





PRODUCT BROCHURE

EDITION 2018

TESTING SYSTEMS FOR SOIL AND ROCK

CONVENTIONAL AND UNSATURATED TRIAXIAL TESTING SYSTEM

Static axial load	Up to 150 kN
Confining pressure	Up to 3500 kPa
Pore pressure	Up to 3500 kPa
Sample size	30 mm to 150 mm

Conventional and unsaturated triaxial testing system

TABLE TOP ELECTROMECHANICAL CYCLIC TRIAXIAL TESTING SYSTEM

Static axial load	Up to 10 kN
Cyclic axial load	Up to 10 kN
Cyclic frequency	Up to 5 Hz
Confining pressure	Up to 3500 kPa
Sample size	Up to 100 mm

Electromechanical cyclic triaxial testing system (table top)

SERVO HYDRAULIC DYNAMIC TRIAXIAL TESTING SYSTEMS

Static axial load	Up to 25 kN
Cyclic axial load	Up to 25 kN
Cyclic frequency	20 / 100 Hz
Confining pressure	Up to 3500 kPa
Sample size	Up to 150 mm

Servo hydraulic dynamic triaxial testing systems

LARGE SCALE DYNAMIC TRIAXIAL TESTING SYSTEMS

Static axial load	Up to 1000 kN
Cyclic axial load	Up to 1000 kN
Cyclic frequency	Up to 100 Hz
Confining pressure	On request
Sample size	Up to 500 mm

Large scale dynamic triaxial testing systems

BACK PRESSURE SIMPLE SHEAR SYSTEM

Maximum shear force	5 / 10 kN
Maximum normal force	5 / 10 kN
Frequency	Up to 10 Hz
Cell pressure	Up to 1000 kPa
Back pressure	Up to 1000 kPa

Back pressure simple shear system

LARGE DIRECT SHEAR TESTING SYSTEM

Maximum shear force	250 kN
Maximum normal force	250 kN
Shear rate (infinitely variable, load independent)	30 – 0.00001 mm/min
Shear displacement	100 mm
Sample dimensions (W x L x H)	Up to 500 x 600 x 160 mm

Large direct shear testing system

DYNAMIC SIMPLE AND DIRECT SHEAR APPARATUS (DSS)

Shear load	Static and cyclic shear load: 5 / 10 kN
Frequency	0 – 5 Hz and 0 – 15 Hz
Resolution	0.0002 N
Axial load / Static axial load	5 kN (Cyclic load as option) / 10 kN
Resolution	0.1 N
Shear rate	0.00001 – 3800 mm/min
Strain amplitude (under load conditions)	2 mm / 5 Hz; 10 mm / 1 Hz

Dynamic simple and direct shear apparatus (DSS)

STATIC AND DYNAMIC RING SHEAR APPARATUS

Normal stress	1000 / 2000 kN/m²
Shear stress	1000 / 2000 kN/m²
Frequency	5 / 10 Hz (optional: 20 Hz)
Angle of rotation	Unlimited
Rotational rates	4500° – 0.00001°/min
Accuracy class	0.1%

Static and dynamic ring shear apparatus

TEMPERATURE CONTROLLED / TRUE TRIAXIAL TESTING SYSTEM

Load range	Up to 100 kN
Cell pressure	3000 kPa
Back pressure	2000 kPa
Frequency	1 – 10 Hz
Sample size (W x L x H)	75 x 75 x 150 mmm

True triaxial testing system (temperature controlled)

TEMPERATURE CONTROLLED DIRECT AND SIMPLE SHEAR SYSTEM (DSS)

Maximum shear force	5 / 10 kN
Maximum normal force	5 / 10 kN
Frequency	Up to 10 Hz
Cell pressure	Up to 1000 kPa
Temperature range	-20°C to +200°C

Direct and simple shear system (temperature controlled)

THERMAL CONSOLIDATION (THM) TESTING SYSTEM

Suitable for frozen tests and high temperature tests

The system ist comprised of an advanced THM consolidation cell for stress and strain controlled consolidation tests under temperature controlled conditions. Closed loop control of sample temperature is possible in order to accurately reach sample temperature. Special modules are required for temperature control.

