FULLY AUTOMATIC TEMPERATURE CONTROLLED PERMEABILITY TESTING FOR ROCKS

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.

Applications
- Geothermal soil and rock testing
- Mining projects
- CO₂ injection
- Hydraulic fracture test
- Gas and oil reservoirs
- Gas hydrates

Features
- Automatic electromechanic corrosion resistant volume/pressure-controller for constant volume flow or constant pressure (ramps)
- Applicable for various testing fluids (such as water, corrosive fluids and gases)
- Different control interfaces are available depending on customer’s requirements
- Different specimen sizes, test jigs and permeability cells

Available Specifications
- Pressure range 1 to 150 MPa
- Temperature up to 300 °C

HIGH PRESSURE TRIAXIAL AND PERMEABILITY SYSTEM FOR CORROSIVE FLUIDS AND BRINES

High pressure and high temperature test systems for investigation of temperature controlled behaviour of gas/fluid/soil or other solid matter compounds.

Features
- Standard and stress path triaxial tests
- Consolidation tests
- High precision strain, stress and position control
- User defined test procedures with the flexible GEOsys software
- Several upgrade options:
  - Unsaturated soil testing
  - Wave velocity measurement
  - Acoustic emission tests

Technical Specifications
- Static axial load up to 1000 kN
- Confining pressure up to 70 MPa
- Temperature range up to 200 °C
- Specimen diameter up to 150 mm

Or customized on request
ADVANCED UNIAXIAL 
AND 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 with high-strength.

The modular systems can be configured with various types of hydraulic actuators with different load ranges, a variety of test jigs, triaxial cells with different specimen diameter and pressure ranges, pressure controllers, as well as different sensors with the necessary attachments.

Advanced software packages and further accessories can also be arranged to suit your specific testing needs.

A variety of jigs and attachments to perform uniaxial compressive strength, triaxial strength, post failure, bending, indirect tensile, direct tensile, fracture toughness, creep, flexural and cyclic loading tests are available.

Features

- Uniaxial compression test (e.g. e-modulus)
- Creep tests of cylindrical specimens in uniaxial compression
- Direct tension tests
- Indirect tension tests (Brazilian Test)
- Fracture toughness tests
- Triaxial test configuration

Technical Specifications

<table>
<thead>
<tr>
<th>Load type</th>
<th>servo-hydraulic or electromechanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial load</td>
<td>up to 5,000 KN</td>
</tr>
<tr>
<td>Confining and pore pressure</td>
<td>up to 300 MPa</td>
</tr>
<tr>
<td>Working temperature</td>
<td>up to 200 °C</td>
</tr>
<tr>
<td>Frame stiffness</td>
<td>up to 10,000 kN/mm, &gt;10 X 10^9 N/m</td>
</tr>
<tr>
<td>Sample diameter</td>
<td>Ø 25 - 100 mm</td>
</tr>
</tbody>
</table>

Or customized on request
TEST SYSTEMS FOR GAS HYDRATE

This gas hydrate-testing system is designed to produce and test gas hydrate sediments under uniaxial and triaxial conditions, at low temperatures and high pressures. The cell can be pressurized up to 40 MPa with a constant temperature between -40°C to 40°C (or any specific temperature).

This modular testing system consists of different components, e.g. a loading frame, pressure controller, etc. The system can be equipped with various sensors and components to monitor experiment progress (e.g. CO₂ trapping).

Main Features

- Special piston pumps to apply back or pore pressure using various gaseous media for example, methane, carbon dioxide, nitrogen or etc.
- Different types and ranges of in-vessel transducers (on sample), for example, load cells, axial displacement, circumferential transducers, wave velocity, acoustic emission and electrical impedance
- Expandable real time high resolution data acquisition and closed-loop control systems
- Controlling software for flexible test procedures of all uniaxial, triaxial or polyaxial test applications with pore pressure and permeability
- Freely programmable test stages with interactive, calculated parameters and procedures via GEOsys software

Different upgrading features

- Radial injection of sub-/supercritical CO₂
- Discharge and quantification of sediment
- Sample volume change determination
- Ultrasonic measurements (P, S₁, S₂),
- Electrical resistivity/impedance tomography (ERT)
- Accessories for permeability tests
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 or 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. The high stiffness system with different accessories and options offers the possibility to perform a variety of tests with one single device.

