



# PRODUCT CATALOGUE

EDITION 2016



**Dear Reader,**

APS Antriebs- Prüf- und Steuertechnik GmbH (drive test and control technology company) is a highly regarded German enterprise due to its soil- rockasphalt 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.

APS is located in the university town of Göttingen, which boasts the largest number of Nobel Prize winners in the country. Göttingen is in the south east part of the state of Lower Saxony, central Germany making it easily accessible. The town is best known for being the home of the Georg-August-Universität Göttingen, ranked the number one university in Germany in 2010 and forty-third in the world according to the QS, and Times Higher Education World University Rankings. In addition, Göttingen also hosts part of the highly prestigious and world renowned Max Planck Society, which setup centers for scientific research in Göttingen in 1948 that continue to develop and expand today, as does our collaboration with such institutions.

All parts of designing, construction, manufacturing, quality-control and delivery tests are conducted by our own qualified experts in our factory in Germany. With high-quality special testing machines the company has received international acknowledgement, in particular by research institutes and universities from all over the world. With such capabilities, the company manufactures standard testing systems as well as customized material testing systems for a wide range of applications. In the meantime the company has grown into a globally expanding enterprise. With our expertise we help a range of users in standard, routine challenges to highly complex investigations.



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The comprehensive assortment of products and an attentive service satisfies the demands on testing devices for civil engineering and for laboratory equipment in both research and industry. Furthermore, our organization is able to arrange complete laboratories with standard devices and newly designed machines for soil, asphalt and material testing.

The APS Antriebs- Prüf- und Steuertechnik GmbH ensures that even the most "state of the art" developments are transformed into user friendly products of the highest quality.



APS is known for delivering advanced technological solutions and products of renowned quality. These cover research activities in the field of soil, asphalt, rock, and building material testing from a single transducer to a complete turnkey system. Whenever you need professional and standardized solutions for your testing demands, APS is a top address.

The APS Antriebs- Prüf- und Steuertechnik GmbH is proud of its high quality product standards and will happily be your partner when quality is of the utmost importance.

To find out about our products and services, please refer to following pages.

Yours faithfully

Thorsten Wille  
General Manager



## INTRODUCTION

During the last 25 years our testing machines for the determination of soil parameters under dynamic loading received international compliment. Individual demands of our customers and latest developments will always be considered in our construction.

This catalogue for soil mechanic and rock testing gives an overview of our comprehensive assortment. However, we are only able to present an extract of our product range in this brochure. You are welcome to contact us directly for further information and any questions. A capable team is at your command for your request and technical challenge!

### 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.

### The ideal solution

All of our testing solutions are manufactured to the highest quality and standards. This is something in which we pride ourselves and we strongly believe defines us as a company.

We deliver advanced technological solutions and products of renowned quality for our high range loading frames, pressure controllers and intensifiers, dedicated software, temperature controlling and everything related to this field of testing.



### Business Philosophy

All company staff have a common aim, to ensure one hundred percent customer satisfaction. This is achieved through close cooperation and internal team work, from project evaluation to design, manufacturing, quality testing and all other aspects of the company that are involved in each project. Working creatively and developing new ideas is a key part of the company's culture. This has helped us to be a leader when it comes to manufacturing and developing new, highly-accurate testing-systems. We have been involved in customized solutions for many years. Such customizations may cover all aspects of a product's life cycle, such as design, development and manufacturing.



Our work is in full compliance with ISO 9001 and other German standards, meaning customers can fully rely on the results and data from our equipment, software and our solutions in working towards technical aims or research activities. It is therefore essential that APS ensures and improves the quality, accuracy and reliability of products and services. In this way, we remain the preferred partner and solution provider in our field. All of our efforts help to secure high quality, timely delivery of products and services.

### World class Service and support

We have gained years of experience from many successful installations and close cooperation with our customers. Our service engineers guarantee smooth, successful commissioning within the shortest time possible after delivery. Customers even have the opportunity to participate in an inspection prior to delivery at our factory. This enables the customer to conduct hands on 'function-testing', familiarizing themselves with the new device with the assistance of our engineers.

## TECHNICAL SUPPORT

APS GmbH provides a variety of technical support services for Wille Geotechnik® Products, starting from procurement till final installation and after sales services. Technical support covers all Wille Geotechnik® Products to new devices and older devices.

Our networks of overseas representatives are there to help you with any enquiries in your native language during office hours. Local representatives are supported directly by our engineering department who can advise and help solve your problems. As a customer you are also able to have direct contact with the designers and manufacturers, as well as receiving all technical advice directly from experienced engineers in our company.



### Procurement

All of our testing solutions are manufactured to the highest quality and standards. This is something in which we pride ourselves and we strongly believe defines us as a company.

We deliver advanced technological solutions and products of renowned quality for our high range loading frames, pressure controllers and intensifiers, dedicated software and everything related to this field of testing.

### Software

Our expert software engineers are well trained and keen to provide efficient and professional programming in line with customer requests and requirements. Upon delivery, customers receive the finished test program along with the relevant documentation needed to operate their new piece of equipment efficiently.

### Commissioning

We pride ourselves on our service and can guarantee smooth, successful commissioning immediately after delivery of our testing systems.

### Machine operation after installation

There are different available services to assist you in operating your testing system in best condition after final installation at your site.

- Calibration
- Maintenance / Inspection
- Repair work
- Spare parts

### After Sales Support

Our homepage provides customer access to technical details and background information about Wille Geotechnik®: [www.wille-geotechnik.com](http://www.wille-geotechnik.com).

Technical support is available via the following Email address: [support@wille-geotechnik.com](mailto:support@wille-geotechnik.com). We aim to reply to any support enquiry on the same day, and at least within 24 hours.

Although a more detailed technical support service is more effective by email contact, you can call our service department to talk with our technical support specialists. For an immediate answer via the central phone number (+49 (0) 551 307520) or by Fax (+49 (0) 551 30752 20). Our competent service staff is ready to give you detailed technical advice and support.



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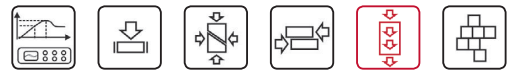
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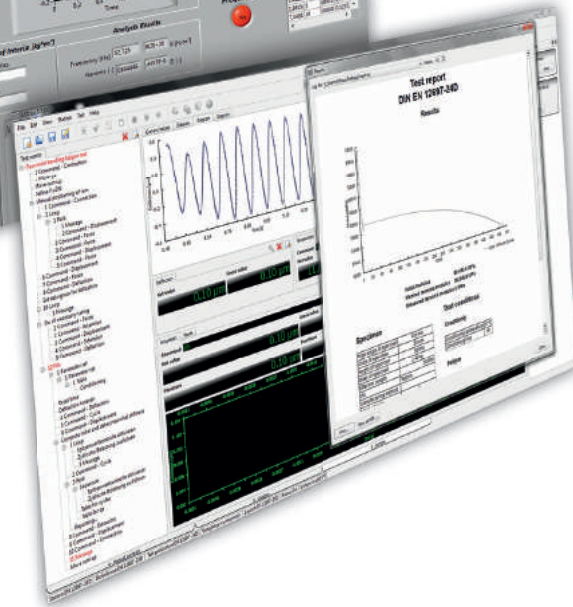
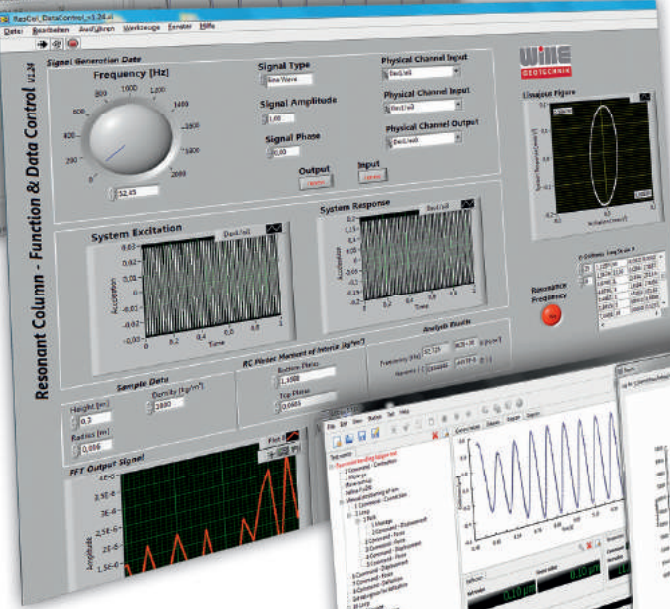
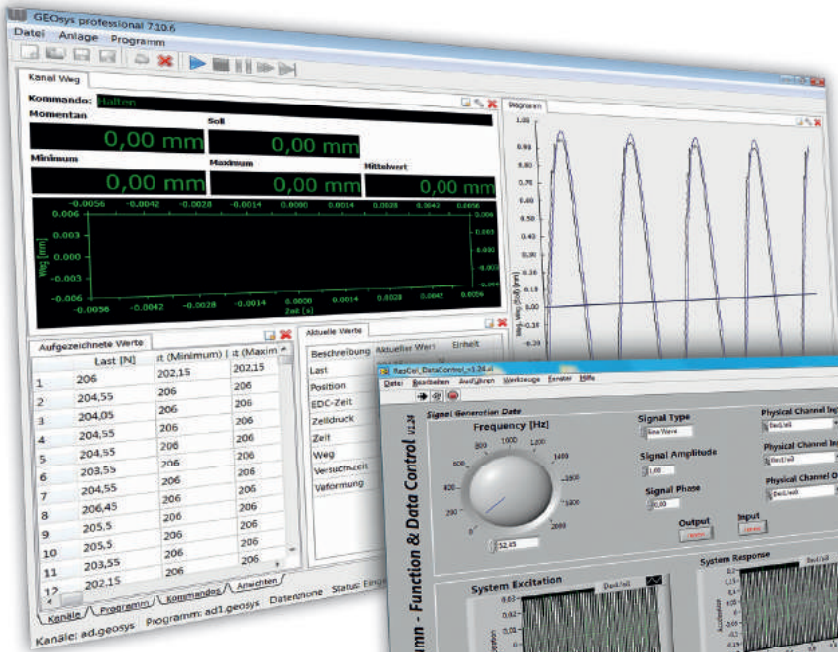
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## GEOSYS Professional

GEOsys is multifunctional and modular controlling and data acquisition software, which also is the universal software for our products. It allows the simple programming of complex user defined test sequences by structured Windows operation on a graphic user interface.

GEOsys has a flexible programmable system environment, which controls test appliances that carry out and 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 it enables a flexible configuration and thus fulfils the specific requirements of the user.

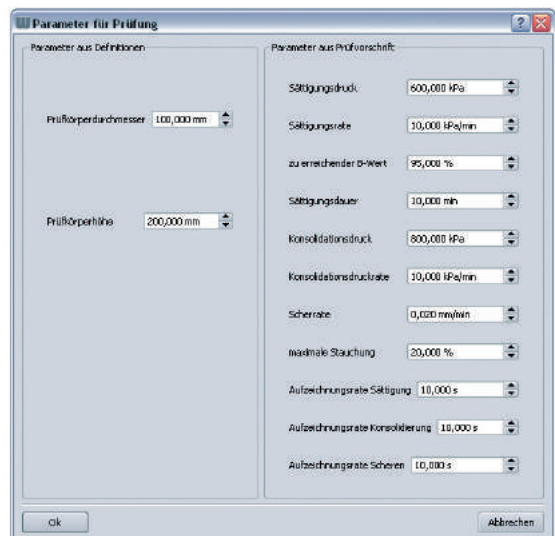
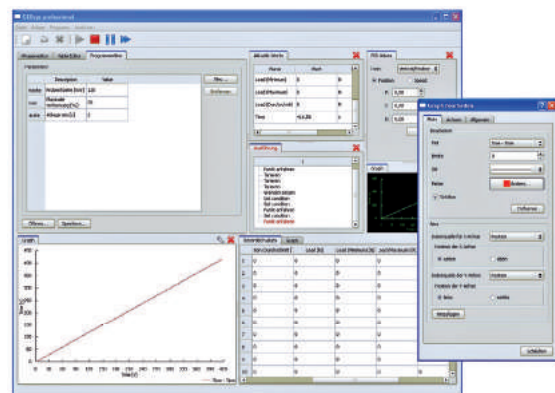
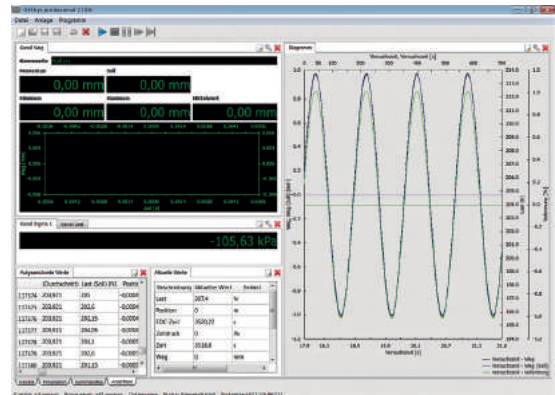
One unique platform addresses all of your testing needs, be it soil, asphalt, rock or construction related, both dynamically and statically. There are various test modules for GEOsys and cover all your test requirements.

The important key feature of this software is the ability to allow users for simple and completely free programming of standard or complex test sequences by structured Windows operation on a user friendly interface.

Thanks to the wide range and brilliant abilities of GEOsys, it is not only universal software for our products but also can be integrated with the hardware of familiar manufacturers to provide control functions and data acquisition.

The clearest advantage of the software is situated in relieved application. Even inexperienced users are within shortest time able to drive not only easy test sequences but complex running procedures.

GEOsys offers the possibility of making an optimization of the machine regulation (PID) even during operation. The effects of the automatic controller adjustments become immediately visible in the diagram. PID control data is storable as a file.



# GEOSYS Professional

## Examples of test modules:

### A. Soil tests

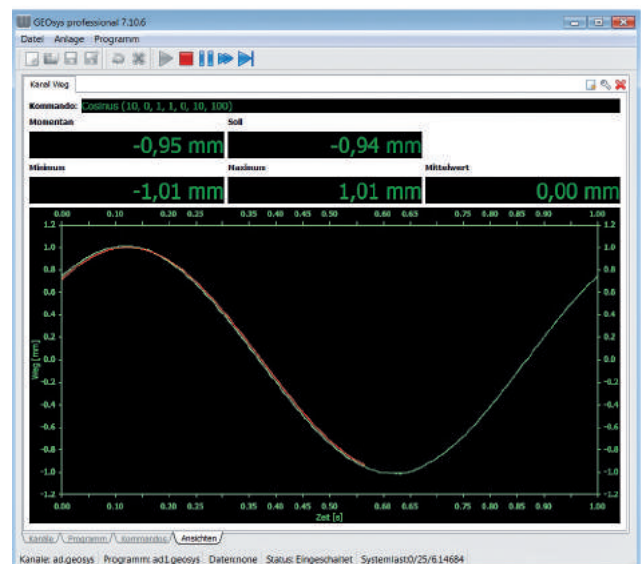
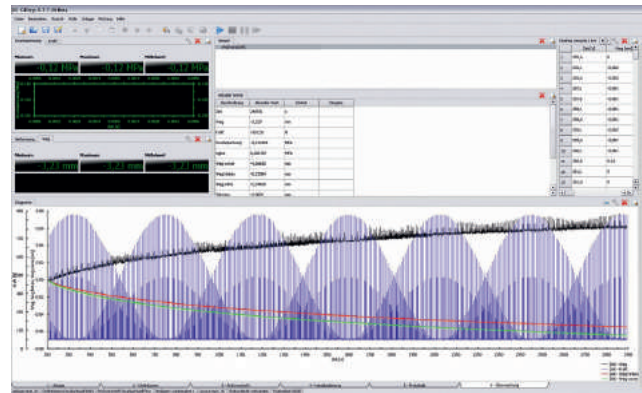
- Triaxial tests; statics and dynamics
  - ▶ UU: Unconsolidated-Undrained
  - ▶ CD: Consolidated-Drained with pore pressure measurement
  - ▶ CU: Consolidated-Undrained with pore pressure measurement
- Stress path triaxial tests ( $p$ ,  $q$  and  $s$ ,  $t$ )
- Unsaturated tests
- Permeability tests
- Low cyclic testing
- Uniaxial compression tests
- Resilient modulus tests
- Frozen soil tests
- Compression tests
- $K_0$  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

### B. Asphalt tests

### C. Rock tests

### D. Concrete tests

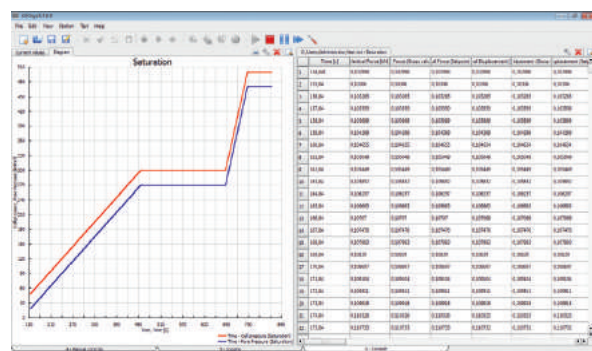
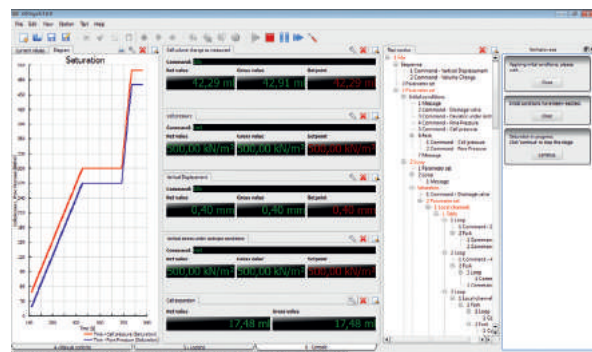
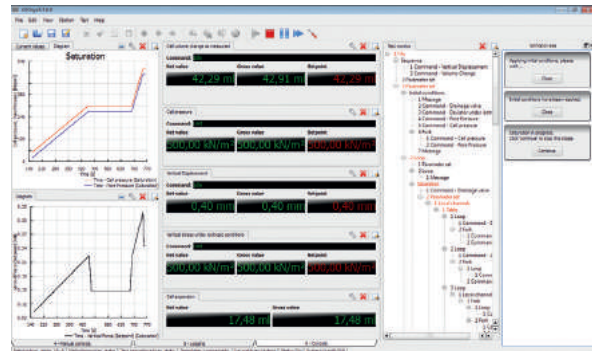
### E. Material tests



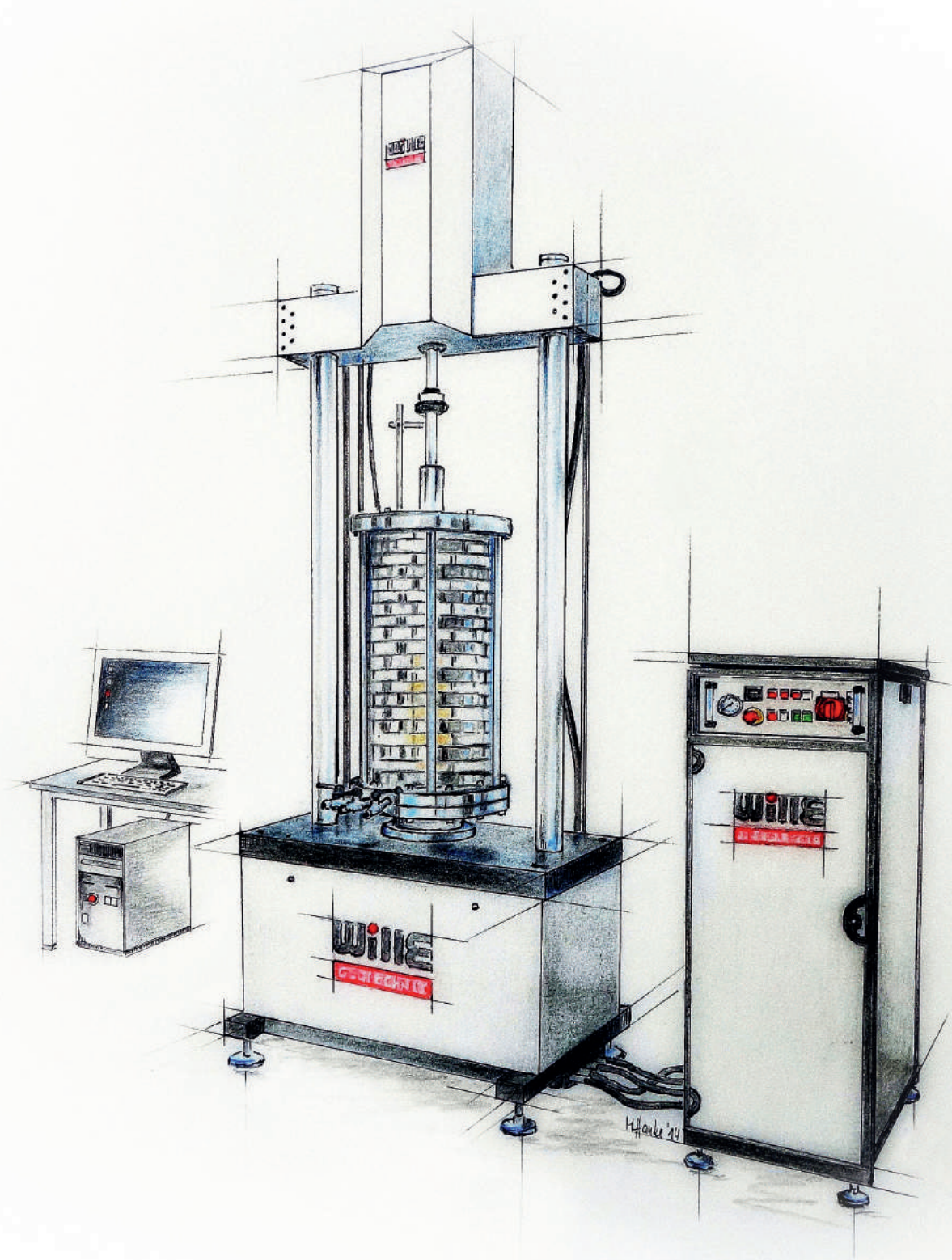
# GEOSYS Professional

## General Features

- One unique platform to address all of your testing needs e.g. soil, asphalt, rock or material testing
- 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
- Digital setting of PID parameters (machine parameters for different materials)
- Implemented transducer library, wave shape library and test procedure library
- For static and dynamic material-testing
- with analogue and status display as well as real-time graphics with zoom and freeze functions for printing output at any time, after and during the test
- User roles (administrator, service, developer, lab assistant) for easiest handling
- Individually modifiable data acquisition
- Data conversion in ASCII
- Flexible and user-friendly
- Supporting other manufacturer similar
- Available for WINDOWS, LINUX or MAC OSX
- Modular composition of the test procedure
- Management of hardware components
- User supplied, calculated measurands
- Easy to use front end for defining test procedures
- Interactive handling
- Data acquisition
- Suitable for up to any number of simultaneous and independent real-time closed-loop controlled channels machines or test devices (like axial load, confining pressure, porewater pressure, poreair-pressure, and others). Peak-control of cyclic and dynamic set-parameters



# TRIAxIAL TESTING SYSTEMS



## TRIAxIAL TESTING SYSTEMS

There are several types and configurations for triaxial test systems, which could be selected or configured by customer based on our components to fit any applications.

