages providing a better understanding of the specimen.

This equipment is ideal for education and research/production facilities as it provides visual specimen behavior and manual controls as well as fully automated controls and data acquisition. Students do not have to treat the STX-50 as a “black box” and yet it offers all the advanced capabilities and automation of more sophisticated and expensive systems.

The unsaturated upgrade enables stress path triaxial system to perform unsaturated soils tests. Suctions are applied to the specimen by axis translation technique. Pore air pressure can be applied and computer controlled up to 1,000 kPa. Hardware attachments are provided for flushing diffused air. For higher applied suctions, up to 2,000 kPa, refer to the GCTS Unsaturated Soil Triaxial System designated USTX-100.
SPECIFICATIONS

1.1) FRM-10-P Load Frame
Two column vertical standing assembly with threaded columns for cross-head adjustment. 10 kN load capacity. Includes double acting Bellofram diaphragm air cylinder with 50 mm stroke and pneumatic servo valve for closed-loop control of axial load or axial displacement at frequencies up to 10 Hz. Includes:

- 50-mm (2 inch) stroke.
- ±10 kN Actuator load capacity.
- 8-mm peak-to-peak amplitude @ 5 Hertz frequency.
- SR-DF-NVT-50 Deformation sensor 50-mm range. 0.25% precision.
- SR-LC-SSM-10k Load cell +/-10 kN range. 0.05% precision.
- Manifold including on/off pressure control solenoid.
- High-Frequency pneumatic servo valve, 100 Hz bandwidth.
- Maximum vertical daylight opening: 940 mm.
- Horizontal daylight opening: 340 mm.

Note: Requires a 1,000 kPa clean, dry air supply.

1.2) TRX-100 Triaxial Cell
Three column stainless steel construction with external acrylic plastic cell wall. 1,000 kPa lateral confining pressure capacity. Includes lines for top and bottom specimen drainage, stainless steel loading piston, ball bushing guide, and low-friction (under 10 N) graphite seal. Accepts samples having a diameter of up to 70 mm with a length of 2.0 to 2.5 times the diameter.

1.3) TRX-ACC-70 Test Specimen Accessories
Set of test specimen accessories and end platens with top and bottom pore water pressure ports including the following:

- (1) Top and bottom 70 mm platens.
- (1) Spherical seat loading connection set.
- (1) Rigid loading connection for stress reversal.
- (1) Set of porous stones (top/bottom) for 70 mm end platens.
- (1) Spherical seat loading connection set.
- (1) Top and bottom 70 mm platen.
- (12) Latex membranes for 70 mm diameter specimens.
- (2) Set of O-rings for sealing membranes to platens.

1.4) PCP-200 Pressure Control Panel & Volume Change Device
Complete pressure control for triaxial and permeability testing. Dual use volume change device for triaxial and permeability testing. 150 cc capacity, and 0.01 cc resolution. Graded water level sight tubes for electronic and manual readings. Includes mounting platform for pressure transducers and necessary plumbing. Meets ASTM D3999-91 and D5311-92 pore water pressure measurement compliance requirements. Includes regulators for manual pressure control, precision pressure gage with 2.5 kPa resolution, regulated air supply to servo valve(s), Venturi vacuum pump, and necessary valves. 1,000 kPa pressure capacity. Requires clean, dry compressed air.

1.5) Computer Controlled Cell Pressure
Includes one EP-Valve and required fittings. Maximum pressure: 1000 kPa (150 psi).

1.6) Computer Control of Back Pressure
Includes one EP-Pressure Valve, one computer controlled ball valve for specimen drain line and required fittings. Provides complete automation of triaxial test including Saturation, Consolidation, and Shear loading stages without user intervention. Maximum pressure: 1000 kPa (150 psi).

1.7) Transducers
The following sensors are included to measure Axial Load, Axial Deformation, Confining Pressure, Effective Stress/Pore pressure, and Volume Change.

- (1) Load cell ±10 kN range.
- (1) Deformation sensor 50-mm range.
- (1) Confining Pressure Transducer 1,000 kPa range.
- (1) Effective stress (pore pressure) differential Pressure Transducer 1,000 kPa range.
- Volume change differential Pressure Trans. 500 mm H2O.

1.8) 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. Configured to read up to 8 transducers or inputs and control up to 4 servo or DC outputs.

- 850 MHz microprocessor and 128 MB solid state disk.
- 4 kHz maximum loop rate (100 kHz conversion rate between channels).
- 16-bit resolution.
- (5) DSB-111 Universal Signal Conditioning boards for load cells, LVDTs (AC and DC), pressure sensors, thermocouples, or other analog input signals. Each module includes digital (computer) controlled offset and gain. Anti-alias filter with 0-50 Hz Bandwidth.
- (3) DSB-113 ±10 volt DC input Board for general analog DC signals. Each module includes digital (computer) controlled offset and gain. Anti-alias filter with 0-50 Hz Bandwidth (can be updated to DSB-111’s at any time).
- (1) DSB-123 Servo Proportional Amplifier Board with 16-bit resolution, ±10 volt DC control output, and 24 VDC supply.
- (2) DSB-121 ±10 Volt DC Output Board with 16-bit resolution, ±10 volt output with 25 mA maximum current.
- (4) digital inputs and (4) digital outputs
- Watchdog timer to detect control program status for automatic interlock shutdown.
- TCP/IP and RS-232 communications.