GEOsys software, with several testing modules/applications for triaxial, uniaxial and direct shear tests, in-line with ASTM, ISRM or national standards. Additionally the system can work fully automated system and provides an easy way to create custom test modules.

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.
- Expandable real-time high resolution data acquisition and closed-loop control system (20 bit)
- Transparent test area guard with front security door
- High-speed, closed-loop control of load, displacement, position and volume or flow
- The system is capable of applying different stress paths or strain rates
- Load independent shear rates (shear stress optionally) via micro-processor controlled high quality servo-valve
- Real-time graphics software with zoom and freeze functions for printer output at any time (after and during the test)

Technical Specifications

<table>
<thead>
<tr>
<th>Load type</th>
<th>servo-hydraulic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial force</td>
<td>up to 5000 kN</td>
</tr>
<tr>
<td>Shear force</td>
<td>100 - 1000 kN</td>
</tr>
<tr>
<td>Specimen Size</td>
<td>25 - 300 mm</td>
</tr>
<tr>
<td>Cyclic Load</td>
<td>on request</td>
</tr>
<tr>
<td>Or customized on request</td>
<td></td>
</tr>
</tbody>
</table>
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 to the research goals of geothermal energy researchers, hydrologists, petroleum reservoir engineers and researchers in the mining section, geophysics and geotechnical sectors.

The system is capable of testing a wide range of materials from granite to mudstones and also for post-failure regime of high-strength brittle rocks.

Polyaxial rock testing systems are designed to induce stress on cubic samples via three independent controlled principal axes ($\sigma_1 \neq \sigma_2 \neq \sigma_3$) up to 600 MPa (depending on sample size).

The sample chamber can house cubic samples up to 300 x 300 x 300 mm and has the option to be equipped with a temperature control up to 200 °C as well as a pore pressure device up to 210 MPa and the ability to have ultrasonic, acoustic emission and permeability testing.

The complete system is fully automated and controlled by our flexible and programmable GEosys Software. Various sensors, transducers, testing and experiment options are available.

**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

**Technical Specifications**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Load type</td>
<td>servo-hydraulic or electromechanic, 6 actuators (or 3 independent stresses)</td>
</tr>
<tr>
<td>Max. stress</td>
<td>up to 600 MPa (depending on sample size)</td>
</tr>
<tr>
<td>Specimen size</td>
<td>up to 300<em>300</em>300 mm</td>
</tr>
<tr>
<td>Permeability test</td>
<td>steady state or transient</td>
</tr>
</tbody>
</table>

*Or customized on request*
NEW “PATERSON APPARATUS”
ULTRA HIGH PRESSURE - HIGH TEMPERATURE GAS TRIAXIAL CELL

In the 1960s-80s, Prof. Mervyn Paterson at the Australia National University (ANU) developed a unique gas-media deformation apparatus.

In 2018 APS-Wille Geotechnik® now presents a new modified and upgraded generation of these sophisticated high pressure high temperature internally heated pressure vessel system aiming to perform complex rock triaxial experiments at elevated P-T conditions. This triaxial system axial stresses down to approximately 13 km, using gas as pressurizing medium. With features for measuring pore size distribution and analysis or the determination of e.g. fluid/gas permeability in rocks.