These variety range of components with the highest flexibility enables user to make their own set up per as their educational, research purposes and also their different type of applications concerning to test procedures, accuracy and other requirements:

- Different type of static or cyclic loading frames (electromechanical, pneumatic and servo hydraulic up to to 10,000 kN)
- Different type of pressure control units (electromechanical, pneumatic and servo hydraulic up to 300 MPa)
- Different type of volume change measuring devices
- Different size of triaxial cells (sample diameters up to 1000 mm) with or without temperature control
- Variety of high quality of sensors (pressure, load, displacement, radial deformation and etc.) to meet your testing demands
- Single or multi axis control and data acquisition systems

All of these systems are connected to our powerful GEOsys multifunctional software and user can control each step of the test by computer.





## CONVENTIONAL TRIAXIAL TESTING SYSTEM

This series of conventional triaxial testing systems include of closed-loop controlled load frame, hand operated or automatic pressure controlling units, volume measuring, controlling and data acquisition system with related transducers and different software solutions.

The test devices are suitable for standard triaxial tests, isotropic or anisotropic consolidation.

These configurations are ideal for educational and commercial purposes.



### Main Features

- Standard triaxial tests:
  - ▶ Consolidated – Drained (CD)
  - ▶ Consolidated – Undrained (CU)
  - ▶ Unconsolidated – Undrained (UU)
- Commercial price
- Strain, stress and position closed-loop controlled load frame
- User defined test procedures with GEOsys Software
- Isotropic and anisotropic consolidation
- Unconfined compression tests
- Several upgrading features:
  - ▶ K0 Consolidation test (upgrade)
  - ▶ Unsaturated soil testing (upgrade)
  - ▶ Bender element tests (upgrade)
  - ▶ Permeability tests (upgrade)
  - ▶ Swelling and swelling pressure test (upgrade)

### Technical Specifications

Static axial load	Up to 100 kN
Confining pressure	Up to 3500 kPa
Pore pressure	Up to 3500 kPa
Sample size	30 mm to 150 mm

## TABLE TOP ELECTROMECHANICAL CYCLIC TRIAXIAL TESTING SYSTEM

The new developed cyclic table top electromechanical closed-loop controlled triaxial load frames are characterized by their high accuracy for static and cyclic automatic loading possibilities.

These test devices are suitable for compression and extension tests with isotropic or anisotropic consolidation and covering whole testing applications and comply with international standards.

This configuration is ideal for educational and research purposes.

### Main Features

- Standard triaxial tests (CD, CU, UU)
- B-value check control
- Stress path triaxial tests ( $p$ ,  $q$  and  $s$ ,  $t$ )
- Resilient modulus
- Uniaxial compression test
- Consolidation test
- Isotropic and anisotropic consolidation
- High precision strain, stress and position closed-loop controlled load frame
- User defined test procedures with advance GEOsys Software
- Several upgrading features:
  - ▶ K0 Consolidation test (upgrade)
  - ▶ Unsaturated soil testing (upgrade)
  - ▶ Bender element tests (upgrade)
  - ▶ Permeability tests (upgrade)
  - ▶ Swelling and swelling pressure test (upgrade)



### Technical Specifications

Static axial load	Up to 10 kN
Cyclic axial load	Up to 10 kN
Cyclic frequency	Up to 5 Hz
Confining pressure	Up to 3 MPa
Sample size	Up to 100 mm





## COMBINED STATIC AND CYCLIC ELECTROMECHANICAL TRIAXIAL TESTING SYSTEM

The high quality electromechanical closed-loop controlled triaxial load frames are characterized by their high features for static and cyclic automatic loading possibilities. Thanks to advanced design of load frame with two different cyclic and high load static actuator, the system is able to apply high static and cyclic loads independently.

This series of triaxial testing system is modular constructed and can be configured with a variety of sample adapters, triaxial cells, pressure controllers and other customized attachments, different software packages and further accessories to suit your specific testing needs.

This configuration is ideal for educational and research purposes.



### Main Features

- Standard triaxial tests (CD, CU, UU)
- B-value check control
- Stress path triaxial tests (p, q and s, t)
- Resilient modulus
- Uniaxial compression test
- Consolidation tests
- Isotropic and anisotropic consolidation
- High precision strain, stress and position closed-loop controlled load frame
- Commercial price
- User defined test procedure with advance GEOsys Software
- Several upgrading features:
  - ▶ K0 Consolidation test (upgrade)
  - ▶ Unsaturated soil testing (upgrade)
  - ▶ Bender element tests (upgrade)
  - ▶ Permeability tests (upgrade)
  - ▶ Swelling and swelling pressure test (upgrade)

### Technical Specifications

Static axial load	25 kN / 60 kN and 100 kN
Cyclic axial load	5 kN (10 kN optional)
Cyclic frequency	5 Hz (10 Hz optional)
Confining pressure	On request
Sample size	Up to 150 mm

## SERVO PNEUMATIC STATIC AND CYCLIC TRIAXIAL TESTING SYSTEM

This series of triaxial testing systems are using servo-pneumatic loading system for automatic static and cyclic requested loading for different applications.

These high quality stress/path triaxial testing systems are consisting basically of a rigid 2 column-load frame, a cyclic actuator, a multi-channel control system for dynamic axis load and actuators for cell-pressure, back-pressure and optional pore air pressure.

It's included of all required components to perform fully automatic saturation, consolidation and static and cyclic triaxial tests. The software is able to produce all types of wave shapes like as sine, square, haversine or different customized wave shapes.



### Main Features

- Standard triaxial tests (CD, CU, UU)
- B-value check control
- Stress path triaxial tests (p, q and s, t)
- Resilient modulus
- Uniaxial compression test
- Consolidation tests
- Isotropic and anisotropic consolidation
- High precision strain, stress and position closed-loop controlled load frame
- User defined test procedure with advance GEOsys Software
- Several upgrading features:
  - ▶ K0 Consolidation test (upgrade)
  - ▶ Unsaturated soil testing (upgrade)
  - ▶ Bender element tests (upgrade)
  - ▶ Permeability tests (upgrade)
  - ▶ Swelling and swelling pressure test (upgrade)

### Technical Specifications

Axial load	5 kN / 10 kN
Frequency	Up to 15 Hz
Confining pressure	On request
Sample size	Up to 150 mm

## COMBINED ELECTROMECHANICAL-SERVO PNEUMATIC CYCLIC TRIAXIAL TESTING SYSTEM

This series of high quality combined electro-mechanical-servo pneumatic closed-loop controlled triaxial load frames are characterized by their high accuracy for static and cyclic automatic loading possibilities.

Thanks to the integrated keyboard or alternatively to the external controller, the operation of the test device is very user-friendly and highly individual tests can be performed.

This configuration is ideal for educational and standard research purposes.



### Main Features

- Standard triaxial tests (CD, CU, UU)
- B-value check control
- Stress path triaxial tests (p, q and s, t)
- Resilient modulus
- Uniaxial compression test
- Consolidation tests
- Swell and swell pressure tests
- High precision strain, stress and position closed-loop controlled load frame
- Isotropic and anisotropic consolidation
- User defined test procedure with advance GEOsys Software
- Several upgrading features:
  - ▶ K0 Consolidation test (upgrade)
  - ▶ Unsaturated soil testing (upgrade)
  - ▶ Bender element tests (upgrade)
  - ▶ Permeability tests (upgrade)
  - ▶ Swelling and swelling pressure test (upgrade)

### Technical Specifications

Static axial load	25 / 60 / 100 kN
Cyclic axial load and frequency	5 kN / up to 15 Hz 10 kN / up to 15 Hz
Confining pressure	On request
Sample size	Up to 150 mm

## SERVO HYDRAULIC DYNAMIC TRIAXIAL TESTING SYSTEMS

This series of high quality servo hydraulic closed-loop controlled triaxial load frames are suitable for generating high accuracy static and cyclic loads.

These high quality stress/path triaxial testing systems are consisting basically of a rigid 2 column-load frame, a cyclic actuator, a multi-channel high speed control system with 20 bit resolution for dynamic axis load and actuators for cell-pressure, back-pressure and optional pore air pressure.

GEOsys software enables us to produce all types of wave shapes like as sine, square, haversine or different customized wave shapes.



### Main Features

- Standard triaxial tests (CD, CU, UU)
- B-value check control
- Stress path triaxial tests (p, q and s, t)
- Resilient modulus
- Uniaxial compression test
- Consolidation tests
- Isotropic and anisotropic consolidation
- User defined test procedure with advance GEOsys Software
- High precision strain, stress and position closed-loop controlled load frame
- Several upgrading features:
  - ▶ K0 Consolidation test (upgrade)
  - ▶ Unsaturated soil testing (upgrade)
  - ▶ Bender element tests (upgrade)
  - ▶ Permeability tests (upgrade)
  - ▶ Swelling and swelling pressure test (upgrade)

### Technical Specifications

Static axial load	Up to 25 kN
Cyclic axial Load	Up to 25 kN
Cyclic frequency	20 / 100 Hz
Confining pressure	On request
Sample size	Up to 150 mm



## LARGE SCALE DYNAMIC TRIAXIAL TESTING SYSTEMS

This series of high quality servo hydraulic closed-loop controlled triaxial load frames are suitable for generating high accuracy static and cyclic loads.

These high quality stress/path triaxial testing systems are consisting basically of a rigid 2 column-load frame, a cyclic actuator, a multi-channel high speed control system with 20 bit resolution for dynamic axis load and actuators for cell-pressure, back-pressure and optional pore air pressure.

GEOsys software enables us to produce all types of wave shapes like as sine, square, haversine or different customized wave shapes.



### Main Features

- Standard triaxial tests (CD, CU, UU)
- B-value check control
- Stress path triaxial tests (p, q and s, t)
- Resilient modulus
- Uniaxial compression test
- Consolidation tests
- Isotropic and anisotropic consolidation
- User defined test procedure with advance GEOsys Software
- High precision strain, stress and position closed-loop controlled load frame
- Several upgrading features:
  - ▶ K0 Consolidation test (upgrade)
  - ▶ Unsaturated soil testing (upgrade)
  - ▶ Bender element tests (upgrade)
  - ▶ Permeability tests (upgrade)
  - ▶ Swelling and swelling pressure test (upgrade)

### Technical Specifications

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

## UNSATURATED TRIAXIAL TESTING SYSTEMS

High quality universal testing devices for fully automatic standard tests like UU, CU and CD tests and fully automatic stress-path controlled tests under saturated and unsaturated conditions.

For triaxial soil testing under unsaturated conditions we provide special modular systems for different specimen diameter and stainless steel cells with internal columns. This enables the subsequent attachment of the cell mantle after the installation of the sample, the fitting of local sensors and the positioning of the top cap and load piston. The base plate with standard porous plates or special ceramic filter plates with different high air entry ceramic discs can be installed as socket for the sample (1, 3, 5 or 15 bar).



### Main Features

- Standard triaxial tests (CD, CU, UU)
- B-value check control
- Stress path triaxial tests (p, q and s, t)
- Permeability tests
- High precision strain, stress and position closed-loop controlled load frame
- Isotropic and anisotropic consolidation
- Several upgrading features
- Diffused air accumulator for determine the coefficient for volume correction (upgrade)
- User defined test procedure with advance GEOsys Software
- K0 Consolidation test
- Bender element tests (upgrade)
- 3 possible methods to determine the change of the sample volume:
  - ▶ Radial deformation and calculation of the volume change
  - ▶ Direct measurement of the pore-water and pore-air volume change with a pressure / volume controller
  - ▶ Exact measurement of the cell water in an additional internal (double wall) cell

### Technical Specifications

Static axial load	Up to 100 kN
Confining pressure	Up to 2 MPa
High air entry discs	0.1, 0.3, 0.5 or 1.5 MPa
Sample size	Up to 150 mm

## FROZEN AND TEMPERATURE CONTROLLED TRIAXIAL TESTING



Special temperature chambers for triaxial cells or pressure vessels with fluids from -70 up to +300 °C.

Suitable for all Wille Geotechnik® standard or high pressure triaxial cells, consolidation cells of different other applications or pressure vessels.

The segmented temperature chambers or heating cell walls consist of a closed loop heating and/or cooling aggregates with a high precision digital controller.

- Suitable for all triaxial cells (as upgrade)
- 3 different environmental simulation systems:
  - ▶ Cell positioned inside a temperature chamber
  - ▶ Special double wall system
  - ▶ Built in submersible heating/cooling coils system
- Free selection of test procedures
- Fully electronic continuous controller with PID action via TFT display

### Technical Specifications

Static axial load	Up to 5000 kN
Confining pressure	Up to 200 MPa
Temperature ranges	-70 up to +300 °C
Sample size	Up to 300 mm

## GAS HYDRATE TRIAXIAL TESTING SYSTEM

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



This series of high quality combined electromechanical-servo hydraulic closed-loop controlled triaxial load frames are characterized by their high accuracy for long-term static automatic loading possibilities.



### Main Features

- One-screw quick closing system of the cell
- Carriage assembly for easy removal and storage of cell system
- In-vessel transducers for load, radial and axial deformation
- Stress path triaxial tests (p, q and s, t)
- Permeability tests
- High precision strain, stress and position closed-loop controlled load frame
- Uniaxial compression test
- Isotropic and anisotropic consolidation
- Several upgrading features
- User defined test procedure with advance GEOsys Software

### Technical Specifications

Static axial load	Up to 1000 kN
Confining pressure	Up to 40 MPa
Temperature range	-40 up to 40 °C
Sample size	Up to 80 mm





## RESILIENT MODULUS TESTING SYSTEM

This series of high quality either electromechanical or servo hydraulic closed-loop controlled triaxial load frames fulfil all criteria to perform resilient modulus tests.

The machines are characterized by their high accuracy for static and cyclic automatic loading possibilities.

GEOsys Software enables us to produce all types of wave shapes like as sine, square, haversine or different customized wave shapes.

Thanks to the integrated keyboard or alternatively to the external controller, the operation of the test device is very user-friendly and highly individual tests can be performed. This configuration is ideal for educational and research purposes.



### Main Features

- Intelligent realtime PID controller to adjust the system according to the changing stiffness of the sample
- Standard triaxial tests (CD, CU, UU)
- Stress path triaxial tests (p, q and s, t)
- Resilient modulus
- Uniaxial compression test
- High precision strain, stress and position closed-loop controlled load frame
- Consolidation tests
- Isotropic and anisotropic consolidation
- User defined test procedure with advance GEOsys Software
- Several upgrading features:
  - ▶ K0 Consolidation test (upgrade)
  - ▶ Unsaturated soil testing (upgrade)
  - ▶ Bender element tests (upgrade)
  - ▶ Permeability tests (upgrade)
  - ▶ Swelling and swelling pressure test (upgrade)

### Technical Specifications

Static axial load	Up to 100 kN
Cyclic axial load and frequency	5 kN / up to 15 Hz 10 kN / up to 15 Hz
Confining pressure	On request
Sample size	Up to 150 mm

## CYCLIC TRIAXIAL TESTING SYSTEM FOR UNBOUND MATERIAL TESTING

This testing system is a dynamic universal testing machine with electro-mechanical precision drive for compression and tension tests up to 30 kN and for high accuracy cyclic tests up to 15 Hz and covers all the test procedures for unbound material triaxial testing.

Different submersible transducers for higher accuracy is available e.g. submersible local axial-deformation; submersible load cell for accurate measurement of axial loads with confining pressure compensation and Submersible local radial-deformation measuring devices.

The powerful multifunctional GEOsys Software supports all the test procedures with a well access to all testing sessions.

### Main Features

- Specially designed and configured for static and cyclic uniaxial and triaxial test methods regarding EN, AFNOR, ASTM and AASHTO
- For all requirements of seismic research, unbound material testing for road research and all kinds of stress and strain path tests
- Special triaxial cell for unbound and granular material
- Cyclic pressure controller for generating hydrostatic pressures (3, 10 or 20 bar) up to 10 bar to perform static or cyclic confining pressures between 0.1 and 10 Hz for use with CLC and CLV tests according to EN 13286-7
- Phase shift control of axial and cell pressure in real time
- With automatic elevation device for the cell wall for easy specimen preparation and positioning of the interior measuring sensors



### Technical Specifications

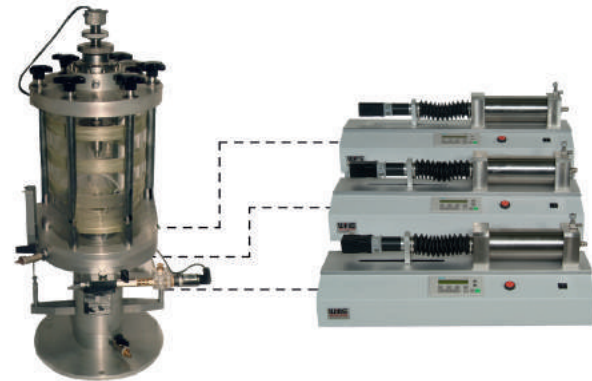
Static axial load	Up to 25 kN
Cyclic axial load and frequency	Up to 25 kN
Cyclic frequency	Up to 15 Hz
Confining pressure	0.3 / 1 / 2 MPa
Confining pressure frequency	Up to 10 Hz
Sample size	100 / 150 / 160 / 300 mm

## STRESS PATH BISHOP & WESLEY TRIAXIAL TESTING SYSTEM

This high quality stress/path triaxial system is consisting basically of a Bishop & Wesley cell, three pressure/ volume controller, internal submersible load cell to measure axial load, a pressure transducer to measure pore water pressure and a linear displacement transducer to measure vertical displacement.

Thanks to the integrated software and also keyboard controller (pressure / volume system), the operation of the device is very user-friendly. Exchangeable, pre-calibrated measuring sensors guarantee high accuracy over a wide measuring range.