Load range	Up to 100 kN
Vertical clearance	Up to 600 mm
Spindle lift	240 mm
Oedometer cells	Ø 20 up to 300 mm
Temperature range	-20°C to +200°C

Thermal consolidation testing system (THM)

HOLLOW CYLINDER APPARATUS

This high-quality and stiff multifunctional testing machine is suitable for static and dynamic, axial and torsional uniaxial and triaxial shear tests. It comes in two variations, hydraulic axial / torsional system, and electromechanical axial / torsional system.

Type of load frame	Electromechanical / servo hydraulic
Axial load	5 up to 150 kN
Cyclic axial load	5 up to 150 kN
Load frequency	2, 5, 10, 20 or 100 Hz
Torsional load	Customized
Sample size height / outer / inner 140 / Ø 70 / Ø 30 mm up to 600 / Ø 300 / Ø 150 mm	

Hollow cylinder apparatus

RESONANT COLUMN APPARATUS

The Wille Geotechnik® resonant column is a high quality apparatus that can determine the geotechnical properties of materials, such as soils for example, under a low strain range for solid- or hollow-cylindrical samples. The resonant column device, with a high-frequency electro-magnetic torsional drive, can be used to vibrate top soil specimens at frequencies up to 2000 Hz in first-mode resonance while the bottom is fixed, or in second mode, while the top and bottom are free.

Diameter of solid and hollow samples	38 / 50 / 70 / 100 and 150 mm
Cell pressure	1000 kPa (higher available)
Torsional frequency	Up to 2000 Hz
Applied pore pressure	Up to 1000 kPa

Customized on request

Resonant column apparatus

BIAXIAL DEVICE / PLANE STRAIN TESTING

Wille Geotechnik® offers a number of different types and sizes of biaxial devices, that allow for the direct testing of soils at real plane strain conditions. More accurate assessments of strength parameters and shear banding phenomena can be simulated in this test.

Different constructions and samples sizes are available.
The picture shows a special edition, which was manufactured for unsaturated soil testing in plane strain tests.

Biaxial cell

FULLY AUTOMATIC TABLE TOP ELECTROMECHANICAL CONSOLIDATION APPARATUS

(suitable for IL and CL tests)

This electromechanical, microprocessor-controlled apparatus for one-dimensional consolidation tests enables the fully automatic performance of incremental and optionally continuous load tests.

Load range	5 / 10 kN

Electromechanical consolidation apparatus (table top)

ROWE BARDEN CONSOLIDATION TEST SYSTEM

Sample area	20, 40, 70, 100 and 140 cm²
Sample height	20 mm (optional: up to 100 mm)
Pore pressure	Up to 1 MPa (optional 1.5, 3.5, 10 or 20 MPa)

Rowe Barden consolidation test system

ADVANCED K0 CONSOLIDATION CELLS

With radial stress measurements

Suitable for compression tests with constant or continuous loading tests with radial stress as well as optional pore water pressure measurement.

- Radial stress management
- Available as a standard K0 cell or in combination with CRS Consolidation cell

Pressure range	1000 and 4000 kPa (or customized)
Sample diameter	63 and 71.4 mm (other sizes available)

K0 consolidation cells

ADVANCED SOIL ANALYSER (ASA SYSTEMS)

These fully automatic universal testing devices are the result of years of our manufacturing experience developing soil testing machines, in particular related to wall friction compensation, guidance of shear boxes and repeatable production tests.

Uniaxial Compression Test

Direct Residual Shear Test

Simple Shear Test

Consolidation Test System

Triaxial Test

GEOTEXTILE TESTING DEVICES

Large scale pull-out test device standard:
ASTM 6706-01
EN 13738: 2004 for the determination of the pull-out friction of geotextiles and geomembranes

Large geotextile shear testing apparatus 500 x 500 mm for different material layers and double layer pull-out tests (for large size geogrids)