Main Features
- Cell made of special, non-corrosive steel
- Pressure-compensated internal and external load cell
- Different high pressure feed-throughs
- Multi-zone furnace with a number of integrated thermocouples for direct temperature measurement and control
- Gas and fluid permeability tests

Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. cell pressure</td>
<td>400 (600) MPa</td>
</tr>
<tr>
<td>Max. temperature</td>
<td>650 °C up to 1200 °C (optional)</td>
</tr>
<tr>
<td>Sample sizes</td>
<td>Ø 24 mm / Height 50 mm</td>
</tr>
<tr>
<td>Axial stresses</td>
<td>1-2 GPa (depending on sample size)</td>
</tr>
<tr>
<td>Pore pressure</td>
<td>300 MPa (optional higher)</td>
</tr>
<tr>
<td>Options</td>
<td>Torque actuator</td>
</tr>
<tr>
<td></td>
<td>Ultrasonic System (P&amp;S)</td>
</tr>
</tbody>
</table>

*Or customized on request*

High pressure/high temperature triaxial deformation apparatus
“SYNCHRO CT” MATERIAL TESTING SYSTEM

Simultaneous CT Uni- and Triaxial Test System

The unique development includes a special frame design and integrated X-ray CT system, which opens a new world of possibilities for dynamic and static uniaxial or triaxial test procedures in geotechnics and material testing under environmental conditions. Sample’s porosity, crystallization and dissolution, exchange of pore fluids, pre- and post-failure geometry or even crack propagation can be now monitored in-situ during testing, also in time resolved manner.

The system is suitable for a wide range of analysis between pore size, fluid and material like soils, gas hydrate bearing sediments, rocks, concrete, asphalt and synthetic construction materials.

Main Features

- Simultaneous real-time CT triaxial test system
- CT-ready load frame design with different test spaces for small to large sizes from 5 to 500 mm diameter and 1500 height
- Max. vertical load from 100 up to 5000 kN
- High potential for upgrades (visualization systems e.g. µ-CT, AE, ERT, custom made test jigs and environmental chambers etc.)
- Low noise hydraulic system
- Triaxial conditions with confining pressures from 0.1 to 100 MPa (or on request)
- Environmental temperature control between -20 and 200 °C as an option
- Pore pressure control system suitable for experiments with different standard or aggressive fluids
- Ultrasound investigations between end-caps
- State of the art close loop control and data acquisition system
- CT resolution > 5 µm
HIGH PRESSURE CONSOLIDATION SYSTEM FOR BOREHOLE SIMULATION

The High-Pressure Consolidation System for Borehole Simulation is a high-end apparatus designed for conducting experiments on cemented soil samples to perform a soil grouting procedure under in-situ geological stresses and simulate petroleum recovery processes at conventional production flow rates.

The device enables conducting consolidation, cementation, saturation, ultrasonic measurement, sample perforation and sand production experimental stages.

The capability of the system operating with special cementing agents (e.g. "CIPS"), reutilization of discharged liquids, extrusion of samples, etc. makes it unique within soil testing devices.

Technical Specifications

- Servohydraulic compression load frame in combination with a hydraulic power pack and digital high-speed controller for axial loading up to 5 MN under stress or position control
- Corrosion protected consolidation cell with inner space Ø 300 x 250 mm can be equipped axially and radially with radial stress, ultrasonic transmission sensors, cell and pore pressure sensors, etc.
- Servo-pneumatic pressure regulator (APC) in combination with medium separator for injection of highly corrosive liquids or gases up to 10 bar under pressure control
- Hydraulic pressure actuator (piston pump) for all-around fluid injection into the cell up to 70 bar under flow and pressure control in combination with 1 m3 liquid reservoirs (e.g. for water, oil)
- Digital mass flow meter for a direct measurement of a single and multiphase mass flow (oil, water, gas) in a range 0.1 – 5.5 l/min under up to 70 bar pressures, suitable for high-viscous oils up to 600 cP
- Ultrasonic sensor system for acoustic wave generation (max. 1 MHz) and measurement of travel-time through the sample for determination of sample’s stiffness properties.
- Automatic multi-channel control and data acquisition software GEOsys for stress, strain, position, pressure or flow-controlled test procedure
HIGH PRESSURE TRIAXIAL CELLS

Advanced high-pressure triaxial cell with up to 300 MPa for different specimen diameter with cell lifting (as optional item) is designed for testing the physical parameters (e.g. shear and creep characteristics) of rock core samples or solid materials (e.g. granites, evaporates, cemented tills or clays) under triaxial stress conditions.