All the tests are running under PC control like stress path, K0, slow cyclic.



### Options:

- Local strain measurement
- Unsaturated testing system
- Bender element test

### Main Features

- An improved Bishop & Wesley triaxial samples with pedestal, top cap
- Internal submersible load cell to measure and closed-loop control of axial load
- Pressure transducer to measure pore water pressure and B-value check
- Linear displacement transducer to measure vertical displacement
- Automatic pressure / volume controller for closed-loop control of axial stress and strain
- Automatic pressure / Volume controller for cell pressure control and back pressure control
- Optional advanced data acquisition system for additional transducer
- A complete PC with user friendly software enables all kinds of stress paths to control automatic pressure volume systems and to acquire all the sensors
- All devices include a serial RS232 and Ethernet port

### Technical Specifications

Sample diameter	Up to 101.8 mm (38, 50, 60, 70 and 100 mm)
Cell pressure	Up to 2 MPa
Max. axial load	5 kN
Max. axial load with motorized version	25 kN

## ULTRA LARGE SCALE TRIAXIAL TESTING SYSTEM

This series of triaxial testing systems are customized constructed systems and can be configured with a variety of sample adapters, triaxial cells, pressure plates and other customized attachments, different software packages and further accessories to suit your specific testing needs.

Exchangeable, pre-calibrated measuring sensors guarantee high accuracy over a wide measuring range. Integrated inputs for measured values allow a wide range of pre calibrated sensors (stress, load, path, etc.), to be directly connected for use as measuring or control variables.

**Note:**

For any other applications we are able to offer customized solutions and other sensor ranges.



### Main Features

- Customized design per as your technical requirements
- Control and evaluation Software GEOsys compatible to all main operating systems, i.e. MS Windows®, Linux®, MAC OS®
- Closed-loop control of load, displacement and extension
- Complete real time data acquisition and closed-loop control for each channel using real parallel configured channels
- Real-time graphics with zoom and freeze functions for printer output at any time, after and during the test
- Turn key systems including sample preparation methods

### Technical Specifications

Static axial load	Up to 5000 kN
Confining pressure	Up to 5000 kPa
Sample size	600 mm to 1000 mm

## TRUE TRIAXIAL TESTING SYSTEM

The true triaxial apparatus is designed and manufactured for testing cubical soil specimens and also prism soil specimens. The normal size of cubical soil specimen is 100 x 100 x 100 mm and the prism specimen size is 80 x 80 x 160 mm.

Other specimen sizes are available on request of the customer. Sample preparation kit is also available for producing the required specimen.

The sample located in the cell is visible through a window and this window makes the visibility to the users for further additional measuring device like PIV.

It allows independent control of normal stresses applied in three dimensions to soil samples. The ability of independent control of the parameters in three dimensions, allows for a wider range of loading condition in a true triaxial test. Three general types of true triaxial apparatus are:

- Stress controlled with flexible boundaries
- Strain controlled with rigid boundaries
- Mixed boundary apparatus

The system includes the triaxial cell and two pair of actuators in vertical and one horizontal direction. These actuators can be hydraulic or pneumatic type and match in mirror position in each side for load and displacement control. A fluid provides the pressure for the third axis (water) as a confining pressure.

The apparatus can perform stress-controlled and strain controlled experiments. It is well instrumented with load, displacement, and pressure sensors and has the capabilities to capture strain localization and shear band development.



All vertical stress and both horizontal stresses applied to the sample and also fluid pressure and pore pressure are continuously recorded during the test and all the data collected and transfer to the PC and the special software for evaluation of the test.

The vertical and horizontal displacements are measured using LVDTs installed on each ram. The system can apply static loads by the actuators and also is able to apply dynamic loads with the frequency up to 5 Hz.

## HIGH PRESSURE / HIGH TEMPERATURE TRIAXIAL TESTING

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

This series of high quality combined electromechanical-servo hydraulic closed-loop controlled triaxial load frames are characterized by their high accuracy for long-term static automatic loading.

The powerful GEOsys Software supports all the test procedures with well access to all testing sessions and also gives this feature to manage and run customized test procedures per as any testing needs.



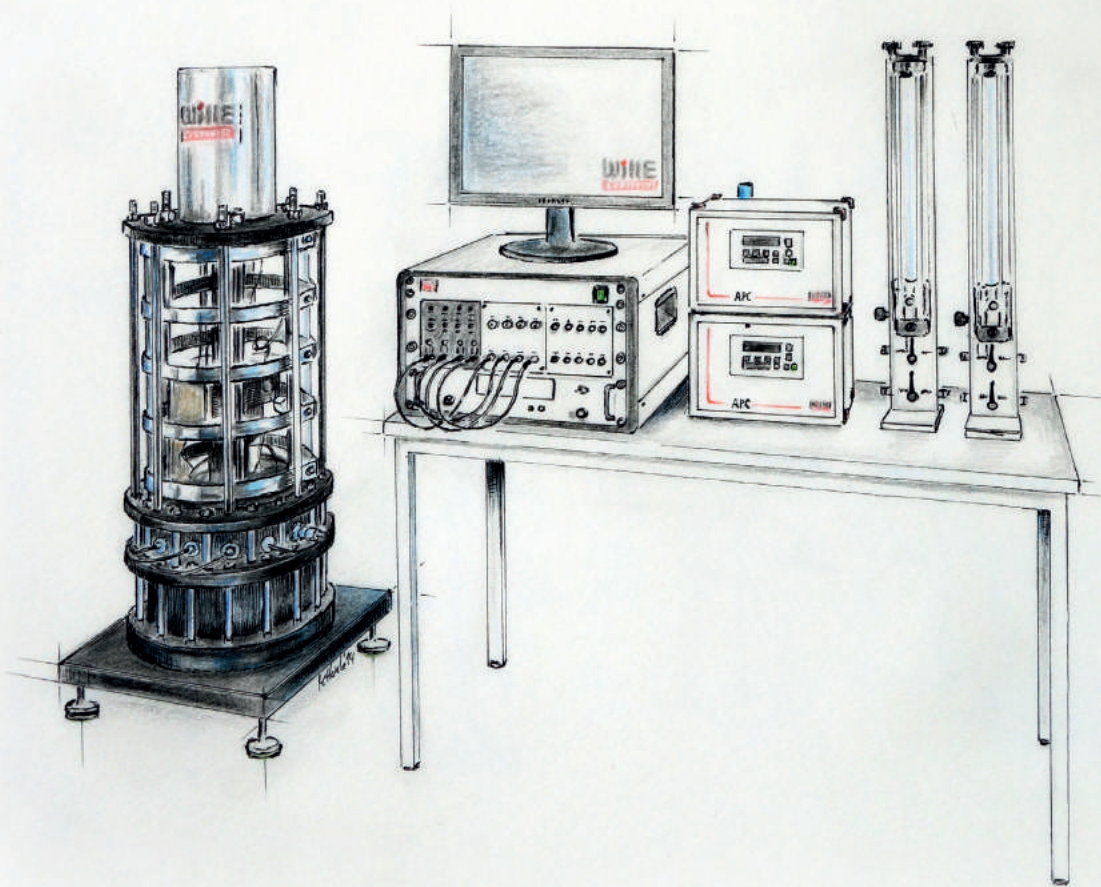
### Main Features

- Standard triaxial tests (CD, CU, UU)
- B-value check control
- Stress path triaxial tests (p, q and s, t)
- Uniaxial compression test
- Consolidation tests
- High precision strain, stress and position closed-loop controlled load frame
- Isotropic and anisotropic consolidation
- User defined test procedure with advance GEOsys Software
- Several upgrading features:
  - ▶ K0 Consolidation test (upgrade)
  - ▶ Unsaturated soil testing (upgrade)
  - ▶ Bender element tests (upgrade)
  - ▶ Permeability tests (upgrade)
  - ▶ Swelling and swelling pressure test (upgrade)

### Technical Specifications

Static axial load	Up to 5000 kN
Confining pressure	Up to 70 MPa
Temperature range	Up to 300 °C
Sample size	Up to 150 mm

# ADVANCED SOIL TESTING SYSTEMS



## 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 in two types (Hydraulic axial / torsional system and electromechanical axial / torsional system).

This hollow cylinder system is modular constructed and can be configured with a variety of sample adapters, triaxial cells, pressure plates and other customized attachments, different software packages and further accessories to suit your specific testing needs.

This system is capable to perform rotational displacement and torque to the hollow cylinder soil specimen.

The hollow cylinder testing apparatus is available in two types, with top or bottom load piston depending on the load system in use (servo-motor or servo-hydraulic actuator).

There is the possibility to control the magnitude and direction of the three principal stresses.



### Main Features

- 2 Rigid construction, flexible for many kinds of testing procedures
- Dynamic high speed closed-loop control of load and displacement, stress and strain, controlled test procedures
- Modular and easy handling system
- 20 bit data acquisition and closed-loop control system
- Flexible controlling software for nearly unlimited test procedures of all uniaxial or triaxial test applications
- Different ranges of high quality transducers for external or internal on-specimen use are available
- Digital setting of PID parameters (parameter optimizing or tuning is depending on the material)
- Complete real time data acquisition and closed-loop control for each channel using real parallel configured channels
- Real-time graphics with zoom and freeze functions for printer output at any time, after and during the test
- High precision angular displacement sensor to measure large shear strains
- Special hollow cylinder triaxial cell with an internal frame to connect all submersible transducers directly at the sample before the cell is closed by the cell-wall
- Bender element test (upgrade)
- Unsaturated soil testing (upgrade)





The main field of application is the determination of soil behavior in traffic underground or earth-quakes, unbound material testing (liquefaction strength tests) with high resolution and synchronized measurement of all channels.

**Controller:**

Controlling system for static & dynamic applications for best test performances up to 100 Hz using high quality controller and an A/D resolution up to 20 bit for closed-loop control:

This series of machine use the latest digital technology to ensure accurate and repeatable results from test to test.

Increasing complex demands are made on materials testing systems. The digital control system includes operation, visualization, digital control, evaluation and documentation.

This high performance digital controller permits the execution either of static or fatigue tests. The controller is either available as single or multi-channel system with phase shift control in real time modus. Modular digital controller for closed loop control in load-, displacement-, deformation or external mode (seismic recordings) and data acquisition. This high-resolution controller is specially designed for static and dynamic testing up to 100 Hz in connection with testing machines.

**Software for static and dynamic applications:**

The controlling software enables the easy programming of complex test sequences by means of clearly structured Windows operation on a graphic user interface. Through a series of menus, it provides quick access to all the controls needed for test set up.



**Technical Specifications**

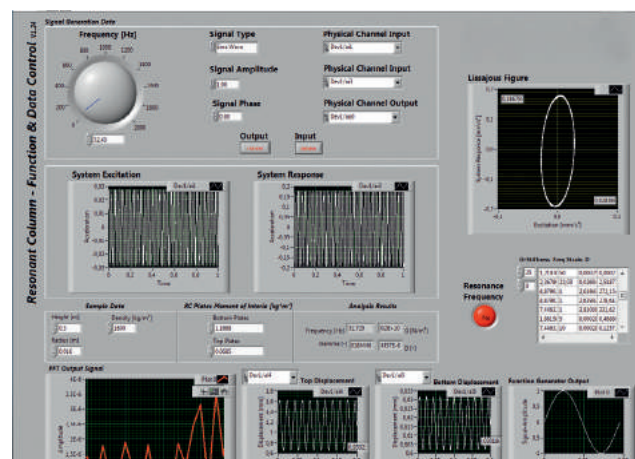
Type of load frame	Electromechanical / servo hydraulic
Axial load	5 up to 150 kN
Cyclic axial load	5 up to 150 kN
Load frequency	2, 5, 10, 20 or 100 Hz
Torsional load	Customized (Note: Any combination of axial and torsional loads are available on request)
Sample Size	Height / Outer / Inner 140 / Ø 70 / Ø 30 200 / Ø 100 / Ø 60 (18 mm wall thickness) 100 / Ø 100 / Ø 60 300 / Ø 150 / Ø 75 400 / Ø 200 / Ø 100 600 / Ø 300 / Ø 150

## RESONANT COLUMN APPARATUS

The Wille Geotechnik resonant column is a high quality apparatus to determine geotechnical properties of materials (e.g. wide variety of soils) under low strain range for solid- or hollow-cylindrical samples. Resonant column device with high-frequency electromagnetic torsional drive used to vibrate the top of the soil specimen at frequencies up to 2000 Hz in first-mode resonance while the bottom is fixed or second mode while top and bottom are free.

The components implemented in the Wille Geotechnik RC are of highest quality possible. The triaxial cell is designed for pressures up to 1000 kPa. Volume and pressure of pore fluid are precisely monitored and controlled with an automatic pressure controller or pressure control panel. The system includes of data acquisition unit for collecting different measuring values like force, travel, pressure, frequency, temperature and more. Transducers and sensors providing analogous signals can be connected.

Several other upgrading options (e.g. larger sample, automatic pressure controlling device, high pressure cell, etc.) are available on request.



GEOSYS Software is capable to measuring, control, or monitor the following parameters:

- Shear strain
- Gamma (Proximeter based measurement, available as option)
- Sample frequency

### Calculation and evaluation:

- Via Lissajous figure
- Via strain / frequency curve
- Strain dependent calculation of shear stiffness (G)
- Calculation of damping (D), (Energy Based Method)
- Shear velocity
- Shear modulus
- Calibration examples
- FFT-Control measured signal (FFT Fast Fourier)



## Main Features

- For solid and hollow samples
- Saturated and unsaturated conditions
- Resonant column cell up to 1000 kPa for sample size 150 mm diameter and height of 300 mm
- Isotropic and anisotropic (optional) test conditions
- Different sample adapters for saturated and unsaturated test conditions are available on request
- Pressure resistant electrical feedthroughs for internal transducers
- Different models fix-tree or free-tree is available
- Electronic control unit, data acquisition and software modules
- Function generator with controlled frequency and wave shape
- Optional pressure resistant transducers (e.g. proximeter, accelerometer)
- Certified calibration rods in different sizes
- High-resolution sensors (accelerometer, submersible load cell, pressure transducer, displacement transducer)
- Advanced user friendly resonant column software to control and measuring the parameters with ability to calculate and produce the results in tables or graphs

## Technical Specifications

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

## BENDER ELEMENT SYSTEM

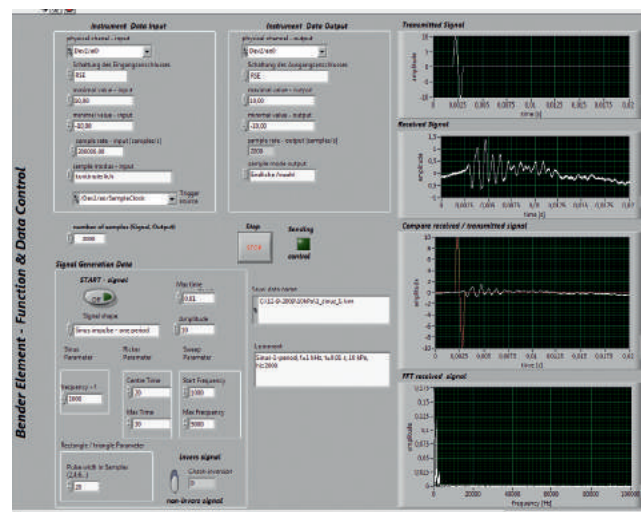
For all specimen diameters from 35 to 300 mm or customized sizes

- Exchangeable Bender-Element-Set for any specimen, designed for usage in triaxial cells, consolidation cells simple-shear or standard shear devices
- The set consists of pairs of piezo-ceramic elements, connected into a special exchangeable adapter solution (without specimen adapter), which are implemented in top and bottom plates of the specimen adapter (e.g. of triaxial cells)
- Available for horizontal testing
- Easy fitting in the cell
- The elements are available for S- and P-waves
- The elements allow maximum flexure at its tip, whilst only protruding into the sample by a reasonable maximum
- The elements are embedded in porous plate or without. This fitting allows pore water flow
- High pressure electrical feed through for the bender element system at the top and bottom plate



### Advanced waveform software:

- Full waveform building tools including standard waveforms, mathematical expressions and freehand drawing
- Operates under Windows, Linux and Mac platforms



## FULLY AUTOMATIC GEOTHERMAL TEMPERATURE CONDUCTIVITY APPARATUS FOR SEDIMENTS

This newly patented fully automatic geothermal temperature conductivity apparatus was developed in collaboration in 4 years research work with the Technical University of Darmstadt. The device allows stress, temperature and volume controlled measurement of the thermal conductivity and thermal diffusivity of soils under calibrated conditions to measure reliable parameter of different sediments or other materials.

Density and compaction can be influenced during the whole test procedure.

The testing device is characterized by its multiple partially or fully automated integrated control options.

### Features:

- Axial force: 0 - 60 kN
- Sample temperature: -20 to +120 °C
- Temperature accuracy: +/- 0,05 °C
- Sample diameter: 50 up to 100 mm



## GEOTHERMAL HIGH PRESSURE HIGH TEMPERATURE PLANT FOR ROCKS

This test system is used to investigate geothermal behavior of rocks under high pressure and high temperature conditions

The properties of rock by the injection of natural or synthetic high-pressure fluids or vapor can be examined (fracking tests).

In combination with the examination of geothermal hydraulic and gas conductivity of rock samples the strength properties could be tested as well.

### Features:

- High pressure and high temperature controlled system
- High capacity load frame up to 3000 kN



## BIAXIAL DEVICE / PLANE STRAIN TESTING

Wille Geotechnik® offers a number of different types and sizes of biaxial devices. They allow direct testing of soils at real plane strain conditions. More accurate assessment of strength parameter and shear banding phenomena could be simulated in this special test. Different types of constructions and samples sizes are available. The picture shows a special edition, which was manufactured for unsaturated soil testing in plane strain tests.



## GEOTEXTILE TESTING DEVICES

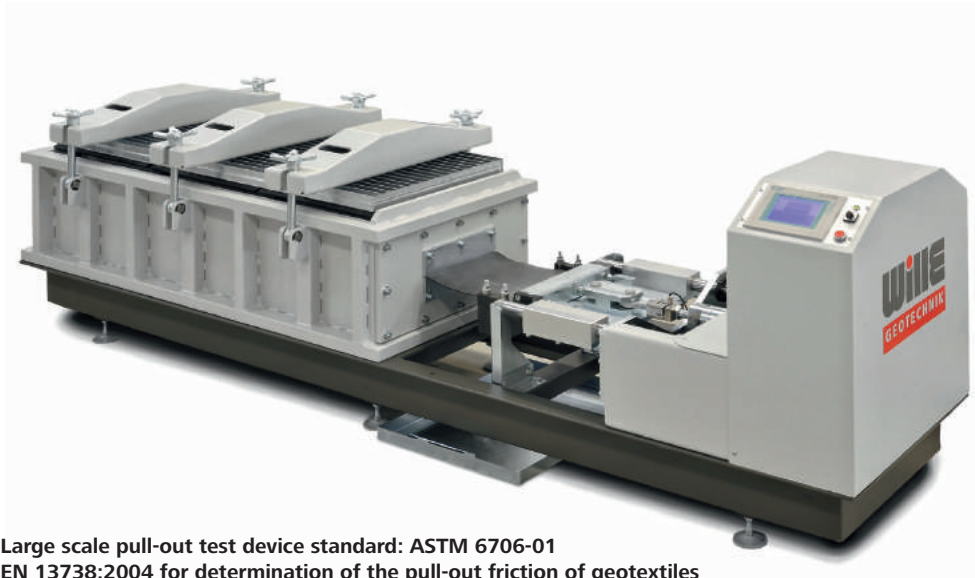


Large geotextil shear testing apparatus 500 x 500 mm for different material layers and double layer pull-out tests (specially for large size geogrids)

Large shear box apparatus with 150 x 150 mm size for testing quality control and resistance of geomembranes



Fully automatic testing apparatus for the determination of the permeability of geo-textiles and geotextile-related products, without load, normal to the plane - according to EN ISO 11058



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



Permeability testing of  
geosynthetic clay liners



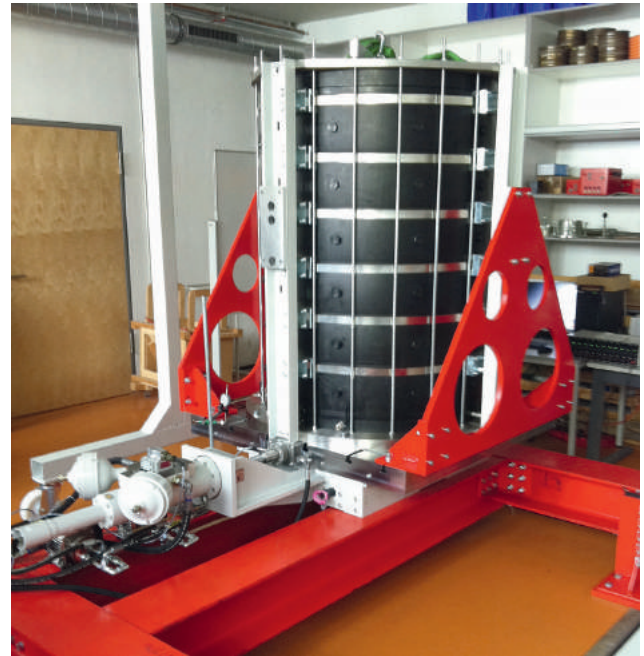
Testing device for the determination of the  
characteristic opening size of geotextiles  
and geotextile-related products - EN ISO 12956:2010-08

## HIGH CAPACITY SHAKING TABLE WITH 1000 MM DIAMETER CELL

Vibrating tables are an important part in the investigation of soils or other building materials under cyclic or dynamic loads. Depending from the application we distinguish and use one- or multidimensional actuator systems.

