32 Rock Mechanics

According to the "Committee on Rock Mechanics, National Academy of Sciences", rock mechanics is a theoretical and applied science concerning the physical behaviour of rocks subjected to stress conditions of different origin.
In generai terms, rock mechanics involves the study of underground works such as tunnels and surface construction such as open quarries or dam foundations.
When a rock sample is subjected to defined stress conditions in the laboratory, the stress-strain diagram can show behaviours of non linearity also for very small strains, hysteresis, anisotropy, fluage conditions, etc. All these phenomena can be mathematically described. This section details our complete range of testing equipment including automatic test systems for the determination of Elastic Modulus and strength characteristics of rock specimens in uniaxial and triaxial conditions.

Contents

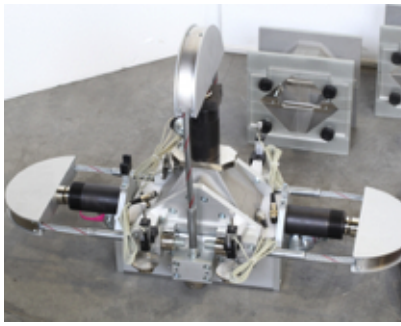
ROCK TESTING

32

Behavior of joints and classifications tests

The behavior of joints is of particular interest: joints originate from geological failures; a break in the rock mass continuity along which no visible displacement has occurred. From a rock mechanics point of view, the discontinuities are characterized by a mechanical strength lower than the original rock matrix and require the following detailed test investigations: shear strength of the joint performed with the rock shear box apparatus, tilt test performed with the tilt test apparatus, surface roughness of the joint performed with the profilometer (Barton comb).

32-D0548/A: Detail of the shear box apparatus fitted with 5 digital gauges (4 vertical and 1 horizontal)



32-D0548/D: Detail of the shear box apparatus fitted with 5 displacement transducers

ROCK SHEAR BOX APPARATUS

STANDARD

- ASTM D5607
- ISRM Suggested method

The test method offers a simple and practical way of determining the strength and slope stability of rock. The apparatus consists of a shear box designed to accept samples measuring no larger than 115 x 125 mm, or alternatively, cores up to 102 mm diameter. The shear box is in two halves, the upper being connected to two rams for reversible shearing action and the lower connected to a ram for normal load application. The loads are recorded by Bourdon tube load gauges. The normal loading system comes with an adjustable low friction pressure maintainer to absorb any changes in the specimen volume during the shearing process and to ensure a constant vertical stress is maintained.
Maximum axial and shear load capacity 50 kN

Two versions are available:

32-D0548/A, (basic version) supplied complete with 5 digital gauges 25x0.001 mm (4 vertical and 1 horizontal); 2 mould formers; 2 hand operated pumps with Bourdon gauges.

32-D0548/D (electronic version) supplied complete with 5 potentiometric transducers with 25mm travel (4 vertical and 1 horizontal); 2 mould formers; 2 hand operated pumps with Bourdon gauges; 2 pressure transducers for the direct acquisition of the load values on external datalogger model 82-P9008 or 82-P9008/F for site use (see page 416)

Ordering information

32-D0548/A
Basic rock shear box apparatus with digital gauges to ASTM D5607

32-D0548/D
Electronic rock shear box apparatus with potentiometric transducers to ASTM D5607

Accessories

82-P9008
DATALOG 8, 8 channels stand-alone multipurpose data logger.
110-230V / 50-60Hz / 1 Ph.

82-P9008/F
DATALOG 8, 8 channels stand-alone multipurpose data logger battery operated with rigid carrying case suitable for use in the field.
110-230V/50-60Hz/1Ph.

82-P9008/ELT
Set of four cables for connecting load cells, pressure transducers, strain gauges, LDT / LVDT / potentiometric type displacement transducers to DATALOG 8. Two sets of cables are required.

32-P0070/6
Excel template for data processing to ASTM D5607

32-D0548/8
Mould former

32-D0548/9
High alumina cement for the cementation of the sample in the shear box. 50 kg bag.