Features

- Applicable for Triaxial shear tests optionally expandable for:
  - In-vessel load cell
  - In-vessel deformation measuring devices
  - Permeability test equipment
  - Ultrasonic material testing equipment
  - Acoustic emission testing equipment
- Cell made of annealed special steel or corrosion resistant steel, depending from the test application
- Cell is comprising exchangeable end caps for different applications and load pistons for different sample diameter
- Including of High-pressure electrical feed-through ports for all internal transducers covered up to 200 MPa
- Permeability end caps for corrosive pore fluids with standard fluid distribution grooves

Technical Specifications

<table>
<thead>
<tr>
<th>Material</th>
<th>Stainless steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confining pressure rating</td>
<td>up to 300 MPa</td>
</tr>
<tr>
<td>Pore pressure rating</td>
<td>up to 300 MPa</td>
</tr>
<tr>
<td>Max. sample diameter</td>
<td>up to 102 mm</td>
</tr>
<tr>
<td>Max. sample height</td>
<td>up to 250 mm</td>
</tr>
<tr>
<td>Operation temperature</td>
<td>up to 250 °C</td>
</tr>
</tbody>
</table>

Custom sample sizes on request

Note: Above technical specifications can be optimized upon request.
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

CIRCUMFERENTIAL AND AXIAL EXTENSOMETER

The transducer-test kit consists of a circumferential deformation-measuring device using a specially manufactured sensitive roller-chain, a high-quality LVDT displacement transducer (extensometer) and a high-pressure cable with a quick connector to adapt to high-pressure cable ports.

A sample attachment kit can be used to help the extensometers work with a variety of sample diameters. Axial extensometers can be mounted simultaneously with circumferential extensometers.

The axial extensometer is placed between two clamps which are mounted on the rock sample to be tested – this is done using coil springs to avoid platen interference.

This series of extensometers is ideal for a variety of test types, such as:

- Uniaxial compression-tension testing under temperature controlled conditions
- High-pressure high-temperature triaxial tests
- Hydrostatic compression
- Asphalt, concrete or rock samples

Technical Specifications

<table>
<thead>
<tr>
<th>Operating pressure</th>
<th>up to 210 MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>various options up to 180°C</td>
</tr>
<tr>
<td>Measuring range</td>
<td>+/- 2.5; +/- 5; +/- 10 mm</td>
</tr>
<tr>
<td>Sample diameters</td>
<td>various versions from 28 mm to 150 mm</td>
</tr>
<tr>
<td>Linearity</td>
<td>0.1% FS</td>
</tr>
<tr>
<td>Accuracy class</td>
<td>0.5</td>
</tr>
<tr>
<td>Output signal</td>
<td>+/- 10 VDC</td>
</tr>
<tr>
<td>Signal condoning</td>
<td>0-10 V</td>
</tr>
</tbody>
</table>

The transducer-set has different configurations, which can consists of single or dual axial deformation transducers (triple is optional between compression platens). The dual transducer can be located 180° apart on the sample and has dual outputs, which can be recorded separately or averaged.
HIGH PRECISION SYRINGE PUMPS

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 or modular version for higher flexibility at customers site (e.g. build-in system for temperature control, etc.).

High accuracy mass flow and pressure control of fluids and gases for applications, e.g., rock core analyzing, reservoir engineering, oil and gas production enhancement studies and reactor feed/chemical synthesis in chemical process.