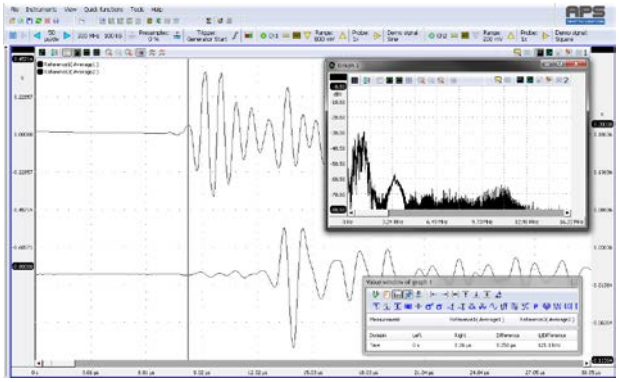
ULTRASONIC WAVE VELOCITY TEST SYSTEM

The ultrasonic velocity measurement system is a non-destructive method of measuring compression and shear waves through rock samples or stiff materials as a function of temperature, confining and pore pressures.

This is a complete system and is comprised of all required electrical and mechanical hardware e.g. signal conditioner and pulse generator, data acquisition controller, ultrasonic platens including combined P and S (S1 & S2) transducers as well as the required software.

Based on the length of the sample and travel-time from transmitter to receiver, ultrasonic wave velocities (Vp & Vs) are calculated and can be used with unaxial, triaxial or polyaxial test system. This simultaneously measures and calculates the static and dynamic properties of rock e.g. shear modulus (G), poisson's ratio (u), bulk modulus (K) and young's modulus (E), as well as other parameters.

Ultrasonic wave velocity test system



Data acquisition software for ultrasonic test system

Main Features

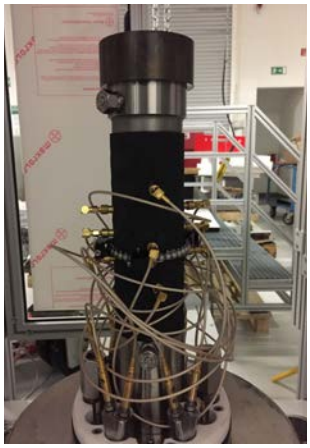
- Complete system for generating, receiving, converting and monitoring ultrasonic waves
- Combined P and S (S1 & S2) transducers
- Optional with pore pressure ports
- Low noise preamplifier to amplify ultrasonic signals
- Multiplexer up to 36 channels for conditioning and pulse generation, high speed data acquisition, and computer interface
- Available for vertical and/or horizontal methods
- Real-time graphics software with zoom and freeze functions for printer output at any given time
- All functions operated via mouse-click

Electronic controller for ultrasonic test system

Technical Specifications

Sampling rate of data acquisition board	Dual channel 200 MS/s (14 bit) Single channel 500 MS/s (14 bit) (16 bit interpolated)
Record length per channel	32.000.000 sampling points
Analog amplification	Max. 60 dB
Onboard trigger system	P- and S-Wave, Switching Frequency max. 100 Hz
Ultrasonic platens	38 mm to 150 mm
Working pressure	up to 210 MPa
Working temperature	up to 180 °C

Or customized on request



Acoustic emission test system

ADVANCED ROCK POLYAXIAL TESTING SYSTEM

This unique experimental testing system is a customized solution used to study the behaviour of rock under various dimensional and compressive stress regimes ($\sigma_1 \neq \sigma_2 \neq \sigma_3$).
This fits the research goals of geothermal energy researchers, hydrologists, petroleum reservoir engineers and researchers in the mining, geophysics and geotechnical sectors.

Options

- Hydraulic fracturing test
- Directional permeability test
- Pore or hydrostatic pressure
- System for measuring P- and S-wave in combination with acoustic emissions
- Temperature controlling up to 200 °C

Load type	Servo-hydraulic or electromechanic, 6 actuators (or 3 independent stresses)
Max. stress	Up to 600 MPa (depending on sample size)
Specimen size	Up to 300 * 300 * 300 mm
Permeability test	Steady state or transient

Customized on request

Polyaxial testing system

Sample installation

SINGLE OR COMBINED ROCK DIRECT SHEAR / TRIAXIAL TEST SYSTEM

The combined modular direct shear and triaxial test system is designed to determine the shear strength of intact, joint rock or concrete samples. Different sample sizes can be tested by the system, no matter if they are cylindrical, prismatic, cubical or irregularly shaped.