82-P9008

32-D0548/D

To get more info visit
www.controls-group.com
or link directly to the QRCode

JOINT ROUGHNESS COEFFICIENT TEST DEVICE (TILT TEST)

It is used to calculate the joint roughness coefficient (JRC) of a rock or joint. The device consists of an adjustable inclined plane, on which the rock sample (100 mm max dia.) is placed, separated along the surface where the roughness is to be measured. Then the plane is slowly tilted until sliding of the upper part of the sample on the lower one occurs. From the measured inclination angle it is possible to evaluate the roughness index.

- Inclination angle: 0 to 50°
- Overall dimensions: 265x170x260 mm
- Weight approx.: 4 kg

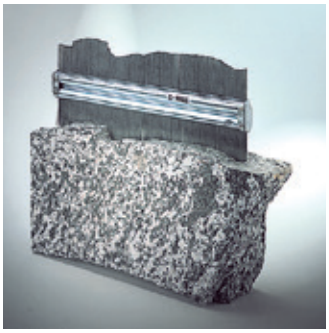
32-B0096
Apparatus for measurement of the joint roughness coefficient (Tilt Test).

PROFILOMETERS (BARTON COMB)

Used for measurement of the roughness profile of rock samples.

Two models available:
32-D0566
Profilometer (Barton comb), 300 mm length. Weight approx. 1 kg

32-D0566/A
Profilometer (Barton comb), 150 mm length. Weight approx. 0.5 kg



STANDARD

- ASTM D5873
- ISRM Suggested method

ROCK CLASSIFICATION HAMMER

Used to measure the rebound index on rock cores and samples. The device is simple, easy to use, and is similar to the one used for testing concrete. The level of impact energy only is different: 0.735 Nm. Rock cores are positioned horizontally and the rebound index is obtained from the average of several measurements performed perpendicular to the longitudinal axis, using the ASTM rock cradle 32-D0562/A (see accessories) as shown in the picture. Supplied complete with case.
Weight approx.: 1.5 kg

32-D0561/C
Rock test classification hammer with low impact energy 0.735 Nm. Supplied with hard plastic carrying case.

32-D0561/C with cradle 32-D0562/A

Accessories

32-D0562/A
ASTM universal rock cradle for testing rock cores
Weight approx.: 27 kg

58-C0184
Calibration anvil for concrete test hammers
Weight approx.: 16 kg

Calibration anvil, 58-C0184

ROCK PICKS

Used for preliminary rock identification. Two models available:

32-D1710
Rock pick with pointed tip.
Weight approx.: 650 g

32-D1711
Rock pick with chisel edge.
Weight approx.: 550 g

32-D1710, 32-D1711

MOHS HARDNESS SCALE SET

32-D0529
Mohs hardness scale. Set of 9 mineral specimens.

32-D0529

Classifications tests

STANDARD

▸ ASTM D5731 ▸ ISRM Suggested method

32-D0550 complete test set

FEATURES and ADVANTAGES

» 100 kN capacity

» Superior functionality and usability of the equipment, since the pump is separate from the frame

» Separate hand pump with pressure transducer and ergonomic 128 x 80 pixel digital read out unit with wide graphical display and 6 keys membrane keyboard

» Effective resolution: 18 bit (1/262'000 div.)

» Load accuracy/resolution: ± 1 % / 1 N

» Piston travel: 100 mm

» Distance between conical platens: 100 mm

» Suitable for compression test on small cylinders with the 45-D0550/D5 accessory

» Supplied complete with traceable calibration certificate for load measurement accuracy

DIGITAL ROCK STRENGTH INDEX APPARATUS

The rock strength index apparatus consists of a high stability load frame 100 kN capacity with hydraulic loading ram actuated by a hand pump. Loading frame and manual pump are independent resulting in a superior functionality and usability of the equipment.

The unit is conforming to ASTM D5731 and ISRM suggested method and the wide testing area allows to test both rock cylinders and irregular shaped samples.

It features an ergonomic digital readout unit with graphic display battery operated and membarane keyboard.