Main Features

- Mass flow and pressure control of fluids and gases
- Modular and expendable system
- Compact and space saving design
- Stainless steel and corrosion resistant pressure chamber
- Integrated limit switches and pressure overload limits (safety stop)
- Operation via touch panel or computer controlled
- Different communication protocols available, e.g., LabView, ASCII
- Calibration of the sensors via operator panel

Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure ranges</td>
<td>From 10 MPa up to 200 MPa (optional up to 400 MPa)</td>
</tr>
<tr>
<td>Pressure resolution</td>
<td>0.01 MPa</td>
</tr>
<tr>
<td>Accuracy (standard)</td>
<td>0.2 (0.1 or 0.05 %)</td>
</tr>
<tr>
<td>Accuracy (optional)</td>
<td>&lt; 0.05 % F.S. (temperature compensated)</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>Standard +5 to +40 °C</td>
</tr>
<tr>
<td>Volume</td>
<td>From 75 ml up to 1150 ml (depending on pressure range)</td>
</tr>
<tr>
<td>Flow range</td>
<td>0.00001 ml/min up to 300/150/150/80/50/40/20 ml/min</td>
</tr>
<tr>
<td>Flow accuracy</td>
<td>0.01 %</td>
</tr>
<tr>
<td>Plumbing ports</td>
<td>Customised / Swagelok</td>
</tr>
<tr>
<td>Output ports</td>
<td>Ethernet and serial port / analogue output</td>
</tr>
<tr>
<td>Working Temperature range (option)</td>
<td>Customized from -20 or +100 °C, or external solution</td>
</tr>
<tr>
<td>Wetted parts</td>
<td>High corrosion resistant stainless steel (optional: Hastelloy C-276)</td>
</tr>
</tbody>
</table>

Or customized on request

Note: Flow rates (max. and min.) always depend on the technical configuration of the pump (pressure, volume etc.). Please contact us for detailed information about how we can help with your testing demands.
CERCHAR ROCK ABRASIVENESS TESTER


The cerchar rock abrasiveness tester is used to determine the CERCHAR Abrasivity Index (CAI) value in accordance with the ASTM D7625-10 standards.

An accurate stainless steel weight is used for axial test loads of 70 N in combination with a cross-table. The cross-table allows for the highly precise movement of samples in a clamping device.

Technical Specifications

- Axial load: 70 N
- Maximum sample height: 200 mm
- Maximum ample diameter: Ø 80 mm

Or customized on request

ABRASIVE TEST MACHINE (LCPC)

Normalised according to AFNOR P18-579

The abrasive nature of rock is an important factor when designing appropriate testing machinery. The impact on tool wear much depends on the machinery used for excavation. This includes all devices and tools that come into contact with the material being excavated. The most technical way to determine rock abrasivity is to use an index laboratory test as well as LCPC.

Technical Specifications

- Rotational speed: 4500 rpm, adjusted electronically
- Dimensions (approx.): 500 × 600 × 1900 mm
- Power supply: 3 x 400 VAC, 50 Hz, 16 A plug IEE
- Power consumption: app. 1,5 kVA
- Miniature fuse: PKZM motor protection 2-5 A adjustable lifting drive LS C 3A

Or customized on request
**CORE DRILLING MACHINE**

This core drilling machine is used in laboratories to cut cores from uniform and non-uniform hard samples, such as rock, natural stone and concrete. The 3 kW electric motor is equipped with a 4-speed mechanical gearbox to provide high torque drilling capability throughout the drilling speed range. This enables the drill bit to maintain speed under loading to produce a uniform core sample.

**Technical Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor power</td>
<td>3 kW</td>
</tr>
<tr>
<td>Coring speed</td>
<td>240/580/1160/2220 rpm</td>
</tr>
<tr>
<td>Coring range</td>
<td>AX to NX</td>
</tr>
<tr>
<td></td>
<td>from 8 to 150 mm diameter</td>
</tr>
<tr>
<td>Level of acoustic power emitted by the LWA device</td>
<td>98 dB (A)</td>
</tr>
<tr>
<td>Dimensions (approx.)</td>
<td>900 × 900 × 2200 mm</td>
</tr>
<tr>
<td>Weight (approx.)</td>
<td>350 kg</td>
</tr>
</tbody>
</table>

*Or customized on request*

**CORE TRIMMER AND CUTTING MACHINE**

The cutting machine is used to cut rock samples of irregular shapes, rock cores, as well as surfacing and machining the ends of the cylindrical or cubical samples.