MAIN FEATURES

- Suitable for precise direct shear and triaxial tests on rocks, sliding surfaces and building materials.
- The shear boxes consist of a tilting free lower and upper shear frame, which is guided by linear bearings, a fixed upper shear frame and a guided load piston.
- Transparent test area guard with front security door
- The system is capable of applying different stress paths or strain rates.

Modular static and cyclic shear testing system

Load type	Servo-hydraulic
Axial force	Up to 5000 kN
Shear force	100 - 1000 kN
Specimen size	25 - 300 mm
Cyclic load	On request

Customized on request

ADVANCED ROCK TRIAXIAL TESTING SYSTEMS

These advanced rock testing plants enable our customers to meet all test requirements in rock research testing. The systems are able to test a range of materials from soft rock (e.g. sandstone) to hard rock and building materials of high-strength.

- Uniaxial tests (compression strength, indirect tensile (Brazilian test), direct tensile, fracture toughness, point load testing, bending)
- Triaxial strength tests
- Post failure test
- Hydraulic fracturing test
- Permeability test
- Ultrasonic wave measurement
- Acoustic emission tests

High pressure / high temperature triaxial test system

Load type	Servo-hydraulic or electromechanic
Axial load	Up to 5,000 kN
Confining and pore pressure	Up to 300 MPa
Working temperature	Up to 200 °C
Frame stiffness	Up to 10,000 kN/mm, >10 X 10^9 N/m
Sample diameter	Ø 25 - 100 mm

Customized on request

TEMPERATURE CONTROLLED PERMEABILITY TESTING SYSTEM

The permeability of rocks in core holders or different sample jigs is a crucial parameter in geothermal reservoir engineering. Due to possible errors in transient temperature condition measurements such as changes of viscosity, salt contents, or thermal expansion can occur. For an accurate permeability or porosity measurement most testing systems require temperature-controlled conditions. This device measures permeabilities under continuous flow or steady/non-steady conditions.

Pressure range	1 to 150 MPa
Temperature	Up to 300 °C

Temperature controlled permeability testing system

HIGH PRECISION SYRINGE PUMP

High precision piston pumps are digital microprocessor servo-controlled hydraulic actuators.
They are considered to provide continuous flow rates or constant pressures.
The syringe pumps are available in different models, like table top, stand floor oder modular version for higher flexibility at customers site (e.g. build-in system for temperature control, etc.).

- Mass flow and pressure control of fluids and gases
- Modular and expendable system
- Stainless steel and corrosion resistant pressure chamber
- Operation via touch panel or computer controlled
- Different communication protocols available, e.g. LabView, ASCII
- Ethernet and serial port included
- Temperature control available

High pressure syringe pump (stand floor)

High pressure syringe pump (table top)

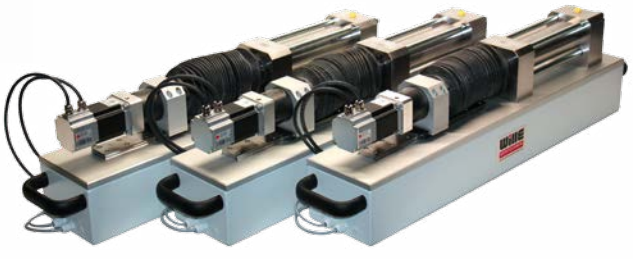
Pressure ranges	from 10 MPa up to 200 MPa (optional up to 400 MPa)
Pressure resolution	0.01 MPa
Volume	From 75 ml up to 1150 ml (depending on pressure range)
Flow range	0.00001 ml/min up to 300/150/150/80/50/40/20 ml/min

Customized on request

AUTOMATIC PRESSURE / VOLUME CONTROLLER (VPC)

Single automatic pressure / volume controller

Twin (Double) automatic pressure / volume controller with two independent outputs up to 300 bar



Triple automatic pressure / volume controller with three independent outputs up to 300 bar

Resolution (volume)	< 0.00001 ml
Resolution (stress)	0.1 kPa
Pressure range	50 to 3500 kPa
Interfaces	Serial port, Ethernet, USB