Vibrating tables provide a platform for different experimental setups such as test cell, building construction or other structures that serve as a boundary condition for the various applications.

The experimental setup represents a frictionless bearing vibration table with a large triaxial cell. Objective of the study is to investigate the grain skeleton under cyclic and dynamic loads. It simulates in a large scale laboratory test the liquefaction behavior under saturated and unsaturated conditions.



### Overview of the technical parameter, configuration and transducer:

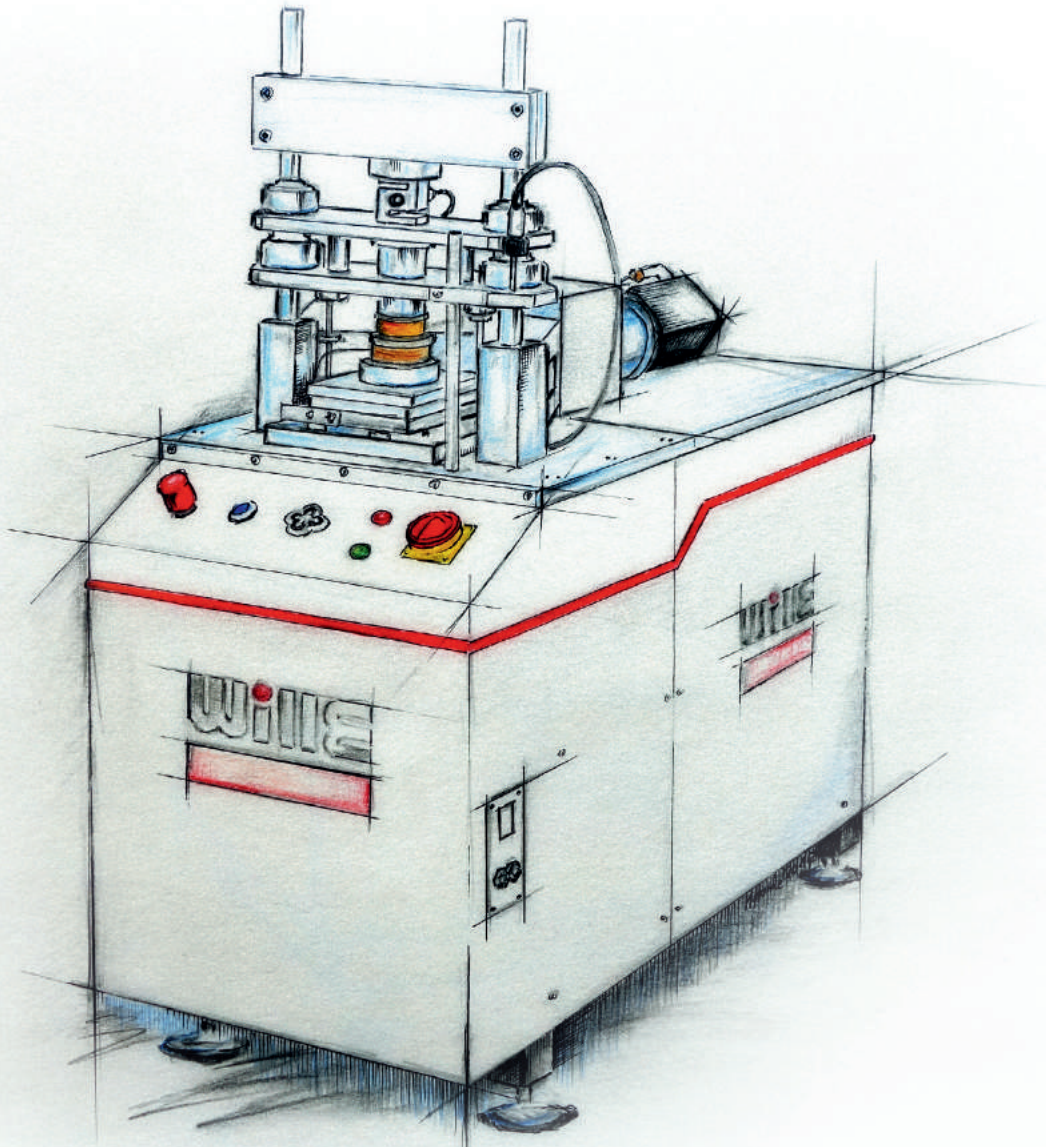
- High load, high frequency frictionless one-dimensional shaking table with large platform, for frequencies up to 100 Hz
- 50 kN frictionless servohydraulic actuator, displacement accuracy < 0.001 mm
- High speed closed-loop control and data acquisition system up to 21 bit resolution
- 1000 mm diameter extra large cell for saturated and unsaturated conditions with HAVE-discs
- Different sample height with segmented cell wall
- Porewater-pressure controller with large volume change measurement (20 l, 0.01 ml)
- Poreair-pressure controller
- Axial penetration actuator with loading plate

### Submersible Built-in Transducer Configuration:

- 60 bender elements sensors with data acquisition and control system for the generation and registration of shear waves
- 20 micro geophones, including amplifier and recording unit
- 6 sensors to register the free pore water pressure, including reinforcement and recording hardware
- 6 sensors for measuring of matrix water stresses, including reinforcement and recording hardware
- 50 geophysical sensors and transmitters for seismic and geo-electric impedance spectroscopy (SIP) to ensure a tomography of an inner area
- Acoustic emission transducers to measure noise levels of grain friction



# SHEAR TESTING DEVICES



## FULLY AUTOMATIC ELECTROMECHANICAL DIRECT-RESIDUAL SHEAR MACHINE

This stand alone electromechanical static machine is a sophisticated robust construction in connection with high-quality mechanic and electronic components designed to test soil specimen in variety range of sizes.

The machine includes of a high stiffness frame and actuator system to compensate any deformation in static loading. This machine is suitable for highly precise direct shear tests in practise and research (optionally expandable for several other tests).

### Main Features

- Suitable for highly precise direct shear tests in practise and research
- The complete shear box system is made of stainless steel, incl. porous plates, load piston and water container for saturated conditions
- The main advantage is an accurate testing of soil parameters without tilting and friction between shear box components (e. g. load piston, upper shear box, lower shear box)
- The normal stress and the shear stress are closed-loop controlled by an electromechanical precision drive system
- The device can be operated by the touch sensitive keypad or fully automatic by a computer with adequate control software



### Standard direct shear boxes:

- ▶ Square size: 60 x 60 mm ( 36 cm<sup>2</sup> )
- ▶ Square size: 100 x 100 mm (100 cm<sup>2</sup>)
- ▶ Circular: Ø 60 mm (28.27 cm<sup>2</sup>)
- ▶ Circular: Ø 71.4 mm (40 cm<sup>2</sup>)
- ▶ Circular: Ø 80 mm (50 cm<sup>2</sup>)
- ▶ Circular: Ø 94.4 mm (70 cm<sup>2</sup>)

**Note: Other sizes are available on request**

### Technical Specifications

Maximum shear force (standard)	5 / 10 kN
Maximum normal force (standard)	5 / 10 / 20 kN
Accuracy class	0.1%
Resolution	0.00001 kN
Shear rate	30 – 0.000001 mm/min



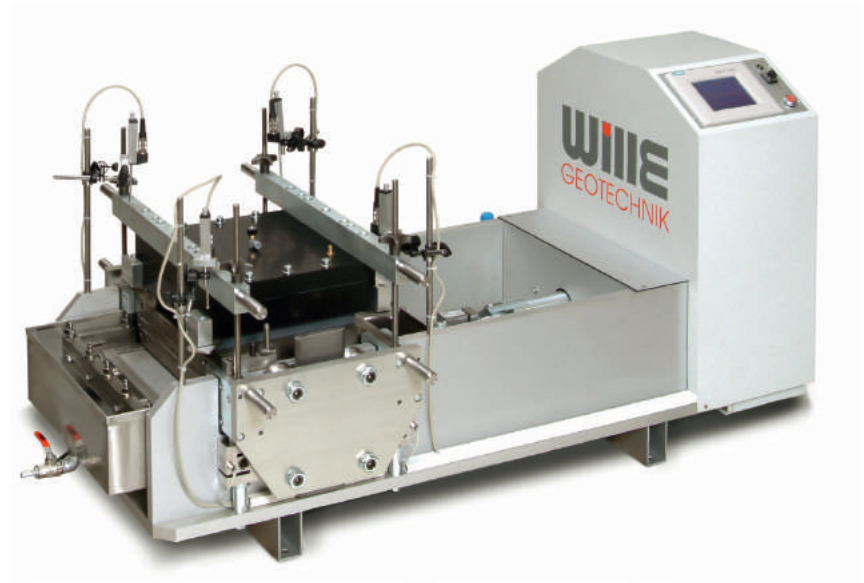
## FULLY AUTOMATIC LARGE SHEAR BOX APPARATUS

The fully automatic large shear box apparatus ADS-300, ADS-500 and ADS-1000 have been developed and designed according to the latest scientific findings and testing demands (ASTM, EN and DIN).

For determining the friction behaviour of soils, gravels, geosynthetics, recycling rubble or industrial slag.

### Note:

Customized sample size and shear rate is available on request.



### Main Features

- Testing apparatus for determining the internal friction of construction materials as well as the friction parameters of interfaces between different construction material layers (e.g. plastic liner/soil, geogrid/soil, geotextile/soil, plastic liner/geotextile, geotextile/concrete, concrete/asphalt, soil/soil, gravel, etc. as option)
- The advanced high accuracy shear box system, developed and exclusively offered by Wille Geotechnik®, prevents against tilting and wall friction during the test
- Stainless steel water receiver in the lower and upper shear box for sample saturation
- Creep test (optional)
- Semi automatic or fully automatic operation via PC
- Smallest and standard shear angles could be measured with highest repeatability
- With automatic wall friction compensation
- Applicable for automatic test control and monitoring of parameters and evaluation with shear software module

#### Direct shear boxes:

- ▶ ADS-300: 300 x 300 mm
- ▶ ADS-500: 500 x 500 mm
- ▶ ADS-1000: 1000 x 1000 mm

### Technical Specifications

Maximum shear stress	300 / 600 / 1000 KPa
Normal stress (higher stresses on demand)	300 / 600 / 1000 KPa
Shear rate (infinitely variable, load independent)	20 – 0.00001 mm/min
Shear displacement	100 mm
Total dimensions (W x L x H)	600 x 1650 x 750 mm

## FULLY AUTOMATIC SIMPLE SHEAR APPARATUS

Advanced fully automatic simple-shear apparatus for saturated and unsaturated tests for static shear loads up to 10 kN.

The precision electromechanical drive with high resolution and 1 ms closed loop control rate generates closed-loop strain and stress controlled static axial load and strain and in addition stress controlled shear forces.

The specimen is mounted in a reinforced rubber-membrane connected to tilting free, parallel guided lower shear frame and a vertical parallel-guided load piston free from tilting.



### Main Features

- For simple shear tests under saturated and unsaturated conditions
- Constant volume conditions (K0-Conditions)
- Load independent shear rates (shear stress optional)
- High precision and stiff load transducer for normal force and shear force
- High accuracy displacement transducers for settlement and displacement (strain)
- Material of specimen adapter: stainless steel standard or customized specimen sizes are available
- Two porewater ports are situated at the top and bottom specimen adapter for saturated conditions
- Applicable for automatic test control and monitoring of parameters and evaluation with shear software module

#### Circular simple shear boxes:

- ▶ Ø 50.0 mm, 20 cm<sup>2</sup>
- ▶ Ø 60 mm, 28.27 cm<sup>2</sup>
- ▶ Ø 63.0 mm, 31.2 cm<sup>2</sup>
- ▶ Ø 66.8 mm, 35 cm<sup>2</sup>
- ▶ Ø 71.4 mm, 40 cm<sup>2</sup>
- ▶ Ø 79 mm, 50 cm<sup>2</sup>
- ▶ Ø 94.4 mm, 70 cm<sup>2</sup>

#### Option: Low cyclic version

### Technical Specifications

Normal force (standard)	5 or 10 kN
Max. shear force (standard)	5 kN, optional 2 or 10 kN
Max. shear displacement	20 mm
Spindle lift and vertical clearance	220 mm
Axial displacement transducer	10 mm
Settlement	25 / 0.001 mm
Accuracy class	0.1%
Resolution	0.00001 kN
Shear rate	30 – 0.000001 mm/min



## FULLY AUTOMATIC DYNAMIC SIMPLE AND DIRECT SHEAR APPARATUS

Advanced fully automatic simple-shear apparatus with two high quality servomotor drives for static, cyclic and dynamic shear loads up to 10 kN.

This electromechanical dynamic cyclic machine is a sophisticated robust construction in connection with high-quality mechanic and electronic components and includes a high stiffness frame and actuator system to compensate any deformation in static or cyclic loading.

The machine includes two high quality servomotor drives for performing vertical load (static and dynamic).



### Main Features

- High stiffness frame and actuator system to compensate any deformation in static or cyclic loading
- Suitable for drained and un-drained direct or simple shear tests
- Double side horizontal and vertical ball-bearing guided cross-head for load piston and shear boxes
- Closed-loop controlled height for constant volume conditions (K0-Conditions)
- Closed-loop control of strain, load and displacement for static and cyclic shear stresses
- Sophisticated robust construction combined with highquality mechanic and electronic components
- The specimen is mounted with a rubber-membrane (spiral wire winding or teflon coated rings) and is connected to a tilting free, parallel guided lower shear box and a tilting free, vertical parallel-guided load piston
- High accuracy displacement transducers for settlement and displacement (strain)

### Technical Specifications

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

## FULLY AUTOMATIC STATIC RING SHEAR APPARATUS

Fully automatic closed-loop controlled ring shear apparatus applicable for highly precise ring shear tests to measure shear strength parameters at failure and residual shear strength using a constant shear plane and an unlimited angle of rotation or shear strain.

This development includes our experience in details of wall friction compensation and guidance of the shear boxes.

Applicable with free selectable and programmable closed-loop controlled stress-paths with stress, strain and height/volume controlled test procedures.

### Options:

- Pore pressure transducer
- Unsaturated test conditions including of automatic pressure controller or conventional pressure panel and confining pressure cell

### Main Features

- The complete ring shear box system is made of stainless steel including upper and lower shear rings, porous ring plates with or without ribs, load piston and water receiver for saturated conditions
- Continuously adjustment of the inner and outer shear band after consolidation, free of tilting
- Sophisticated robust construction combined with high quality mechanic and electronic components of industrial standard
- Closed-loop controlled normal stress by a load cell
- Closed-loop controlled shear strain rates by high resolution transducer
- High resolution data acquisition system with high quality transducers for shear stress, normal stress, shear strain and axial strain
- The device can be operated by the touch sensitive keypad or by PC control with adequate software



### Technical Specifications

Normal stress	1000 / 2000 kN/m <sup>2</sup>
Shear stress	1000 / 2000 kN/m <sup>2</sup>
Angle of rotation	Unlimited
Rotational rates	180° – 0.00001°/min
Accuracy class	0.1%
Shear ring sizes	94/50 mm, 100/50 mm, 150 / 100 mm



## FULLY AUTOMATIC DYNAMIC RING SHEAR APPARATUS

Fully automatic advanced closed-loop controlled dynamic ring shear apparatus applicable for highly precise ring shear tests to measure shear strength parameters at failure and residual shear with a maximum frequency of 20 Hz.

This development includes our experience in details of wall friction compensation and guidance of the shear boxes.

Applicable with free selectable and programmable closed-loop controlled stress-paths with stress, strain and height / volume controlled test procedures.

### Options:

- Pore pressure transducer
- Unsaturated test conditions including of automatic pressure controller or conventional pressure panel and confining pressure cell



### Main Features

- The complete ring shear box system is made of stainless steel including upper and lower shear rings, porous ring plates with or without ribs, load piston and water receiver for saturated conditions
- Continuously adjustment of the inner and outer shear band after consolidation, free of tilting
- Sophisticated robust construction combined with high quality mechanic and electronic components of industrial standard
- Closed-loop controlled normal stress by a load cell
- Closed-loop controlled shear strain rates by high resolution transducer
- High resolution data acquisition system with high quality transducers for shear stress, normal stress, shear strain and axial strain
- The device can be operated by the touch sensitive keypad or by PC control with adequate software

### Technical Specifications

Normal stress	1000 / 2000 kN/m <sup>2</sup>
Shear stress	1000 / 2000 kN/m <sup>2</sup>
Frequency	5 / 10 Hz (optional: 20 Hz)
Angle of rotation	Unlimited
Rotational rates	4500° – 0.00001°/min
Accuracy class	0.1%
Shear ring sizes	94/50 mm, 100/50 mm, 150/100 mm

## FULLY AUTOMATIC LARGE RING SHEAR APPARATUS

Bromhead type and high accuracy (Wille Geotechnik®) type of large ring shear box construction standard Ø 600 / 360 mm (1800 cm<sup>2</sup>) (available also on request sizes) for tills, gravels and industrial slag.

After years of manufacturing ring shear machines this development includes all our experience in details of wall friction measurement, guidance of the shear boxes and receiving repeatable and feasible test results.

The complete ring shear box system has a robust construction and is including of upper and lower shear rings, porous ring plates with or without ribs, load piston and water receiver for saturated conditions.

### Options:

- Different shear ring sizes (available on request)
- Higher rotational rates (available on request)
- Higher normal stresses (available on request)



### Main Features

- The complete ring shear box system is made of stainless steel including upper and lower shear rings, porous ring plates with or without ribs, load piston and water receiver for saturated conditions
- Continuously adjustment of the inner and outer shear gap after consolidation
- Sophisticated robust construction combined with high quality mechanic and electronic components of industrial standard
- Closed-loop controlled normal stress by a load cell
- Closed-loop controlled shear strain rates by high resolution transducer
- High resolution data acquisition system with high quality transducers for shear stress, normal stress, shear strain and axial strain
- The device can be operated by the touch sensitive keypad or by PC control with adequate software

### Technical Specifications

Normal stress	300 kN/m <sup>2</sup> (customized)
Shear stress	200 kN/m <sup>2</sup> (customized)
Angle of rotation	Unlimited
Shear ring sizes	600 mm / 360 mm
Effective sample area	1800 cm <sup>2</sup>



## DYNAMIC HIGH CAPACITY MULTI-DIMENSIONAL SIMPLE- AND TRIAXIAL SHEAR APPARATUS

Vibrating tables are an important part in the investigation of soils or other building materials under cyclic or dynamic loads. Depending from the application we distinguish and use one- or multidimensional actuator systems.

Vibrating tables provide a platform for different experimental setups such as test cell, building construction or other structures that serve as a boundary condition for the various applications.

The experimental setup represents a frictionless bearing vibration table with a large triaxial cell. Objective of the study is to investigate the grain skeleton under cyclic and dynamic loads. It simulates in a large scale laboratory test the liquefaction behavior under saturated and unsaturated conditions.