**Main Features**

- Stainless steel cutting bed
- Compact, powerful, easy and quick operation
- Maximum safety standards with electronic brake and interlocking safety device
- Includes cooling fluid inlet for cutting blade
- Transparent sample holder chamber
- It can work with big samples by placing them upside down in the device
- Special clamping devices for non-uniform samples can be provided upon request

**Technical Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheel speed</td>
<td>2800 rpm</td>
</tr>
<tr>
<td>Operation</td>
<td>manual</td>
</tr>
<tr>
<td>Wheel Diameter</td>
<td>Ø 250 mm / Ø 350 mm</td>
</tr>
<tr>
<td>Cutting Capacity</td>
<td>Ø 90 mm / Ø 115 mm</td>
</tr>
<tr>
<td>Cutting Capacity</td>
<td>50 x 165 mm / 50 x 195 mm</td>
</tr>
<tr>
<td>T-Slot table dimension</td>
<td>255 x 250 mm</td>
</tr>
</tbody>
</table>

*Or customized on request*
GRINDING MACHINE

This grinding machine has two electronic motors and is used for the vertical grinding of rock samples on two parallel sides. It can be used for working with natural stones, concrete, as well as ceramic and other materials.

The grinding distance can be adjusted in micrometres for various sample lengths from 50 to 320 mm via a hand wheel.

Cube or cylinder samples are easily locked in place on the grinding table. Grinding is carried out automatically by moving the sample from one side to the other side through the grinding wheels.

The machine is equipped for grinding cubic samples from 50 mm to 200 mm in size, as well as cylindrical samples with diameters from 50 to 150 mm.

Technical Specifications

<table>
<thead>
<tr>
<th>Dimension</th>
<th>1800 × 1500 × 1700 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (approx.)</td>
<td>350 kg</td>
</tr>
<tr>
<td>Electrical connection</td>
<td>400 V, 50 Hz</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>Cooling unit capacity (available on request)</td>
<td>50 l/h</td>
</tr>
</tbody>
</table>

Or customized on request

PORTABLE POINT LOAD TEST APPARATUS

The portable point load tester provides an index for the strength classification of hard rocks and allows for a quick, non-expensive on-site evaluation of hard rock strength.

The rock sample is mounted between two hardened cones to apply the point load. The peak-applied load is recorded and used to calculate the point load index.

The standard test-set consisting of:

- Hydraulic cylinder with conical pistons
- Hydraulic pump
- Digital-manometer with pressure and load display
- Base plate
- Operator protection set

Ordering Information:

- Version with digital precision pressure gauge Cl. 0.1% with maximum memory, IP 65, resolution 0.1 kN
- Version with analogue pressure gauge, pressure range: 0 – 100 kN and 0 – 25 kN, accuracy: 1.0 kN resp. 0.5 kN
- Digital measuring device for axial strain
- Splinter protection
- Test set for uniaxial test includes lower and upper platens Ø 110 mm
- Test set for indirect tensile test (Brazilian test) for Ø 50/60 mm or Ø 80/90 mm includes hardened moulds and ball adapter
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 (μ), bulk modulus (K) and young’s modulus (E), as well as other parameters.

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

Technical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling rate of data acquisition board</td>
<td>Dual channel 200 MS/s (14 bit)</td>
</tr>
<tr>
<td></td>
<td>Single channel 500 MS/s (14 bit)</td>
</tr>
<tr>
<td></td>
<td>(16 bit interpolated)</td>
</tr>
<tr>
<td>Record length per channel</td>
<td>32,000,000 sampling points</td>
</tr>
<tr>
<td>Analog amplification</td>
<td>Max. 60 dB</td>
</tr>
<tr>
<td>Onboard trigger system</td>
<td>P- and S-Wave, Switching Frequency max. 100 Hz</td>
</tr>
<tr>
<td>Ultrasonic platens</td>
<td>38 mm to 150 mm</td>
</tr>
<tr>
<td>Working pressure</td>
<td>up to 210 MPa</td>
</tr>
<tr>
<td>Working temperature</td>
<td>up to 180 °C</td>
</tr>
</tbody>
</table>

Or customized on request
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.