Customized on request

Core trimmer and cutting machine

Abrasiveness test machine (LCPC)

Core drilling machine

Cerchar rock abrasiveness tester

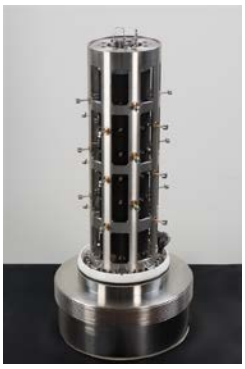
Grinding machine

Portable point load test apparatus

SENSORS

We offer a wide range of sensors and transducers for high-precision measurements for static or dynamic application.

- Radial deformation
- Axial deformation
- Circumferential deformation
- Pore pressure
- Force
- Submersible load
- Ultrasonic wave
- Acoustic emission
- Electrical conductivity



Acoustic emission test system

Circumferential deformation measuring device

Axial deformation measuring device

HYDRAULIC FRACTURING TESTING SYSTEMS

Hydraulic fracturing is performed to determine the magnitude and direction of the in-situ stress in the process of fluid pumping with an injection rate into a cavity hole that subsequently leads to an increase in pressure and formation of tensile fracturing in the cylinder wall.
Breakdown pressure is defined as the wellbore pressure when inducing hydraulic fracturing.

High pressure syringe pump

Applications:

- Study of hydraulic fracture initiation and propagation
- Testing with a variety of fluids and additives (water, brine and oil)

Technical Specifications

Confining pressure	Up to 300 MPa
Pore pressure rate	1 up to 300 MPa
Flow rates from	0.001 µl up to 1000 ml/min
Core diameter	25 mm to 102 mm

Custom sample sizes on request

Example of a fractured rock sample

GEOSYS Professional

GEOsys is a multi-functional, modular, controlling and data acquisition software for Windows. It allows for the simple programming of complex, user defined test sequences via structured Windows instructions on a graphic user interface.

GEOsys utilizes a flexible, programmable system that controls test appliances that coordinate various test operations. The flexible operating panel provides tools to configure the appliance, editors to carry out load procedures and functions for analysis, presentations and logs.

The software is designed to support a modular structure for the test environment to enable flexible configuration and thus fulfil the specific requirements of the company.

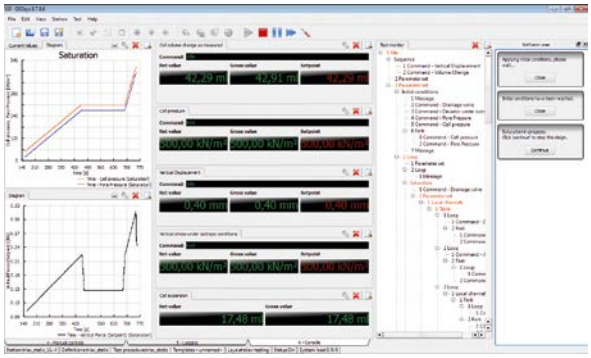
The important key feature of this software is the ability to allow users to simply and freely program standard or complex test sequences with structured Windows operations via a graphic user interface.

Thanks to the wide range of options GEOsys offers, it is not only compatible with our products, but can also be used with hardware from other manufacturers. This works towards data acquisition and test controlling for hardware of a similar or more advanced standard.

MAIN FEATURES

- Unique platform to address all testing needs, be it soil, asphalt, rock or building material related, both dynamically and statically
- Controlling and data acquisition software
- Simultaneous loops for all connected actuators
- Freely programmable test sequence control and formula editor
- Complete real-time data-acquisition and closed-loop control for each channel, using real parallel configured channels
- Flexible and user-friendly
- Supporting functions of similar manufactures
- Options concerning data conversion in ASCII
- Digital setting of PID parameters (parameter optimizing or tuning depending on the material) even during operation
- User roles (administrator, service, developer, lab assistant) for easy handling – decreasing the likelihood of errors
- OS platform independent software (e.g. available for WINDOWS, LINUX or MAC OS X)
- Allows users to simply and freely program standard or complex test sequences with structured Windows operations via a graphic user interface.
- Suitable for up to any number of simultaneous and independent real-time, closed-loop controlled channels, machines or test devices. For example axial load, confining pressure, pore water pressure, and pore air-pressure
- Management of hardware components
- User supplied, calculated measurements
- Languages: English, German, Russian, Chinese

The advantage of the new software is in its application. Even inexperienced users are able to program complex checking processes within a short space of time.