### Extract of technical features:

- 3 x dynamic axis with servohydraulic actuators up to 25 kN, 20 Hz
- 2 x dynamic horizontal axis for two-dimensional shear loading
- Small and large sample sizes up to 200 mm for large grain sizes
- Isotropic and anisotropic consolidation and shear procedure with K0-Conditions
- Small non-contact strain measurement during cyclic and dynamic test procedures
- Submersible 3-dimensional load transducer for simultaneous measurement of all three axis

## FULLY AUTOMATIC LABORATORY VANE SHEAR TESTER

- Fully automatic controlled laboratory vane tester including data acquisition and evaluation system
- Determination of the shear strength of undrained soils with soft to stiff consistency
- Software with complete data evaluation and print out with diagram on every commercial printer



### Main Features

- Control and evaluation software
- Fulfills all standards (BS, DIN, ASTM, ... ) and all demands in research
- Providing a wide measuring range of shear stress
- Optional complete data acquisition and evaluation software
- Determination of the shear strength of undrained soft to stiff soils
- Test runs completely reproducible
- Shear stress measured by two high accuracy load transducers, without friction
- Automatic recording of the shear resistancy (torque) against the displacement (angle)

#### Vane sizes:

- ▶ FL 25012: 12.7 x 12.7 mm
- ▶ FL 25050: 25.4 x 50.8 mm
- ▶ FL 25019: 12.7 x 19.0 mm
- ▶ FL 25060: 30.0 x 60.0 mm
- ▶ FL 25025: 12.7 x 25.4 mm
- ▶ FL 25080: 40.0 x 80.0 mm
- ▶ FL 25030: 20.0 x 30.0 mm

### Technical Specifications

Diameter of specimen	50 – 200 mm
Torque	> 3 Nm
Resolution	0.001 Nm
Measuring range according to vane size	0 – 466 kN/m <sup>2</sup>
Shear displacement	Unlimited
Angular speed (stepless)	20 – 0.0001°/s
Power supply	50 W, 230 V, 50 Hz



## MOTORIZED VANE SHEAR TESTER

For determination of undrained shear strength

Standard: DIN 4094, BS 1377, ASTM 4648

### Main Features

- With speed control and digital shear stress measurement
- Determination of the shear strength of undrained soft to stiff soils
- Rigid and height adjustable frame construction
- Analogue output signal for data acquisition of torque
- Unlimited shear displacement
- Motorized vane speed with different ranges
- Quick clamp attachment from 50 to 170 mm sample diameter (or optional customized)



### Vane Sizes:

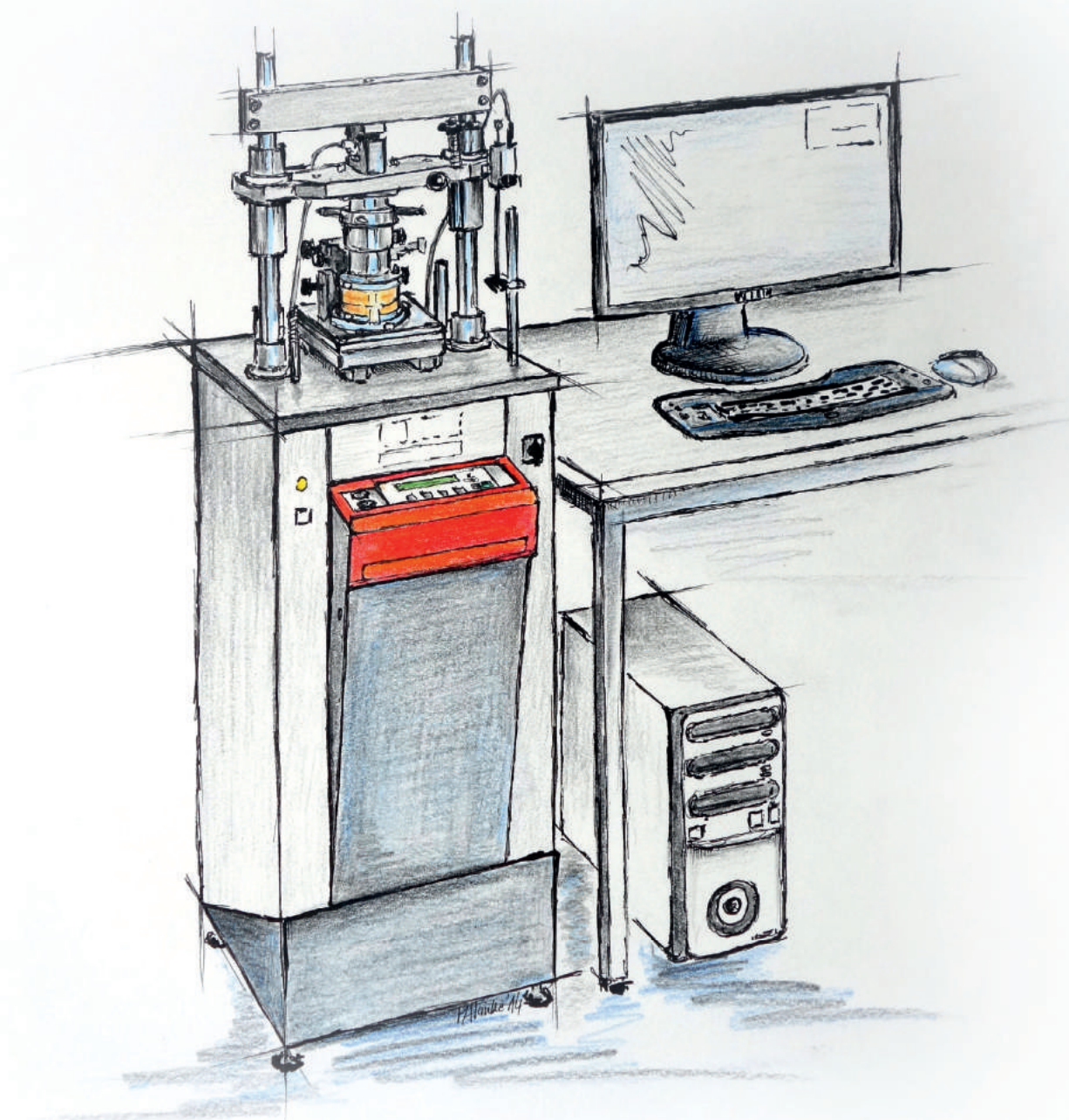
- ▶ FL 25012: 12.7 x 12.7 mm
- ▶ FL 25050: 25.4 x 50.8 mm
- ▶ FL 25019: 12.7 x 19.0 mm
- ▶ FL 25060: 30.0 x 60.0 mm
- ▶ FL 25025: 12.7 x 25.4 mm
- ▶ FL 25080: 40.0 x 80.0 mm
- ▶ FL 25030: 20.0 x 30.0 mm

### Technical Specifications

Sample diameter	50-200 mm
Torque	> 3 Nm
Resolution	0.001 Nm
Torque accuracy	Kl. 0.1 %
Speed ranges	0.01... 10 / 100 / 1000°/min
Power Supply	50 W / 220 V / 50 Hz



# ADVANCED SOIL ANALYSER



## ADVANCED SOIL ANALYSER (ASA SYSTEM)

Universal machine for fully automatic soil mechanic analyses for research and standard use.

This fully automatic universal testing device includes all our experience after years of manufacturing soil testing machines, in particular wall friction compensation, guidance of shear boxes and producing repeatable test results.

This universal testing machine can be used for several soil mechanical testing procedures when it is equipped with the according testing inserts and adapters.

- Triaxial tests
- Direct-residual shear test
- Simple shear tests
- Creeping tests
- Vienna shear test (with constant height)
- Compression (oedometer) tests
- Special swell tests and swell pressure tests
- Uniaxial compression tests



### Main Features

- Sophisticated robust and extremely rigid construction using high-quality components in the mechanism
- Microprocessor-controlled drive motors with precision gearing for load-independent normal stresses, shear rates or shear stresses
- Use of pre-calibrated, customer replaceable precision force sensors to measure and control of the normal stresses
- Suitable for installation of high quality shear inserts, oedometer cells, uniaxial and triaxial jigs
- Microprocessor-controlled drive motors with precision gearing for load-independent normal stresses, shear rates or shear stresses
- Sophisticated robust construction combined with high quality mechanic and electronic components of industrial standard
- Easy specimen fitting and cleaning
- Electronically data transmission by high precise measuring sensors and fully automatically control of the normal stress by an electromechanically precision drive (processor-controlled, direct force measurement)
- The device can be operated directly by a touch sensitive keypad or remote controlled by a PC with adequate software
- Different software modules and sample testing inserts are available due to the desired application
- Fully automated control and actual value of the check-point directly on the connected sensors (closed-loop control force sensor, position sensor) with up to 1000 / s
- Integrated, menu-driven calibration with calibration for all measuring sensors
- High quality, robust and globally proven control electronics SIEMENS long parts warranty



Uniaxial  
Compression test



Compression  
(Oedometer) test



Direct-Residual  
Shear test



Simple Shear test



Triaxial test

## FULLY AUTOMATIC SHEAR DEVICE FOR SATURATED OR UNSATURATED DIRECT SHEAR TESTS

This special device was developed for direct shear tests, which can be realized under different pore pressure conditions.

Using a pressure chamber around the direct shear box, pore pressures up to 1000 kPa can be applied during the test.

**Option:**

As a special edition we offer additional equipment for unsaturated direct shear tests.

In combination with modified HAEV-ceramic discs and a pore air pressure control system, unsaturated conditions with different suction stress ranges are possible.





# PERMEABILITY TESTING DEVICES



## COMBINED PERMEAMETER (FALLING HEAD + CONSTANT HEAD) APPARATUS

This apparatus serves to determine the coefficient of water permeability of soil in laboratory tests and allows to process both types of tests i.e. with constant and variable hydraulic pressure (constant and falling head), basically according to relevant standards.

According to the test requirements, a number of four installed manometer tubes with different diameters can be chosen. The apparatus consists of two piezometer pipe systems for testing with high and low water flow, instrument panel, 1 water storage vessel.

### Options:

- Water deairing system



### Main Features

- Constant and falling head apparatus for permeability testing of soils with constant and falling hydraulic gradient
- Two piezometer pipes with mm-scale for exact determination of the water gradient
- Suitable for determination of the permeability from  $10^{-3}$  to  $10^{-8}$  m/sec
- Apparatus is mountable on table or wall
- Standard: DIN, ASTM, BS
- The apparatus is also useable for proctor moulds and sample tubes
- Dimension: 500 x 1250 x 350 mm (B x H x D)

### Accessories

- Permeability cells for non cohesive materials from  $\varnothing$  75 to 150 mm
- For testing the water permeability of non-cohesive soils and construction materials, performed with a constant hydraulic gradient
- Transparent chamber for connecting up to 4 manometer tubes in different heights
- Including ball valve, deairing valve and ram with top plate to apply a constant axial load in a loading frame
- Sample preparation plate for permeability cell with rod
- External water storage vessel (5 to 20 l)

## COMPACTION PERMEAMETER

The compaction permeability test is a common laboratory testing method used to determine the permeability of cohesive and non-cohesive materials. This testing method can be applied as constant head or falling head permeability tests on undisturbed, remoulded or compacted samples.

The compaction permeameters are available in different sizes like 100 / 101.6 / 150 / 152.4 mm and options for compaction test before permeability test is also available.



## PORTABLE PERMEAMETER

The portable permeability testing device determines the permeability of cohesive soil samples as a quick test at site (2 hours). As an alternative for the proper determination of permeability in the laboratory experiment, this device can be used at site under pressure conditions.

This equipment is available with different permeability cells and different sample sizes in respect to saturation pressure up to 150 kPa, higher hydraulic gradients than in-site test could be applied.



## PERMEABILITY CONTROL PANEL (250KPA)

Triaxial permeability control panel for three triaxial permeability cells, with 6 pressure gauges and 6 pressure regulator up to 250 kPa.

3 precision pressure gauges for saturation pressure and 3 standard pressure gauges for cell pressure, 6 precision pressure regulators to control 3 triaxial permeability cells up to 250 kPa with one side saturation pressure, second is outflow without pressure. The inflow could be measured with the burette system, or with continuous inflow using the supply cylinder, only measuring the outflow of the sample using burettes or bottle, measuring the weight of the water in the bottles.

Including of de-aired air/water bladder cylinder for continuous supply of the triaxial cell under pressure conditions up to 250 kPa, volume: 2 l.



### Technical Specifications

Supply pressure	250 kPa
Max. working pressure	250 kPa
Coefficient of permeability	$10^{-5}$ to $10^{-12}$ m/sec
Burette standard	50 ml
Burette optional	10 / 100 ml

## PERMEABILITY CONTROL PANEL

For saturated conditions

These permeability systems are designed to determine the hydraulic conductivity of porous and cohesive materials under saturated and unsaturated conditions. The panel enables constant and small falling head tests.

These triaxial control panels are designed according to ASTM D 5084, D 2850, D 4767, DIN 18130/3, BS1377 Standards, AASHTO T296, T297.

For permeability test sources like clean and dry air (air compressor unit) and water are needed.

The permeability test sets are available for 1000 kPa and optional 2000 kPa (double side saturation).



### Main Features

- High precision pressure control for small and high hydraulic gradients under saturated conditions
- Calibrated digital pressure control
- Options for testing aggressive fluids (toxic)
- Options for automatic volume measurement
- Options for vacuum control system
- Modular system for tests up to any number of samples
- Cells with exchangeable sample diameters from 35 mm up to 100 mm
- Confining and saturation pressures up to 1000 kPa
- User friendly and clearly arranged control panel
- Exchangeable burettes, 10-200 ml to determine different coefficients of permeability
- Vacuum control system for de-aired water conditions (optional)
- Needle valves for charging and discharging the burettes under pressure
- Quick connection system between master panel, auxiliary panels and cells

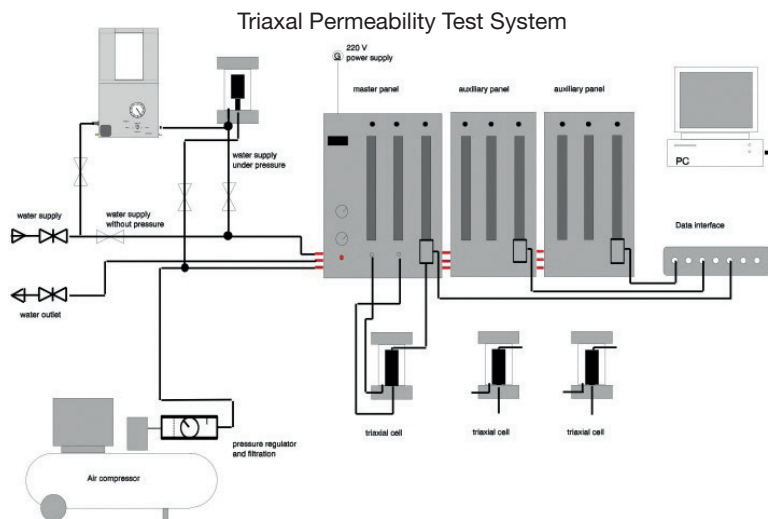
### Technical Specifications

Supply pressure	1000 kPa (optional 2000 kPa)
Max. working pressure	1000 kPa (optional 2000 kPa)
Coefficient of permeability	$10^{-7}$ to $10^{-12}$ m/sec
Burette standard	50 ml
Burette optional	10 / 100 / 150 / 200 ml

## PERMEABILITY CONTROL PANEL

These combined permeability control panels are designed to apply the test conditions on three triaxial permeability cells simultaneously. The main part of the test set is permeability control panel, which is connected to other control panels and

is a modular testing system for tests up to any number of samples. For numbers of 3 cells, combined control panels, permeability cells and data acquisition system with automatic volume measurement are used as shown in the picture.



### Models

#### D52010/2 ECONOMY VERSION

This triaxial permeability control panel is low cost version for three triaxial permeability cells. It's included of three precision pressure gauges and three precision pressure regulator to control three triaxial permeability cells. The cells are working under identical confining pressures and also identical saturation pressures simultaneously.



#### D52010

Triaxial permeability control panel with one digital display and change over switches and 3 separate precision pressure regulator for each panel. The master panel is suitable for one permeability cell and for any extra cell an auxiliary panel should be connected to the master panel.



## D53010

Triaxial permeability control panel with pressure gauges and separate precision pressure regulators for confining pressure and both side saturation pressures for each triaxial cell. The panel is suitable for one permeability cell and for any extra cell, additional panel could be connected to the main panel.

In this photo 3 panels are used for 3 permeability cells.



## D53010/D

Triaxial permeability control panel with digital pressure displays and separate precision pressure regulators for each cell. The panel is suitable for one permeability cell and for any extra cell, additional panel could be connected to the main panel.



## Options

### ▪ Data acquisition system

This device is a controlling system (Octocon) for up to 8 volume change and pressure transducer for permeability applications for best test performances. The data acquisition unit is fixed in a PC for collecting different measuring values and conducting to the software. For more information please refer to the data sheet of Octocon in this catalogue.

### ▪ Permeability software

Permeability software is flexible to be used with data acquisition or without data acquisition system. This software is compatible with Windows (Windows XP or Vista, on request Linux and Mac OS). It could be used also without data acquisition system then the input data for this software should be entered manually to the software.

### ▪ Automatic volume change measurement device

## Technical Specifications

Max. working pressure	1000 kPa (optional 2000 kPa)
Coefficient of permeability	$10^{-7}$ to $10^{-12}$ m/sec
Burette standard	50 ml
Burette optional	10 / 100 / 150 / 200 ml
Digital pressure output	0 – 10 V

## FULLY AUTOMATIC PERMEABILITY TESTING SYSTEM

This permeability testing system is used for different pressure applications and consisting of three advanced high quality automatic electro mechanic stainless steel volume / pressure-controller with volume measurement and special pressure permeability cells to carry the required test conditions at different ranges of pressures and temperatures for cell pressure and pore pressures at top and bottom of the sample.

GEOsys as a multifunctional powerful software is used to control the test and the module of permeability in the software allow users to control the test parameters easier.

A system with continuous flow and corrosion resistance is available.



Three automatic pressure/volume controller for controlling cell pressure and pore pressure at top and bottom of sample

### Main Features

- Automatic electromechanic volume / pressure controller with constant pressure or constant volume flow or pressure / volume ramps
- Stainless steel chamber to avoid corrosion
- Compact and space saving design  
different control interfaces are available depending from customers requirements
- Different sample sizes
- Continuous flow (optional)



### Technical Specifications

Max. pressure	0 - 4 MPa / 4 - 70 MPa
Sample size	On request
Volume	1000 ml to unlimited
Resolution	< 0.001 ml





## FULLY AUTOMATIC TEMPERATURE CONTROLLED PERMEABILITY TESTING SYSTEM

Most of the applications, where accurate permeability or porosity measurement is the point of view, require temperature-controlled conditions. Parameter changes of the flow medium and test sample depending from temperature is a widely spread measurement error. In a wide range of applications Wille Geotechnik® got a number of projects and was able to collect 20 years experience in different fields:

- Geothermal soil and rock testing
- Mining projects
- CO<sub>2</sub> injection
- Hydraulic fracture test
- Gas and oil reservoirs
- Gas hydrates



### Main Features

- Automatic electromechanic stainless steel volume / pressure-controller with volume measurement, up to 10 MPa, up to 1000 cm<sup>3</sup> with high quality SIEMENS-controller and touch-panel for stand alone use
- Stainless steel chamber to avoid corrosion
- Compact and space saving design different control interfaces are available depending from customers requirements
- Different sample sizes



### Technical Specifications

Max. pressure	10 MPa
Resolution	0.1 kPa
Volume (standard)	250 cm <sup>3</sup>
Resolution	< 0.001 cm
Temperature	Up to 300 °C

## PERMEABILITY TEST SYSTEM FOR CORROSIVE FLUIDS / LARGE VOLUME

This high quality permeameter system is designed for determining hydraulic conductivity of different porous materials, leachate conductivity and intrinsic permeability under triaxial stress conditions.