The compression load is measured by a in-built pressure transducer, assuring the best accuracy and resistance to the failure shocks. A ruler is assembled on the frame allowing the direct measurement of the distance D between the conical platens before and after the test.

The complete set is housed in an ergonomic carrying case with wheels and is supplied complete with clear safety goggles

Accessories

32-D0550/D5
Set of lower and upper platen 52 mm dia. with spherical seat

32-D0550/D6
Mounting tool suitable for the conical points fitted on point load machine 45-D0550

58-C0215/T2
Serial cable for PC connection. Requires a PC with RS232 serial port or RS232/USB adaptor (see our model 82-Q0800/3)

Spare parts

32-D1717
Clear safety goggles

32-D0550/A7
Set of hardened conical points

32-D0550/A9
Set of spare gaskets for the hydraulic cylinder fitted in the point load tester model 32-D0550

Technical specification

- Frame dimensions (l x w x h): 200 x 200 x 418 mm
- Wheeled carrying case dimensions: 447 x 265 x 558 mm
- Total weight (case + frame + pump): 22.3 kg

Ordering information

32-D0550
Digital rock strength index apparatus, 100 kN capacity

Digital rock strength index apparatus housed in the practical robust carrying case with wheels for easy transportation.
Total weight 22.3 kg.

32-D0550/D5
Set of lower and upper platen 52 mm dia. with spherical seat model for compression tests

Specimen preparation

LABORATORY CORING MACHINE AND BITS

This machine is specifically used in the laboratory for cutting core samples from hard materials such as rock and concrete. A clamp is provided to firmly secure the material during the cutting cycle. The coring area is protected with a transparent cylinder. A special clamping device for preparing rock samples from core pieces is also available - see Accessories.

Note: *drill bits are not included.*

Technical specifications

- Power unit: 1800 W
- Coring speed: 1485/2720 rpm
- Coring range: from 8 to 100 mm diameter
- Dimensions of the base tray assembly: 600 x 500 x 200 mm
- Weight: 80 kg (approx.)

Ordering information

32-C0330
Laboratory coring machine, 2-speed, complete with water inlet.
230 V, 50-60 Hz, 1 ph.

32-C0330/Z
As above but 110 V, 60 Hz, 1 ph.

Accessories

Drill bits with spigot adaptors. Bit thread 1 ¼ W.

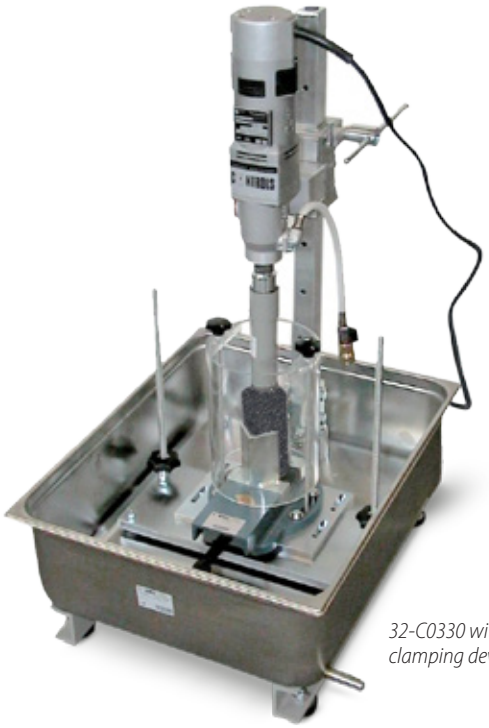
Code	Description	Specimen diameter		Effective length	D.C.D.M.A. reference
		mm	inches	mm	
32-C0342	Diamond core bit for	21.46	0.850	110	EX
32-C0343	Diamond core bit for	30.10	1.185	110	AX
32-C0344	Diamond core bit for	38.10	1.500	110	1.5 in.
32-C0345	Diamond core bit for	42.04	1.655	120	BX
32-C0346	Diamond core bit for	54.74	2.155	140	NX
32-C0347	Diamond core bit for	63.5	2.5	150	HQ

CLAMPING DEVICE

32-C0331
Clamping device for cores with a maximum diameter of 100 mm, complete with transparent guard.