Soil test modules

- Triaxial tests; statics and dynamics
  - UU: unconsolidated-undrained
  - CD: consolidated-drained with pore pressure measurement
  - CU: consolidated-undrained with pore pressure measurement
- Stress path triaxial tests (p, q and s, t)
- Unsaturated tests
- Permeability tests
- Low cyclic testing
- Uniaxial compression tests
- Resilient modulus tests
- Frozen soil tests
- Compression tests
- K0 Consolidation test
- Swell and swell pressure tests
- Direct residual shear test
- Cyclic shear test
- Simple shear test
- Cyclic simple shear test
- Ring shear test
- Cyclic ring shear test
- Hollow cylinder test
- Resonant column test
- Oedometer tests
- Laboratory shear vane test
- CBR test
- Unbound material testing
- Data acquisition

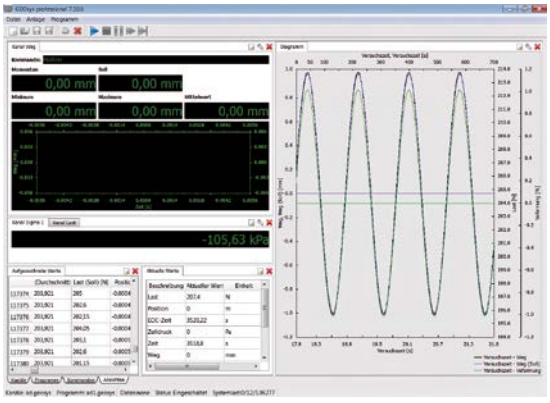
Rock test modules

GEOsys is designed for closed-loop controlled static and dynamic tests for all test applications in material testing, such as stress-controlled, strain-controlled, all stress paths, loops any kind of waveforms like sine, rectangle, triangle and predefined waves.

GEOsys is a controlling and data acquisition software and also has different modules to run tests according to ASTM or ISRM methods.

Depending on the requirement of the customer, a single or several modules can be delivered with the main software.

- Uniaxial compression tests
- Uniaxial creep tests
- Indirect tension tests on rock specimens
- Direct Tension tests on rock specimen
- Fracture toughness according to the recommendations of ISRM
- Strength of rock tests
- Angle of internal friction
- Poisson's ratio
- K ratio
- Adhesive force (cohesion)
- Ultimate and breaking strength
- ASTM, Triaxial compression strength test
- ASTM, Rock core creep test software in triaxial compression
- ISRM Rock triaxial compression test software
- Static rock shear testing
- Cyclic rock shear tests
- Rock permeability tests
- Temperature control tests
- Rock polyaxial tests
- Data acquisition



About us

APS GmbH offers different testing machines and also extensive expertise and knowledge. This comes from more than 25 years of experience in this field helping you support and manage your testing to the highest standards.

APS GmbH, with its brand “Wille Geotechnik®”, develops and produces standard and fully automated testing machines. These enable engineers to determine the mechanical characteristics and bearing capacity of material by uniaxial and triaxial shearing tests. Our high resolution transducers and individual adjustable controlling software lead to highly accurate strain analysis.

- Over 25 years experience
- Standard testing systems
- Customized testing system
- Calibration
- Modernisation
- Worldwide service and support

Make it unique

With many years of experience we are able to tailor our products and services to your aims and needs.

Our customized solutions can help you achieve unique and specific requirements. We approach each project individually and openly and would be proud to support you in achieving the desired laboratory testing system.

We have the knowledge and experience to help with a variety of testing systems, for example:

- Soil and rock mechanic research
- Geothermal energy development
- Geotextile/geosynthetics
- Gas hydrate
- Frozen soil tests
- High temperature tests
- Mining and construction
- Tunneling
- Earthquake mechanics

Made in Germany

Wille® GEOTECHNIK

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