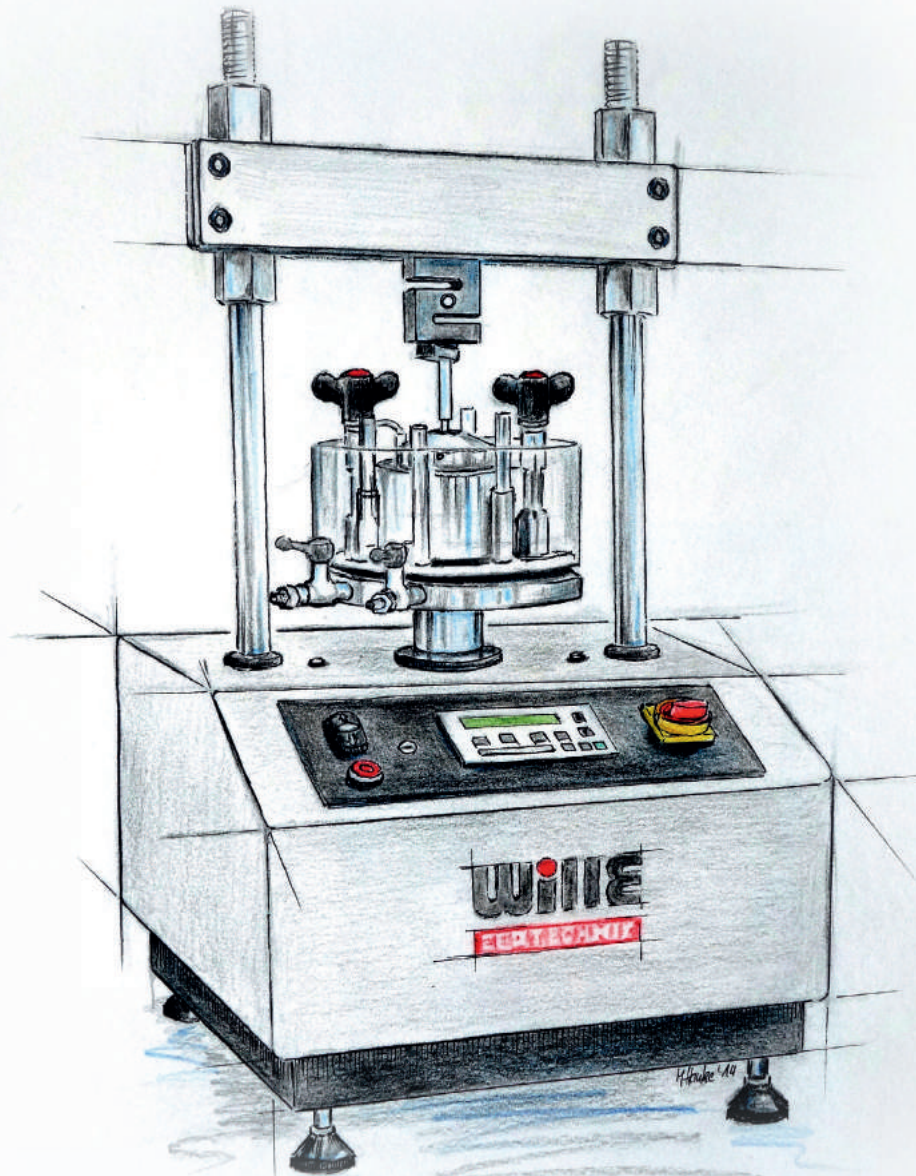
The panel enables constant permeability tests. This is a special permeability testing system for salty fluids or toxic solution with data acquisition system.

### The system includes of:

- Master pressure control panel with pressure displays and regulators
- Pressure interface chamber for aggressiv permeants
- Data aquisition system for volume change and pressure
- Pressure range up to 1 to 2 MPa



# CONSOLIDATION DEVICES



## FULLY AUTOMATIC ELECTROPNEUMATIC CONSOLIDATION APPARATUS

This fully automatic one-dimensional consolidation apparatus with high precision servo pneumatic load system ensures precise and sensitive adjustment of sample loading and unloading.

Controlling and data acquisition software for consolidation tests with monitoring system has possibility of controlling up to 8 consolidation apparatus simultaneously and independently.

In regard to our complete range of standard and advanced consolidation cells with fixed or floating ring various sample dimensions can be tested. In addition automatic examination of pore pressure and permeability is executable.

The machine is designed for minimum air pressure consumption, no waste of air pressure and includes calibrated load transducer and has variable vertical clearance by adjustable crossbar.



### Main Features

- Precision sensor placed directly at the top of the cell for load-control (time and settlement dependent), Optional: Porewater/pressure control and swell pressure tests
- Fully automatic adjustment of load stages according to the selected stop-criteria
- Digital settlement control by displacement transducer
- Fully automatic testing procedure and monitoring via PC control, up to 12 devices simultaneously and independent
- Automatic acquisition of settlement, time and normal stress
- Suitable for all consolidation cells
- Standard software solutions:
  - ▶ Load controlled, settlement and / or time dependent for standard consolidation tests
  - ▶ Displacement controlled for constant pore volume (Swell pressure control)
  - ▶ Porewater pressure controlled consolidation tests

### Accessories

- ▶ PC or multi-channel control unit
- ▶ Control and evaluation software
- ▶ Consolidation cell with fixed or floating ring
- ▶ Compressor or compressed air plant

### Technical Specifications

Axial load	5 kN, optional 10 kN
Displacement transducer	25 mm
Resolution	0,001 mm
Dimension (L x W x H )	350 x 350 x 500 mm
Rated power	< 60 W
Power supply	230 V, 50 Hz
Supply pressure	Min. 6 bar; max. 10 bar



## FULLY AUTOMATIC TABLE TOP ELECTROMECHANICAL CONSOLIDATION APPARATUS

(suitable for IL and CL tests)

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

The loading range of this machine is up to 10 kN with accuracy higher than pneumatic systems specially at low loads.

In regard to our complete range of standard and advanced consolidation cells with fixed or floating ring various sample dimensions can be tested. In addition automatic examination of pore pressure and permeability is executable.

A direct operation and calibration of the device is possible by control unit with keypad and LC-display.



### Main Features

- Precision sensor placed directly at the top of the cell for load-control (time and settlement dependent)
  - Optional: Porewater pressure control and swell pressure tests
  - Calibrated, exchangeable load transducer and additional sensors inputs (e.g. pore water pressure transducer) enable individual test performances and control parameters
  - Fully automatic adjustment of load stages according to the selected stop-criteria
  - Digital settlement control by displacement transducer
  - Suitable for all consolidation cells
- Software:
    - ▶ Controlling software for closed-loop controlled load, continuous loading consolidation and swelling pressure tests with monitoring system
    - ▶ Independent, automatic test control and data acquisition according to freely configured test criteria depending from load, porewater pressure or settlement
    - ▶ Simultaneous monitoring and data acquisition of the measured values (load, settlement, porewater pressure and time) during the test for all test phases
    - ▶ Error detection and diagnosis
    - ▶ Data transfer in ASCII code

### Technical Specifications

Load range	5 / 10 kN
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## FULLY AUTOMATIC ELECTROMECHANICAL CONSOLIDATION APPARATUS

(suitable for IL and CL tests)

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

The design of this apparatus offers new possibilities for determining the Young's modulus. High-precision, user-friendly measurement and control components coincide with a solid, functional construction.

In regard to our complete range of standard and advanced consolidation cells with fixed or floating ring various sample dimensions can be tested. In addition automatic examination of pore pressure and permeability is executable.

A direct operation and calibration of the device is possible by control unit with keypad and LC-display.

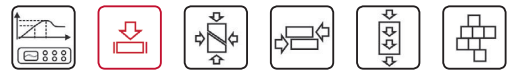


### Main Features

- Precision sensor placed directly at the top of the cell for load-control (time and settlement dependent). Optional: Porewater pressure control and swell pressure tests
- Calibrated, exchangeable load transducer and additional sensors inputs (e.g. pore water pressure transducer) enable individual test performance by defining different measurement parameters as and control values
- Fully automatic adjustment of load stages according to the selected stop-criteria
- Digital settlement control by displacement transducer
- Suitable for all consolidation cells
- Software:
  - ▶ Controlling software for closed-loop controlled load, continuous loading consolidation and swelling pressure tests with monitoring system
  - ▶ Independent, automatic test control and data acquisition according to freely configured test criteria depending from load, porewater pressure or settlement
  - ▶ Simultaneous monitoring and data acquisition of the measured values (load, settlement, porewater pressure and time) during the test for all test phases
  - ▶ Error detection and diagnosis
  - ▶ Data transfer in ASCII code

### Technical Specifications

Load range	25 / 60 / 100 kN
Vertical clearance	Up to 600 mm
Spindle lift	200 mm
Consolidation cells	Ø 20 - 300 mm
Dimension (H x W x D)	1300 x 400 x 350 mm



## LARGE CONSOLIDATION SYSTEM WITH PORE PRESSURE CONTROL

This consolidation system has been especially designed to perform consolidation tests on saturated fine grained soils and tailing muds. It's also used to perform consolidation tests on sea or lake sediments.

The combination of the special consolidation cell with electromechanical loading system made by Wille Geotechnik® all kind of consolidation procedures can be applied (e.g. IL, CRS, CL, CG tests).

The base of the cell is equipped with a pressure transducer in order to determine the porewater pressure, the results being processed as test control criteria.



### Main Features

- Special-compression cell for measuring the consolidation behaviour of muds and viscous materials with measuring and / or porewater pressure controlling.
- Special cell resistance to aggressive fluids e.g. saline solution and corrosive materials
- Special construction allows accurate measurement and control of normal stress, including measurement and compensation of wall friction influences
- Built-in filter plates in the head and base plate for removing the free porewater
- Multi stage load cells allow highest accuracy in control at lowest and highest stresses
- Multi stage load cells

### Options:

- ▶ Different force sensors
- ▶ Different displacement sensors
- ▶ Different porewater pressure ranges
- ▶ Different sample sizes
- ▶ Different sample height (on request)
- ▶ Different environment condition

### Technical Specifications

Max axial load	5 / 10 / 25 kN
Maximum cell pressure	300 kPa
Sample size	100 / 150 / 200 / 300 mm
Specimen height	Customized
Settlement	Up to 200 / 300 mm

## FULLY AUTOMATIC THERMAL CONSOLIDATION (THM) TESTING SYSTEM

Suitable for frozen tests and high temperature tests

This high-precision advanced thermo-hydromechanical (THM) consolidation testing system for one-dimensional consolidation tests enables menu-driven, fully automatic performance of incremental and optionally continuous load tests under different range of temperatures of sample.

The system includes of advanced THM consolidation cell for stress and strain controlled consolidation tests under temperature controlled conditions. Closed loop control of temperature of sample is possible to reach the highest temperature accuracy on samples with special module of software for temperature controlling.

Different range of temperature for frozen tests or high temperature tests or both is available.



### Main Features

- Precision sensor placed directly at the top of the cell for load-control (time and settlement dependent)
- Heating thermostat -20°C to +200°C including of:
  - Large display, two-line LCD display for numbers, symbols and letters with comfortable backlighting
  - Simultaneous displaying of set and actual values
  - External control by additional PT-100 probe (option)
- Digital settlement control by displacement transducer
- Suitable for all oedometer cells
- Calibrated, exchangeable load transducer and additional sensors inputs (e.g. pore water pressure transducer) enable individual test performance by defining different measurement parameters as and control values.
- Software:
  - ▶ Controlling software for closed-loop controlled load, continuous loading oedometer and swelling pressure tests with monitoring system
  - ▶ Independent, automatic closed loop temperature control
  - ▶ Simultaneous monitoring and data acquisition of the measured values (load, settlement, porewater pressure and time) during the test for all test phases

### Technical Specifications

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





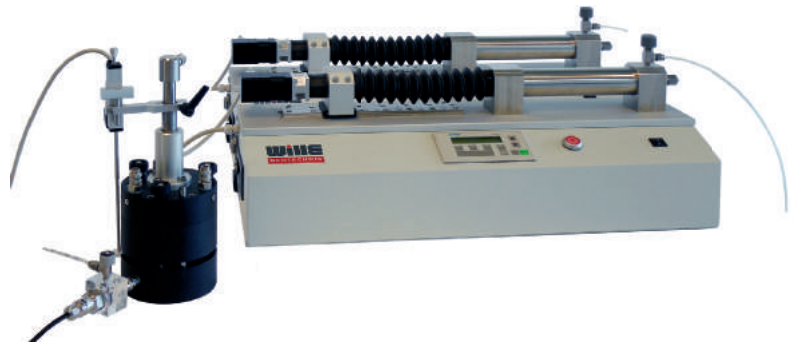
## ROWE BARDEN CONSOLIDATION TEST SYSTEM

These type of cells are designed for stress and strain controlled consolidation tests:

- Rowe cells / Rowe Barden cells
- CRS consolidation cells

Special developed cells by Wille Geotechnik®:

- K0 Consolidation cells
- Unsaturated consolidation cells (Prof. Schanz)
- Swelling pressure cells
- Temperature control consolidation cell
- High pressure cell



### Main Features

- CRS, CL, IL or swelling pressure tests
- For use with different load frames and load ranges
- For all kinds of permeability tests
- Optional water pressure or load frames for generating normal stresses
- Expandable for unsaturated conditions
- Applicable for all swelling and swelling pressure tests
- Different sample heights optional available
- For saturated conditions with pore pressure measurement or pore pressure/back pressure control
- Air pressure for axial stresses control
- Specifications and components:
  - ▶ Available as corrosion-resistant material (optional)
  - ▶ Lower cylinder with 2 inlet and outlet connections, equipped with needle valves, stainless steel sample ring and stainless steel porous discs
  - ▶ Special flushing system for best de-aired conditions
  - ▶ Upper cell part with pressure and de-airing connection and needle valves
  - ▶ Teflon guided, low friction stainless steel load piston
  - ▶ Bracket for strain transducer

### Technical Specifications

Sample area	20, 40, 70, 100 and 140 cm <sup>2</sup>
Sample height	20 mm (optional: up to 100 mm )
Pore pressure	Up to 1 MPa (optional 1.5, 3.5, 10 or 20 MPa)

## ADVANCED K0 CONSOLIDATION CELLS

With measurement of the radial stress

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

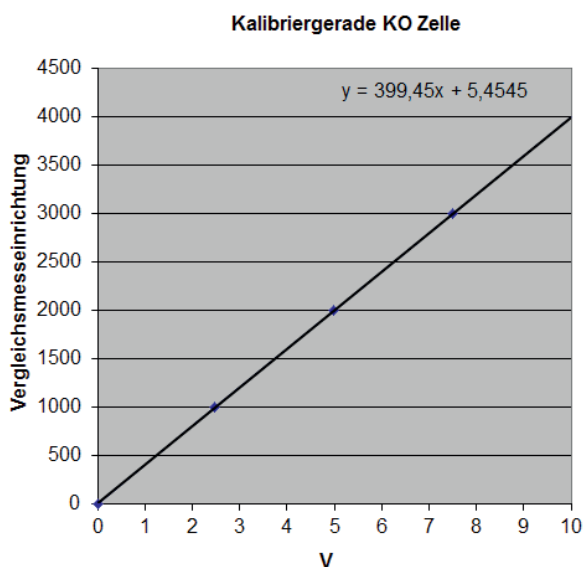
### Main Features

- K0 Consolidation cell with different sample diameters and stress ranges
- Available as standard K0 cell or in combination with CRS Consolidation cell
- Different models available (e.g. saturated condition, pore pressure condition, unsaturated tests)
- All parts with direct sample contact in stainless steel or titanium K0 Ring
- Waterproofed conditions
- In combination with Wille Geotechnik® load frames and software modules suitable for different consolidation tests like fully automatic IL, CL, CRS, CG or swelling tests
- Stress and temperature calibrated certificate



CRS cell with K0 ring

Characteristic calibration curve for the K0 consolidation cell



K0 Consolidation cell

### Technical Specifications

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

## SWELLING PRESSURE CELLS

This type of consolidation cells were developed by Wille Geotechnik® to measure increasing swelling pressure under saturated conditions without load frame for long term tests.

Independent from swelling pressure test, standard incremental or continuous loading test can be realized in preliminary stage or after swelling stage in combination with load frame.

### Features:

- Built in swelling pressure cells with height adjustment
- Available as low or high pressure version up to 20 MPa
- Standard or corrosion resistance cell 20 or 40 cm<sup>2</sup>



## STANDARD CONSOLIDATION CELLS

High quality stainless steel or brass consolidation cells in various diameters per as standards and also available on request for customized diameters.

- Stainless steel with fixed ring
- Stainless steel with floating ring
- Brass steel with fixed ring
- Specimen cutting ring
- Specimen diameters from 50.47 mm to 100.86 mm
- Cells from 20 to 100 cm<sup>2</sup>



### Main Features

- Special consolidation cell for compression permeability and swelling pressure tests
- 3 porewater connectors for flushing and permeability tests
- Ring completely made of stainless steel
- Stiff construction
- Porous discs, ram, walls and sample
- 3 porewater connectors for flushing and permeability tests

### Technical Specifications

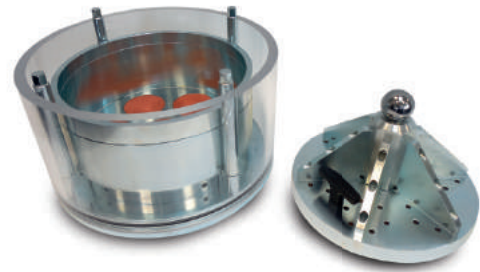
	Stainless steel Fixed ring	Stainless steel Combined fixed and floating ring	Brass Fixed ring
Specimen diameter	50 to 200 mm	50 to 200 mm	50 to 100 mm
Specimen height	20 to 100 mm	20 to 100 mm	20 mm

## LARGE CONSOLIDATION CELLS

The large consolidation cell is developed for consolidation testing for large samples. It is made from stainless steel in various diameter up to 300 mm. We are able to manufacture customized sizes and also oversize consolidation cells up to 1000 mm in combination with large loading system.

### Main Features

- Available for high loads up to 5,000 kN
- Standard or corrosion resistance cell
- Up to 300 mm diameter
- Radial stress measurement (option)



## TEMPERATURE CONTROLLED CONSOLIDATION CELL

High quality stainless steel temperature controlled cell in various diameter up to 150 mm and also a variety range of temperature from -20 °C (for frozen test applications) to +200 °C (for high temperature tests). Including of temperature sensors for closed loop control of temperature to reach required temperature with minimum temperature gradient in sample during test.

### Main Features

- Different sample diameters
- Stainless steel with floating and fixed ring
- Frozen tests -20 °C (lower temperature is available on request)
- High temperature up to +200 °C
- Temperature closed loop control with highest accuracy



## CONSOLIDATION CELL FOR TESTING OF TAILING MUDS

Special designed consolidation cell for testing of saturated fine grained soils and tailing muds.