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

Technical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confining pressure</td>
<td>up to 300 MPa</td>
</tr>
<tr>
<td>Pore pressure rate</td>
<td>1 up to 300 MPa</td>
</tr>
<tr>
<td>Flow rates</td>
<td>0.001 µl up to 1000 ml/min</td>
</tr>
<tr>
<td>Core diameter</td>
<td>25 mm to 102 mm</td>
</tr>
</tbody>
</table>

Custom sample sizes on request

DIGITAL CONTROLLER SYSTEM

Different digital real-time multi-channel control systems (20 bit) with closed-loop control for static and dynamic applications.

Features
- High performance real-time multi-channel controller system
- Expandable up to any number of controller with master/slave function
- High speed high resolution closed-loop control (up to 24 bit)
- The controller is a real digital controller. That means, all adjustments like PID parameters will be done by the software.
- This offers a smooth bumpless transfer between load-, position- and strain control.
- Almost all kinds of analog or digital transducers can be connected via plug-in cards.
- Communication using Ethernet and serial ports
GEOSYS Professional

GEOSys is a multi-functional and modular controlling and data acquisition software in 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 so as to enable a 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.

Main Features

- Unique platform to address all testing needs, be it soil, asphalt, rock or construction related, both dynamically and statically
- Controlling and data acquisition software
- Simultaneous loops for all connected actuators
- Free 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 manufacturer
- 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)
- Ability to allow 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, such as axial load, confining pressure, pore water pressure, as pore air-pressure
- Management of hardware components
- User supplied, calculated measurements
- Languages: English, German, Russian, Chinese

Thanks to the wide range of abilities Geosys offers, it is not only compatible with our products, but it can also be used with hardware from other manufacturers, providing data acquisition and test controlling for hardware of a similar or more advanced standard.
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. The software opens up the possibility of optimizing the machine regulation during operation. The effects of the automatic controller adjustments become immediately visible in the diagram.

PID control data is storable as a file, so different test programs with the automatic controller adjustments optimized particularly for it can be carried out.

More Features

- Simultaneous loops for all connected actuators
- Peak-control of cyclic and dynamic set-parameters
- Complete real-time data-acquisition and closed-loop control for each channel using real parallel configured channels
- It includes of transducer library, wave-shape and test library
- Analogue and status display, as well as real-time graphics with zoom and freeze functions for printer output at any time, after and/or during the test
- Individually modifiable data acquisition
- Each channel can be controlled by any transducer or parameter (load, displacement, pressure) using the digital calibration and PID-parameter setting software windows
- Individually configurable data acquisition, such as collecting rate, parameter setting, recording type (e.g. ASCII)
- Interactive change of test parameters for all channels or test devices
- Various platforms for operators and different users for system parameter settings, for example, configuration, PID-Parameters, transducer configuration, and range plausibility
- Integrated simulation. For instance, functionality can be checked without installing a sample

Rock test modules

GEOsys is designed for closed-loop controlled static & 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 controlling and data acquisition software and also has different modules to run tests according to ASTM or ISRM methods.

Depends on the requirement of the customer one or several modules would be delivered with main software.
About us

APS Antriebs- Prüf- und Steuertechnik GmbH (drive test and control technology company) is a highly regarded German enterprise due to its soil, rock, asphalt and material testing machines, which are marketed under the brand name “Wille Geotechnik”.

The initial activities of the company began in the 1990s in cooperation with universities and the implementation of research activities and development of scientific equipment. The contact and collaboration with such institutes remains strong to this day, and has developed over the past years with the APS GmbH having now over 40 employees.

Make it in Germany

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:

- Exploration and production of fossil fuels
- Gas hydrate
- Mining and construction
- Tunneling
- Geothermal energy development
- Rock mechanics research
- Earthquake mechanics