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Dynamic Characteristic of Axial Loader (Displacement)

![Graph](image1.png)

Dynamic Characteristic of Axial Loader (Load)

![Graph](image2.png)

* Response measured under optimum conditions
1.9) Software
Windows 98/2000/NT/XP software with digital servo controller and testing environment shell including the following software modules:
- a) triaxial test module to automatically perform conventional triaxial static tests (UU, CU, and CD) as well as other advanced tests such as Stress-Path, Ko-Consolidation, etc. Includes procedures for back pressure saturation, consolidation, and shear loading.
- b) triaxial Dynamic test module to perform triaxial dynamic tests such as liquefaction, modulus measurement, cyclic strength, etc.

Note: System requires a PC computer and 1,000 kPa clean, dry air supply to operate. Computer and air compressor sold separately.

OPTIONS

2) Unsaturated Soil Testing Upgrade
Additional hardware to enable stress path triaxial system to perform unsaturated soils tests. Includes the following:
- (1) Pore Air Pressure Computer Controller (1,000 kPa capacity).
- (1) 1,000 kPa pressure transducer.
- (1) Signal conditioning modules for above pressure transducer.
- (1) Modified bottom platen with a High Air Entry Value (5 bar) ceramic disk recessed into the platen (platen with other HAEV values available).
- (1) Diffused air flushing manifold and plumbing

3) Compaction Split Mold for 70-mm (2.8”) diameter specimens
Forming mold/jacket stretcher for 70-mm specimens with a height of 2.0 times the diameter. Anodized aluminum construction with vacuum ports on each side. Includes internal grooves to distribute vacuum throughout the inner surface of the mold for even membrane expansion.

4) Accessories for 35 mm (1.4”) Diameter Test Specimen
Set of test specimen accessories for TRX100 and end platens with pore water pressure ports including the following:
- (1) Set of Top/Bottom platens.
- (1) Set of porous stones (top/bottom).
- (1) Forming mold/jacket stretcher for 35 mm specimens with a height of 2.0 times the diameter.
- (12) Latex membranes for 35 mm diameter specimens.
- (2) Set of O-rings for sealing membranes to platens for 35 mm specimens.

5) Internal Instrumentation Feed-Through Connectors
Includes four sealed feed-through connectors to accommodate different type of sensors like load cells, LVDTs, ultrasonic transducers, etc. Also includes four plugs for sealing the feed-through connectors while not in use.

6) Internal Load Cell: (0.5kN, 1 kN, 2 kN or 5 kN)
Internal submersible load cell including feed-through electrical connector. Available ranges: 0.5kN, 1 kN, 2 kN or 5 kN (specify range at time of ordering).

7) External Load Cell (2, 3 or 5 kN)
S-type external load cell with 2, 3 or 5 kN range and 0.05% accuracy. Includes calibration (specify range at time of ordering).

8) External Load Cell (10 or 20 kN)
S-type external load cell with 10 kN or 20 kN range and 0.05% accuracy. Includes calibration (specify range at time of ordering).

9) Internal/External Instrumentation for Small Strains
Soil Deformation Device for 70-mm specimens. Compatible with AASHTO T-274, AASHTO T-307-99 and SHRP-P46 specifications for Resilient Modulus Testing. Includes the following components:
- (1) Set of internal clamps to support two LVDT’s directly on test specimen to measure average axial strain.
- (1) LVDT holder for two LVDT’s to measure triaxial piston rod average deformation.
- (2) ±2.5 mm LVDT for axial deformation
- (2) Signal conditioning modules for above LVDT transducers.

- (2) Feed-through connectors.

10) Evacuation Chamber
Acrylic plastic chamber with vacuum port, water inlet, spray, and de-aired water outlet. Stores up to 10 liters of de-aired water. Requires vacuum source.

11) Controlled Gradient Consolidation Apparatus
Consolidation kit apparatus to perform Controlled Gradient (CG), Constant Rate of Strain (CRS), and Incremental (conventional) consolidation tests. To be used inside the triaxial chamber and loading frame listed above. Includes stainless steel specimen ring, porous stones, O-ring seals, and necessary plumbing.

12) Electro-hydraulic Servo Control of Axial loads for 20 Hz operation
Electro-hydraulic option for the performance of dynamic triaxial tests at up to 20 Hz. Substitutes the pneumatic loader and servo valve specified in item 1 with the following specifications:
- 12.1) Double Acting Hydraulic Loading Piston:
  20 kN load capacity, 50 mm stroke. Includes 19 LPM electro-hydraulic servo valve.
- 12.2) Electro-Hydraulic Pump System:
  19 LPM, 10 HP, 20 MPa variable volume constant pressure pump. 100 liter reservoir, oil temperature indicator, filter, pressure gage, valves, thermal and low fluid level shut off protection, heat exchanger, hydraulic hoses, accumulator, filter strainer, drain port and motor starter. Includes remote on/off controls. Voltage: 208, 230, 380 or 460 V / 50 or 60 Hz / 3-phase (please specify electrical power at time of ordering).

13) Computer Interface Unit
Hydraulic control unit with motor on/off control signal and solenoid control outputs. Front panel status indicators and remote emergency stop interlock. Watchdog timer to detect control program status for automatic interlock shutdown in case of computer power failure or control program malfunction.

14) Computer System
IBM-PC compatible computer and software to control and execute the test automatically.

14) Installation & Training (three days)
Installation assistance and training at customer facility. Includes air fare, lodging, food, etc.

WARRANTY
One (1) year parts and labor.

SHIPPING
Standard shipping volume: 1.0m x 1.3m x 1.0m
Standard shipping weight: 230 kg

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