### Main Features

- Special-compression cell for measuring the consolidation behaviour of muds and viscous materials with measuring and/or porewater pressure controlling
- Special construction allows accurate measurement and control of normal stress including measurement and compensation of wall friction influences
- Maximum cell pressure: 300 kPa
- Sample size: 100 / 150 / 200 / 300 mm
- Specimen height: customized
- Settlement: up to 200 / 300 mm



# SOIL STANDARD DEVICES



## PLATE BEARING TESTING EQUIPMENT

Standard: DIN 18134, ENV 1997-3



### Ordering Information

- FV 21000 Plate bearing test apparatus, single gauge type 100 kN complete with diameter 300 mm loading plate, precision dial gauge and double scale manometer cl. 0.6 (0 – 390 bar / 0 – 0,8 MN/m<sup>2</sup>)
- FV 21000 / 100 kN-set Plate bearing test apparatus, single gauge type 100 kN complete with diameter 300 mm loading plate, digital displacement transducer and load transducer with digital display
- FV 25100 Plate bearing test apparatus 100 kN, three gauges type, complete with diameter 300 mm loading plate, aluminium datum bar adjustable to 2.5 m, 3 digital displacement transducers, pressure transducer, digital data acquisition unit and data processing software

### Accessories

- ▶ FV 22004 Loading plate Ø 600 mm
- ▶ FV 22005 Loading plate Ø 762 mm
- ▶ FV 210121 Datum bar extension 500 mm
- ▶ FV 22070 Hydraulic unit 200 kN
- ▶ FV 21100 Wooden transport cases set
- ▶ FV 21306 Graphic calculator with pre-programmed evaluation software value input, exact calculation of the module and display of the load-settlement curve
- ▶ FV 20300 Depth stylus 300 mm
- ▶ FV 20500 Depth stylus 500 mm
- ▶ FV 21325 Load transducer with digital display for 100 kN, case and adapter set, RS 232 interface
- ▶ FV 21391 Load transducer 100 kN with automatic digital data acquisition, memory and display
- ▶ FV 2139102 Data transmission and evaluation software for FV 21391

## MOTORIZED PLASTIC LIMIT TEST DEVICE

Standard: DIN 18 122-1

This apparatus is designed for rolling out cohesive soil material, in order to determine the lower plastic limit of soil samples  $w_p$

- With this plastic limit device the soil specimens are automatically formed into rolls of an exact defined diameter
- The diameter of a soil rolls are adjustable
- The adjustable speed of the rollers and an air dryer to reduce the water content by air flow enable an optimized soil specific test procedure
- This provides the high reproducibility of this method
- The electric supply is effected by an external mains adapter (prim. 230 V, 50 Hz, 35 W / sec. 12 V, 2 A)



## POCKET PENETROMETER

For determination of soil consistency and approximate unconfined compression strength in situ

Standard: DIN 18136-2, ASTM D 2573-94

### FL 2950 Pocket penetrometer TP 1

- Case made of anodized aluminum
- Plunger  $\varnothing$  6.35 mm
- Scale range 0 – 4.5 kg/cm<sup>2</sup>

### FL 2955 Pocket penetrometer TP 2

- Case made of nickel-plated steel
- Plunger  $\varnothing$  6.35 mm
- Scale range 0 – 16 kg/cm<sup>2</sup>

Pocket penetrometer TP2



Pocket penetrometer TP1

## Accessories

- ▶ FL 29704 Additional plunger for stiff soils  $\varnothing$  4.50 mm
- ▶ FL 29703 Additional plunger for stiff soils  $\varnothing$  3.17 mm
- ▶ FL 29714 Additional plunger for soft soils  $\varnothing$  14.2 mm
- ▶ FL 29725 Additional plunger for soft soils  $\varnothing$  25.4 mm

## FIELD INSPECTION POCKET VANE TESTER

To determine the shear strength of undrained (CU) cohesive soft soils  
Standard: ASTM D 2573

### Main Features

- 3 vanes, zero vane, 1 extension rod for 0.5 m and tools
- Torsion device: scale range 0 – 200 kPa
- Vane dimensions:  $\varnothing$  16 x 32 mm,  $\varnothing$  20 x 40 mm,  $\varnothing$  25.4 x 50.8 mm
- Carrying case: 500 x 300 x 100 mm
- Weight: approx. 4 kg

### Accessories

FL 14071 Extension rod 0.5 m



## POCKET SHEAR VANE DEVICE

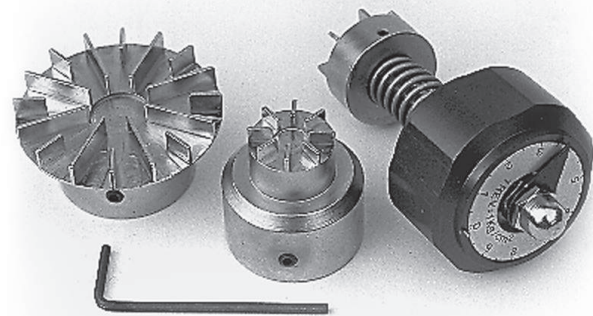
For determination the undrained shear strength in situ

### Ordering Information

FL 1420 Rigid metal version

FL 1410 Plastic version

- Inclusive 3 vanes: 0 – 2 N/cm<sup>2</sup>, 0 – 10 N/cm<sup>2</sup>, 0 – 25 N/cm<sup>2</sup>
- Scale range: 0 – 10 kg/cm<sup>2</sup>
- Scale division: 0.05 kg/cm<sup>2</sup>







## FIELD VANE TESTER

According to DIN 4096

- Set to determine the shear strength of undrained cohesive soft soils to firm non-fissured soils until  $I_c = 1$
- Easy and functional handling

### Ordering Information

- FL 2220 Set field vane with electronically torque measurement
- FL 2210 Set field vane with analogue torque key

Set content:

- FL 22110-2 1 analogue device for torque measurement  
or
- FL 22115-1 1 electronically device for torque measurement
- FL 22210 1 vane 100 x 50 mm for stiff samples
- FL 22230 1 vane 150 x 75 mm for soft samples
- FL 22102 1 adapter torque-sensor / wrench socket
- FL 22120 1 drive head to protect rods
- FL 22130 1 adapter rotating vane to determine the friction resistance
- FL 22241 1 transport case

### Accessories

- ▶ FL 222001 PC connection cable and software for data transmission
- ▶ FL 22103 Set for measurement of angle of rotation
- ▶ B 202210 Extension rod 22 x 1000 mm





# ROCK TESTING SYSTEMS



## ADVANCED UNIAXIAL AND TRIAXIAL TESTING SYSTEMS

These advanced rock testing plants enables our customers to meet all test requirements in rock or high pressure material testing and research.

The system, depending from its configurations, comply different standards like ASTM D2664-86, ASTM D2936-84, ASTM D2938-86, ASTM D3148-86, ASTM D3967-86, ASTM 4341-84, ASTM D4405-84, ASTM D 4406-84, ASTM D5407, EN 14580, EN 1926 and ISRM suggested methods for related tests.

The modular constructed system can be configured with different types of hydraulic frames with different load ranges, a variety of test jigs, triaxial cells with different specimen diameters and pressure ranges, pressure controllers, different sensors with attachments, advanced software packages and further accessories to suit your specific testing needs.

The systems are capable to test variety range of materials from soft sandstone to high-strength brittle rock or building materials.



As example different jigs and attachments for performing uniaxial compressive strength, triaxial strength, post failure, bending, indirect tensile, direct tensile, fracture toughness, creep, flexural and cyclic loading tests are available.

### Main Features

- Fitted frame sizes and load ranges from 500 to 10.000 kN with different actuators for each test requirement
- Test equipment for environmental temperature conditions are available
- Dynamic high speed closed-loop control of load, displacement, position and volume or flow
- Expandable real time high resolution data acquisition and closed-loop control system up to 21 bit with unlimited number of control axis and sensor channels
- Flexible controlling software for nearly unlimited test procedures of all uniaxial, triaxial or polyaxial test applications with pore pressure and permeability
- Different types and ranges of high quality transducers for external or internal on-specimen use like strain measurement, wave velocity, acoustic emission and electrical impedance measurement are available
- Advanced high quality hydraulic power packs with best noise protection, different emergency functions or cyclic test procedures
- Digital setting of PID parameters for test parameter optimization and tuning
- Free programmable test stages with interactive, calculated parameter and test procedures
- Real-time graphics with zoom and freeze functions for printer output at any time, after and during the test



### Triaxial accessories

Advanced high-pressure / high temperature triaxial cell with cell lifting (as optional item) designed for testing the shear and creep characteristics of rock core samples or solid materials (i.e. granites, evaporates, cemented tills or clays) under triaxial stress conditions to perform tests with temperature control conditions.

### Uniaxial accessories

There are different jigs for uniaxial tests e.g. uniaxial compression, local circumferential and axial strain measurement, indirect tension (Brazil test), creep behaviour, direct tension and fracture toughness. The GEOsys-Professional is a specific software for uniaxial tests as well as for triaxial tests.

### Direct shear test jig

As an option, the axial load frames can be upgraded and assembled with extra hardware for direct shear tests with additional horizontal actuator, hydraulic supply, shear boxes in different sizes and related load cells and transducers. The shear test jig can apply also cyclic loads as an extra option.

### Software

GEOsys the controlling and application software enables the easy programming of complex test sequences by means of clearly structured Windows operation on a graphic user interface. Through a series of menus, it provides quick access to all the controls needed for test set up and follows standard test sequences. The software is able to create unlimited number of tests stages with interactive and calculated parameter for closed-loop control in real-time. Unlimited number of control and measuring channels can be simultaneously controlled.

## Technical Specifications

Type of load frame	Electromechanical / servo hydraulic
Axial load	up to 10,000 kN
Cyclic axial load	up to 5,000 kN
Pressure ranges	up to 30, 70, 100, 150, 200 and 400 MPa
Sample sizes	up to Ø 150 (height ratio 2:1)

Custom sample sizes on request

## MODULAR STATIC / CYCLIC ROCK SHEAR TESTING SYSTEM

The Geotechnik Wille® modular rock shear testing system combines the opportunities of a triaxial rock testing and a direct shear system.

Due to its modular approach, the user is enabled to upgrade the system to a fully equipped triaxial device.

The rock shear testing system is able to perform static and dynamic loading tests on different rock samples up to 200 mm with an axial force up to 3,000 kN and a shear force up to 1,000 kN. Different sample sizes are available per request.

The complete system is fully automated and controlled by our flexible and programmable GEOsys Software.



As an option, the system can be equipped with an ultrasonic system with different transducers for P (compression waves), S1/S2 (polarized shear waves) and acoustic emission.

Various other sensors and different materials as well as experiment options (e.g. permeability) are available. The system can be fully customized to the needs of the user and the scientific problem.

### Technical Specifications

Compressive force	Up to 1500 kN
Pore pressure	Up to 150 MPa
Resolution	$\geq 0.5 \mu\text{m}$
Sample size	100 x 100 x 100 mm / 200 x 200 x 200 mm / 300 x 300 x 300 mm

## POLYAXIAL ROCK TESTING SYSTEMS

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 1400 kN.

The sample chamber can house samples up to 300 mm and has the option to be equipped with a temperature control up to 200 °C and a pore pressure device up to 140 MPa.

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



### Technical Specifications

Axial force	Up to 3000 kN
Shear force	Up to 1000 kN
Loading frequency	Up to 15 Hz
Sample size	100 x 100 x 100 mm / 150 x 150 x 150 mm / 200 x 200 x 200 mm

## GAS HYDRATE ROCK TRIAXIAL TESTING SYSTEM

The gas hydrate testing device is designed to produce and test cylindrical gas hydrate sediments with a dimension up to 180 mm under triaxial conditions. In order to conduct experiments under thermodynamic stable conditions of gas hydrates, confining and cell can be pressurized up to 40 MPa and the temperature can be kept constant in the range -40°C to 40°C. The loading frame is constructed for an axial load up to 2,000 kN. The system can be equipped with various sensors.



### Main Features

- One-screw quick closing system of the cell
  - Carriage assembly for easy removal and storage of cell system
  - In-vessel transducers for load, radial and axial deformation
  - Permeability tests
  - High precision strain, stress and position closed-loop controlled load frame
  - Uniaxial compression test
  - User defined test procedure with advance GEOsys Software
- Several upgrading features
    - ▶ Radial injection of sub-/supercritical CO<sub>2</sub>
    - ▶ Discharge and quantification of sediment
    - ▶ Sample volume change determination
    - ▶ Ultrasonic measurements (P, S1, S2), Electrical Resistivity / Impedance Tomography (ERT)



### Technical Specifications

Static axial load	Up to 1000 kN
Confining pressure	Up to 40 MPa
Temperature range	-40 up to 40 °C
Sample size	Up to 180 mm





## CUTTING MACHINE

This series of cutting machines are ideal abrasive cut-off machines for sample shaping purposes, offering perfect solutions for efficient, versatile and high-quality cutting.

Microprocessor controlled, front panel with / out touch pad controls, compact version with cutting capacity up to 90/115mm solid stock ,for cut off wheels up to diameter of 250/300 mm, twin T-Slotted.

The machine is excluded of clamping device but includes standard set of cutting consumable cooling fluid and cut-off wheels.



### Main Features

- Modern stylish outlook
- Compact and powerful
- Easy and quick operation
- Designed for different sample sizes and also irregular workpieces
- Manually controlled cutting lever
- Maximum safety with electronic brake and interlocking safety device
- Stainless steel cutting bed

#### Clamping devices:

- Quick acting clamping vice assembly-right
- Quick acting clamping vice assembly-left
- Compact Vise assembly
- Vertical clamping device, clamping height up to 90mm

#### Models:

- Cabinet model
- Floor model

### Technical Specifications

Wheel speed	2800 rpm
Operation	Manual
Wheel Diameter	Ø 250 mm / Ø 350 mm
Cutting Capacity	Ø 90 mm / Ø 115 mm
Cutting Capacity	50 x 165 mm / 50 x 195 mm
T-Slot table dimension	255 x 250 mm
T-Slot dimension	12 mm

## ECONOMIC CERCHAR ROCK ABRASIVENESS TESTER

Standard: acc. Cerchar (1986), is used to determine the CERCHAR Abrasivity Index (CAI) value per as standard ASTM D7625-10.

Accurate stainless steel mass for axial test load of 70 N in combination with cross table which allows high resolution movement of the specimen clamping device in one directions to achieve tool wear and repeat traverse action.

The standard package includes of a binocular microscope and as an option with a trinocular microscopes, CCD camera and measurement software.



### Main Features

- Simple manual operation
- Stiff frame with precise movement of the clamping device
- Portable cross table with clamping device for the adjustment the specimen in one direction
- Easy adjustment for different sample sizes
- Easy loading and unloading of the specimen

### Technical Specifications

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

Larger sample size on request

### Accessories

- ▶ Binocular or trinocular microscopes.

Test pin for Cerchar device:

- ▶ Rockwell hardness: 40 / 42 HRC
- ▶ Rockwell hardness: 54 / 56 HRC

### Options

- ▶ Hi-performance camera with advanced software package for measurement



## STANDARD CERCHAR ROCK ABRASIVENESS TESTER

Standard: acc. Cerchar (1986), is used to determine the CERCHAR Abrasivity Index (CAI) value per as standard ASTM D7625-10.

Accurate stainless steel mass for axial test load of 70 N in combination with special cross table which allows high resolution movement of the specimen clamping device in two directions (X, Y) to achieve tool wear and repeat traverse action.

The standard package includes of a binocular microscope and as an option with a trinocular microscopes, CCD camera and measurement software.



### Main Features

- Simple manual operation
- Stiff frame with precise movement of the clamping device, head and base plate made of solid aluminum
- Portable cross table with clamping device for the adjustment the specimen in X and Y directions
- Easy adjustment for different sample sizes
- Easy and smooth loading and unloading of specimen using a special extender wheel solution

### Accessories

- ▶ Binocular or trinocular microscopes.

Test pin for Cerchar device:

- ▶ Rockwell hardness: 40 / 42 HRC
- ▶ Rockwell hardness: 54 / 56 HRC

### Options

- ▶ Hi-performance camera with advanced software package for measurement

### Technical Specifications

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

Larger sample size on request

## PORTABLE POINT LOAD TEST APPARATUS

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

A sample of rock is mounted between two pointed platens and pressure is applied until failure of the sample occurs. 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
- Operating manual



### Main Features

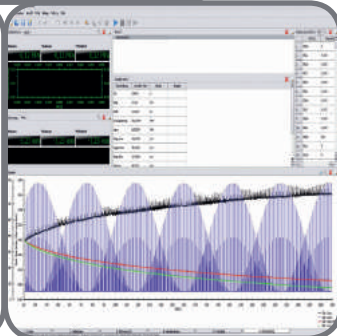
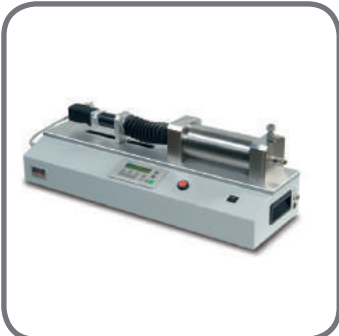
- Easy to handle, functional design
- High stiffness and light weight frame with special hardened conical pistons
- Suitable for testing specimen up to 120 mm diameter
- Hand-operated hydraulic pump, pressure cylinder, aluminum base plate
- High quality hydraulic components with fine adjustable two stage hydraulic pump
- Height adjustable, stiff crosshead for different specimen heights



### Ordering Information:

LP 4500	Version with digital precision pressure gauge Cl. 0.1% with maximum value memory, IP 65, resolution 0.01 kN
LP 4600	Version with analogue pressure gauge, Pressure range: 0 – 100 kN and 0 – 25 kN, accuracy: 1.0 kN resp. 0.5 kN
LP 4500002	Digital measuring device for axial strain
LP 4500001	Solid wooden case
LP 4500004	Plastic case

# COMPONENTS



## FULLY AUTOMATIC UNIVERSAL LOAD FRAMES

Fully automatic universal load frames of the brand mark Wille Geotechnik® are characterized by their robust, functional design with a large variety of semi-automatic and fully automatic controlling possibilities.

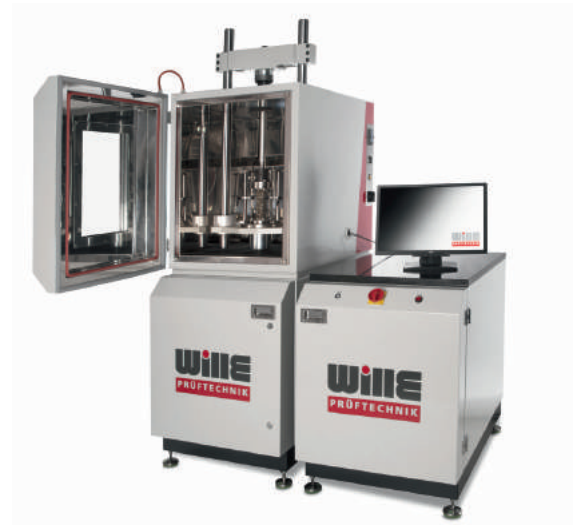
We manufacture multipurpose static and dynamic high precision load frames in the wide range of electromechanical types, servo pneumatic and also servo hydraulics. All the load frames has the feature to be equipped by temperature control chamber.

### Main Features

- Advanced closed-loop controlled load frame offers a large variety of controlling possibilities
- High stiffness construction; precision aligned for static and dynamic testing on different materials
- Can be configured with a variety of different modules for compression, tension and torsion tests with static or dynamic loading
- Single or multi axis high resolution up to 20 bit data acquisition system
- Available with upper adjustable crosshead for required vertical clearance
- Control and data transmission via serial Ethernet port
- For different applications:
  - ▶ Soil testing (e.g. offshore, earthquake, traffic)
  - ▶ Asphalt testing (stiffness plus fatigue)
  - ▶ Aggregate testing
  - ▶ Rock testing (triaxial and compression tests), concrete and any construction materials (compression tests)
- Load capacities in the range of 1 N to 10,000 kN

### Models

- Electromechanical type (cyclic and static)
- Servo pneumatic type (cyclic and static)
- Servo hydraulic type



## STATIC UNIVERSAL LOAD FRAMES

Fully automatic electromechanical

Electromechanical universal load frames of the brand mark Wille Geotechnik® are characterized by their robust, functional design with a large variety of semi-automatic and fully automatic controlling possibilities.

The well-proven measurement and control electronics are assisted by a menu-driven monitoring system and enable the performance of complex analyses as well as stress-path tests. Exchangeable, pre-calibrated measuring sensors guarantee high accuracy over a wide measuring range.

When fitted with appropriate software modules and accessories, the fully automatic load frames are suitable for:

- Triaxial shear tests
- Stress-path tests, isotropic and anisotropic consolidation
- Compression tests, oedometer tests
- Uniaxial compression tests
- Continuous or incremental loading
- Swell tests and swell pressure tests



### Technical Specifications

Normal force	0 – 10 kN	0 – 25 kN	0 – 60 kN	0 – 300 kN
Spindle lift	50 / 100 / 200 mm			
Speed range	0.000001 mm/min to 10 / 30 / 60 / 100 mm/min			

## CYCLIC AND DYNAMIC UNIVERSAL LOAD FRAMES

This series of load frames are used for static and dynamic compression or extension in uniaxial or triaxial tests (optional static and dynamic confining pressure, with phase shift control or static and dynamic torque, with temperature control chamber).

## TABLE TOP ELECTROMECHANICAL LOAD FRAME

The new developed cyclic table top electromechanical closed-loop controlled triaxial load frames are characterized by their high accuracy for static and cyclic automatic loading possibilities.

### Technical Specifications

Static axial load	Up to 10 kN
Cyclic axial load	Up to 10 kN
Cyclic frequency	Up to 5 Hz



## COMBINED STATIC AND CYCLIC ELECTROMECHANICAL LOAD FRAME

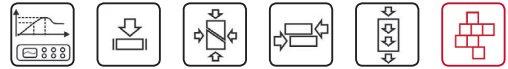
The high quality electromechanical closed-loop controlled triaxial load frames are characterized by their high features for static and cyclic automatic loading possibilities. Thanks to advanced design of load frame with two different cyclic and high load static actuator, the system is able to apply high static and cyclic load independently.

### Technical Specifications

Static axial load	25 kN / 60 kN and 100 kN
Cyclic axial load	5 kN (10 kN optional)
Cyclic frequency	5 Hz (10 Hz optional)







## COMBINED ELECTROMECHANICAL-SERVO PNEUMATIC CYCLIC LOAD FRAME

This series of high quality combined electromechanical- servo pneumatic closed-loop controlled triaxial load frames are characterized by their high accuracy for static and cyclic automatic loading possibilities.

### Technical Specifications

Static axial load	Up to 100 kN
Cyclic axial load and frequency	5 kN / up to 15 Hz 10 kN / 5 Hz



## SERVO PNEUMATIC CYCLIC LOAD FRAMES

This series of triaxial testing systems are using servo-pneumatic loading system for automatic static and cyclic requested loading for different applications.

### Technical Specifications

Load parameters	5 kN / up to 15 Hz 10 kN / 5 Hz
-----------------	------------------------------------

## STATIC AND CYCLIC AXIAL AND TORSIONAL ELECTROMECHANICAL LOAD FRAME

The high quality electromechanical closed-loop controlled triaxial load frames are characterized by their high features for static and cyclic automatic loading possibilities. Thanks to advanced design of load frame with cyclic and high load static actuator, the system is able to apply high static and cyclic load.

Note:  
Torsional torque ist available on request

### Technical Specifications

Static axial load	10 / 16 / 30 / 60 kN
Cyclic axial load	10 / 16 / 30 / 60 kN
Cyclic frequency	2 / 5 / 10 / 30 Hz



## SERVO HYDRAULIC DYNAMIC LOAD FRAME

This series of standard and high quality servo hydraulic closed-loop controlled triaxial load frames are suitable for generating standard and high accuracy static and cyclic loads.

### Technical Specifications

Static axial load	Up to 25 kN
Cyclic axial load	Up to 25 kN
Cyclic frequency	5 / 20 / 100 Hz

High capacity type:

Static axial load	60 / 100 / 250 / 500 / 1000 kN
Cyclic axial load	60 / 100 / 250 / 500 / 1000 kN
Cyclic frequency	5 / 20 / 100 Hz



## AXIAL / TORSIONAL DYNAMIC LOAD FRAME

This high quality and stiff multifunctional testing machine is suitable for static and dynamic, axial and torsional uniaxial and triaxial shear tests in two types (Hydraulic and electromechanical torsional system).

### Technical Specifications

Type of load frame	electromechanical / servo hydraulic
Axial load	5 kN up to 150 kN
Cyclic axial load	5 kN up to 150 kN
Load frequency	Up to 100 Hz
Torsional load	Customized





## PRESSURE CONTROL PANEL

### ANALOGUE TRIAXIAL PRESSURE CONTROL PANEL

- The pneumatic control panel serves to produce hydrostatic pressures, which are required for standard triaxial tests by constant cell and saturation pressure and for permeability tests
- Using precision pressure regulators, the selected pressures keep constant even during pressure fluctuations
- Quick coupling system for all connections to the Triaxial cell
- Generating confining and pore pressure
- User friendly and clearly arranged control panel
- Precision pressure regulator and pressure gauge for pressure control
- One pressure gauge for supply pressure

#### Technical Specifications

Pressure range	Up to 1000 / 1600 / 2000 kPa
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### TRIAXIAL PRESSURE CONTROL PANEL

- Generating confining and porewater pressure up to 1000 or 1600 kPa
- 2 exchangeable measuring burettes 10 - 150 ml (Standard: 100 ml) for measurement of cell or porewater volume
- User friendly and clearly arranged control panel
- 2 precision pressure regulators and pressure gauges for pressure control
- One pressure gauge for supply pressure
- Valve-system for charging and discharging the burettes
- Quick coupling system for all connections to the triaxial cell

Options:

- Options for automatic volume measurement
- Digital or analogue pressure control

#### Technical Specifications

Dimensions (H x L x W)	1050 x 600 x 250 mm
Supply pressure	Max. 1600 kPa / 1000 kPa
Pressure range	1600 kPa / 1000 kPa
Burette	100 ml
Options	10 / 50 / 150 ml



## AUTOMATIC AIR PRESSURE CONTROLLER (APC)

Microprocessor closed-loop controlled pressure controller APC with alternatively 1, 2 or 3 pressure outlets with 1000 or 1600 kPa maximal operating pressure

- Fully automatic, servo-pneumatic control system to generate hydrostatic pressures (e.g. confining and pore pressure)
- Fully automatic pressure adjustment by integrated microprocessor
- Closed-loop control of the pressure with an accuracy of 0.2 % by internal high quality pressure transducers
- Direct, menu-driven control via PC or the integrated control panel with foil-keyboard
- Easy handling
- Compact and space-saving construction
- Suitable e.g. for permeability test apparatus, triaxial shear apparatus, pneumatic oedometer, etc.



### Technical Specifications

Maximum pressure	0 – 1000 / 1600 kPa
Accuracy	0.2 % (optional 0.1 % v. E.)
Pressure outlets	1, 2 or 3 channels
Supply pressure	1000 / 1600 kPa

## AUTOMATIC PRESSURE / VOLUME CONTROLLER (VPC)

- Electromechanic pressure and volume controller for different testing media like water, oil or airpressure
- Optional available in acid-proof stainless steel for aggressive media
- Fully automatic closed-loop regulation of pressure by an internal high pressure transducer
- Direct, menu-driven operation by touch sensitive keypad or by PC with controlling software (communication protocol available)
- Compatible to LABVIEW©
- Different modes of pressure control (e.g. constant pressure, pressure ramps, constant volume flow)
- Automatic volume measurement
- Integrated software supported calibration module
- Can be connected to all triaxial and permeability testing systems
- Easy to handle
- Compact and space saving design (for wall-mounting or table use)
- There is a selection of different connection couplings



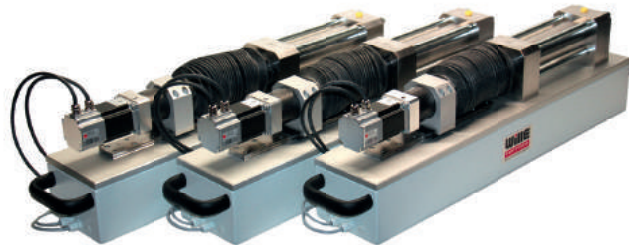
### Different Versions



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

### Technical Specifications

Volumes	100 / 250 / 400 / 500 / 1000 / 2000 ml
Resolution (volume)	0.0001 ml / 0.005 ml
Resolution (stress)	0.1 kPa
Pressure range	50 to 300,000 kPa
Interfaces	Serial port, Ethernet, USB

## CYCLIC AUTOMATIC PRESSURE / VOLUME CONTROLLER (VPC) UP TO 10 MPa AND UP TO 10 Hz

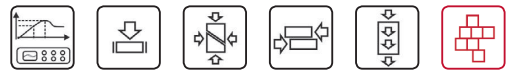
- Electro mechanic pressure controller with integrated high precision volume measurement for different testing media like water, oil or airpressure
- Optional available in acid-proof stainless steel for aggressive media
- Fully automatic closed-loop regulation of pressure by an internal high pressure transducer
- Direct, menu-driven operation by touch sensitive keypad or by PC with controlling software (communication protocol available)
- Compatible to LABVIEW©
- Different modes of pressure control (e.g. constant pressure, pressure ramps, constant volume flow)
- Automatic volume measurement
- Integrated software supported calibration module
- Can be connected to all triaxial and permeability testing systems
- Easy to handle
- Compact and space saving design (for wall-mounting or table use)
- There is a selection of different connection couplings



Cyclic pressure controller  
(Servo hydraulic / electromechanical)

### Technical Specifications

Pressure range	Up to 70 MPa
Volumes	250 / 500 / 1000 ml
Resolution (volume)	0.0001 ml / 0.005 ml / 0.01 ml
Resolution (stress)	0.1 kPa
Frequency	2 / 10 / 20 Hz
Interfaces	Serial port, Ethernet, USB



## AUTOMATIC ADVANCED PRESSURE / VOLUME CONTROLLER

For aggressive media and high pressure conditions up to 100 MPa

Advanced high precision pressure / volume controller is a unique device with high corrosion resistant pressure chamber for pressure/volume controlling of special fluid and gases (like He, CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub> and etc.) with high quality controller for any corrosion tests

Options:

All customized volumes and pressures are available on requests

- Optional available in acid-proof stainless steel for aggressive media
- Is able to inject water, oil, special fluids and different type of gases
- Explosion proof



### Technical Specifications

Pressures	Up to 100 MPa	Resolution (volume)	< 0.000075 ml
Resolution (stress)	0.001 MPa	Voltage	230 V / 110 V
Volumes	250 / 500 / 1000 ml	Interface	Serial port, Ethernet

## AUTOMATIC ADVANCED PULSE FREE PRESSURE/VOLUME CONTROLLER FOR CONTINUOUS PULSE FREE FLOW

Advanced high precision pulse free pressure / volume controller is made for continuous pulse free flow for normal feeding of water, air, gas and with options to have high corrosion resistant pressure chamber for pressure/ volume controlling of aggressive fluid and gases (like He, CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub> and etc.) with high quality Controller for any tests related to a porous medium. All customized volumes and pressures are available on requests.



### Technical Specifications

Pressures	Up to 140 MPa	Temperature resistance	Up to 160 °C
Resolution (stress)	0.001 MPa	Voltage	230 V / 110 V
Minimum flow volume rate	< 0.0001 cm <sup>3</sup> /min	Interface	Serial port, Ethernet
Maximum flow volume rate	< 0.000075 ml		

## HIGH QUALITY TRIAXIAL CELL

Stress-path triaxial cells for diameter up to 300 mm for internal, local transducer expandable for saturated or unsaturated tests and double wall system for high accuracy volume change.

- Special stainless steel triaxial cell with an internal frame to connect all submersible transducers directly at the sample before the cell is closed by the cell-wall
- Easy in handling and sample preparation
- Through ports for internal transducers (not included) for direct measurement at the sample like:
  - Local radial deformation
  - Local axial deformation
  - Rotational displacement
  - Local axial load
  - Local torque



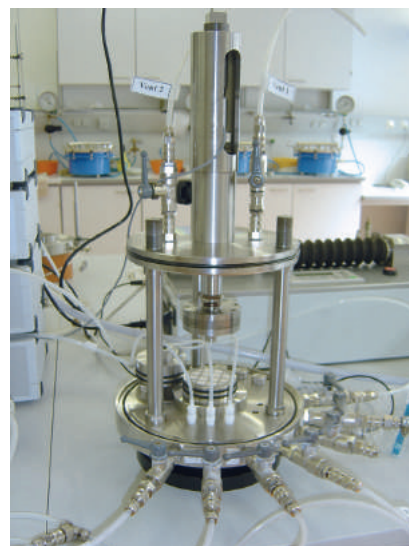
- Porewater pressure
- Unsaturated test conditions (ceramic discs)
- Bender elements wave generators
- Temperature measurement
- Temperature control

### Technical Specifications

Cell-construction	Stainless steel or light alloy
Max. cell pressure	1 / 2 / 3.5 / 6 MPa
Sample diameters	25 mm up to 300 mm

## DOUBLE WALL TRIAXIAL CELL

- Adapter-set with top and base caps with stainless steel porous plates and hoses for different diameters for saturated tests, the same for unsaturated tests (complete with special HAEV ceramic porous plates for 0.1, 0.3, 0.5, 1.5 MPa)
- Double wall internal chamber for high accuracy volume change measurement of the sample with best de-airing conditions, available for different sample diameters
- Double wall stainless steel chamber and an isolating-set for different temperature test conditions





## SPECIAL TEMPERATURE CHAMBERS FOR TRIAXIAL CELLS

### Main Features

- The segmented temperature chambers consists of a closed loop heating and/or cooling aggregate with a high precision digital controller
- Suitable for all Wille Geotechnik® high pressure standard or high pressure triaxial cells, consolidation cells or different other applications or pressure vessels

#### Options:

- Additional temperature sensor for local closed-loop control of fluid temperature inside the pressure vessels or triaxial cells
- Software modules for fully automatic PC temperature control

### Technical Specifications

Temperature control:	+/- 0.1 or +/- 0.2 °C
Temperature ranges:	from -70 °C up to +300 °C or customized ranges



## ADVANCED HIGH PRESSURE TRIAXIAL CELL

### Main Features

- Suitable for triaxial tests with permeability survey and supersonic measurement
- 4 special apertures for user-defined connection of internal measuring sensors
- Pressure resistance up to 350 MPa
- Optional cell material made of high quality/stainless steel for corrosion-free investigation under different suspensions
- Designed for high test temperatures
- Internal support frame for cell cap and load piston for easy sample preparation
- De-airing, cell pressure measuring, temperature control, socket and stamp with stainless steel filter plates and de-airing system



### Technical Specifications

Sample Diameter:	25 to 100 mm
Pressure range:	Up to 350 MPa

## AUTOMATIC HIGH PRECISION WATER VOLUME MEASURING DEVICE

This automatic volume measuring device was created to indicate smallest amounts of water volume change, independent from the influence of temperature and pressure changes.

This measurement device uses a high accuracy transducer for weighing the water column in a burette independent from the system pressure, which can be up to 2 MPa. This comfortable and precise measuring instrument can be used optimally e.g. for the determination of pore water running in or out during triaxial tests, in special oedometer tests or especially in permeability tests. Suitable to connect with all data acquisition systems with analogue input signals.

### Technical Specifications

- Max. system pressure: 1 / 2 MPa
- Volume: 10, 50, 100, 150 ml or larger (max. 1000 ml)
- Resolution of water volume: <0,001 ml



Volume measuring

## BLADDER TYPE AIR/WATER PRESSURE CYLINDER

For providing water supply under pressure up to 1000 kPa

The Bladder-type air / water pressure cylinder provides the water supply under defined pressures (usually the cell pressure dominating in the test cell) up to 1000 kPa – for permeability tests under isotropic or anisotropic static loads.

### Technical Specifications

- Volume: 2 l
- Operating pressure: 10 bar (Option: Up to 17 bar)



Volume measuring

## WATER DE-AIRING APPARATUS

This compact unit provides de-aired water with an extremely low level of gas content as it is demanded for saturation in triaxial tests, permeability tests and further geotechnical examinations.

An additional vacuum connector allows a separate use of the vacuum pump.

Designed for wall mounting the apparatus can also be placed on a bench.

### Technical Specifications

- Tank volume: Up to 40 l
- Power supply: 220 V / 50 Hz



## TRANSDUCERS

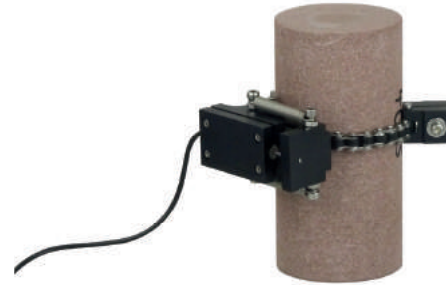
This wide range of transducer is suitable for high-precision measurements under static and dynamic applications.

### Main Features

- Transducer systems to measure directly at the sample (i.e. deformation or pore pressure)
- Adjustments to every triaxial cell and a wide range of applications via adjustable sensor positions
- High quality transducer made of stainless steel
- Non-contacting measurement
- Pressure resistant versions up to 700 bar
- Temperature resistance from -25 °C up to +170 °C

### Applications

- ▶ Radial deformation measurement
- ▶ Axial deformation measurement
- ▶ Circumferential measurement
- ▶ Pore pressure measurement
- ▶ Force measurement
- ▶ Submersible load measurement



## STANDARD DATA ACQUISITION SYSTEMS

This compact data logging system is characterized by its high performance and it is extremely easy to operate. The system is capable of reading sensor output signals up to 16 channels. It is provided with suitable logging software and a power supply for the different sensors. The modular AD converter is adjusted to record electronically measurement values such as force, displacement, pressure or temperature in static and dynamic processes (optional).



The operation of the data acquisition systems is given by a PC with a sophisticated, test specific data-logging and evaluation software (i.e. GEOsys).

All data are logged continuously and are provided in an ASCII format, which is commonly used by data processing programmes.

### Technical Specifications

Channels	4 / 8 / 16
Signals	0 – 10 V, 4 – 20 mA, etc.
Supply	24 V
Interface	RS232, USB, Ethernet

## UNSATURATED TESTING SYSTEMS

In the many years of cooperation with international research institutes in the field of unsaturated soil testing, a large number of test devices have been developed.

Here are different types of tests such as axis-translation method or vapour equilibrium method which has been applied.

Due to the different applications and materials testing equipment was developed for the smallest suction stresses (e.g. for sand) and high pressures systems for e.g. high pressure bentonite.

The following pictures may reflect only a small example of the test apparatus for the unsaturated test devices.

If interested, please contact us. We are at your disposal for any further information.

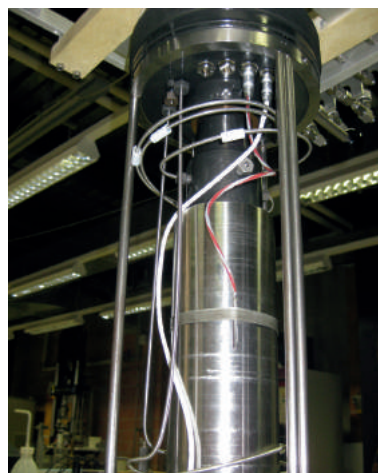


**Double wall biaxial cell for plane strain tests with unsaturated conditions.**

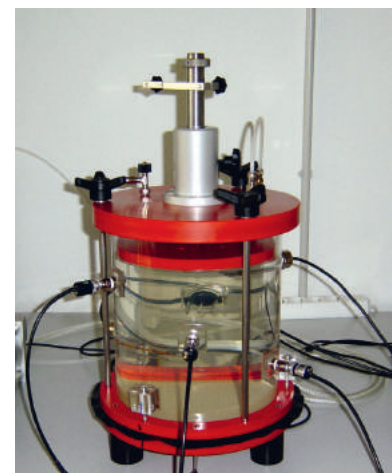
**Porous and HAEV-discs in high pressure systems for high pressure bentonites.**

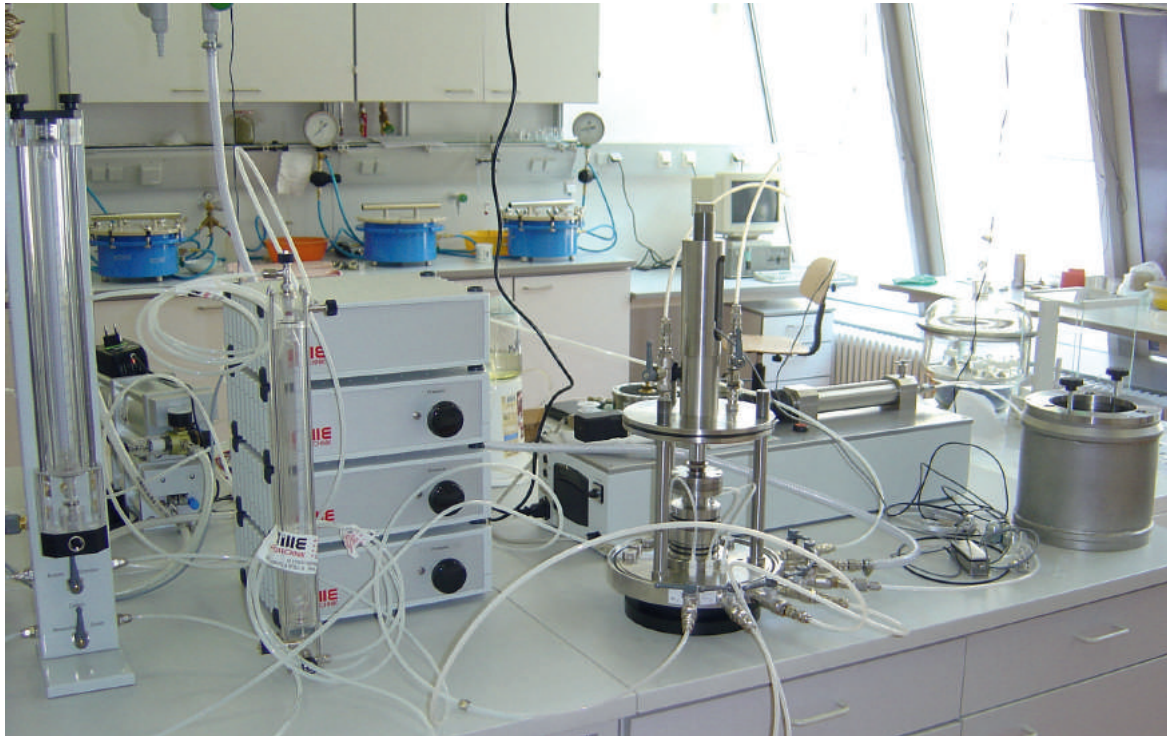


**High pressure triaxial cell up to 40 MPa with double wall volume measurement, vapour measurement etc.**



**Consolidation cell for unsaturated sand tests with low suction stress, direct measuring of suction stress and humidity with special transducer and water content transducer.**





**Triaxial testing system with high confining pressure, fluid and vapour pressure control and volume measurement, air flushing device and specially developed air entry discs with cross pattern between HAEV and porous discs.**

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