32-C0331

32-C0330 with core bit, taking sample from a large rock core

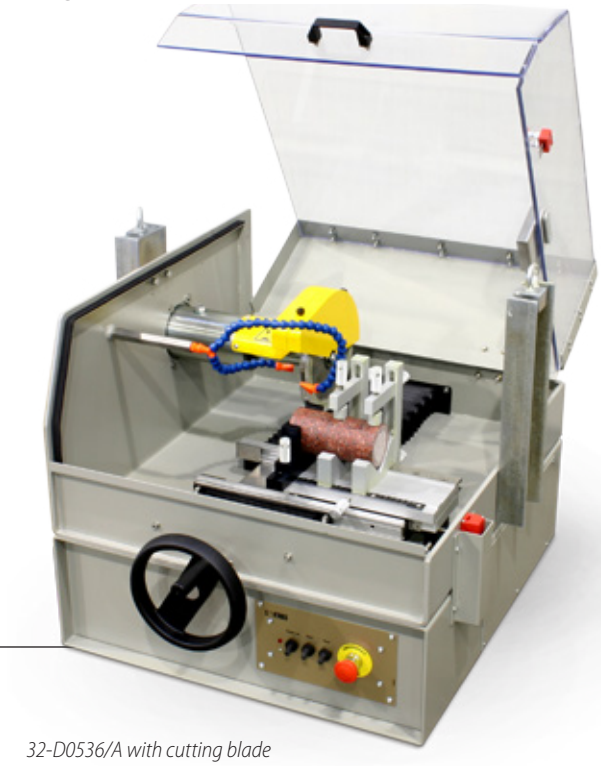


32-C0330 with core bit and clamping device 45-C0331

32-D0343, 32-D0344, 32-D0345

Specimen preparation

CORE TRIMMER AND CUT-OFF MACHINE



32-D0536/A with cutting blade 32-D0536/2

This machine is used to obtain machined rock samples (cubes, prisms, etc.) from irregular rock or core pieces. It is supplied complete with a standard vice to hold irregular pieces (up to approx. 70 x 140mm) firmly in place, and a "V" device for cores up to 75mm diameter x 140 mm height. Longer cores can be machined by turning the sample upside down in the device. The machine also includes a cooling water inlet and transparent cover, conforming to CE requirements, with a switch that automatically stops the machine when it's opened.

The machine can be fitted with either a cutting blade or a double-faced cup wheel for surfacing the ends of cylindrical specimens.

Note: blade, cup wheel and water pump are not included and have to be ordered separately - see Acessories.

Specifications

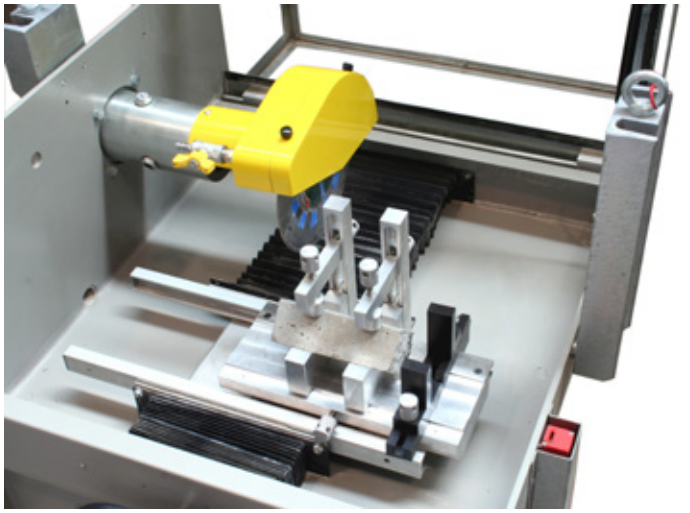
- Power: 1100 W
- Blade speed: 3000 rpm
- Dimensions: 730 x 1050 x 590 mm (approx.)
- Weight: 100 kg (approx.)

Ordering information

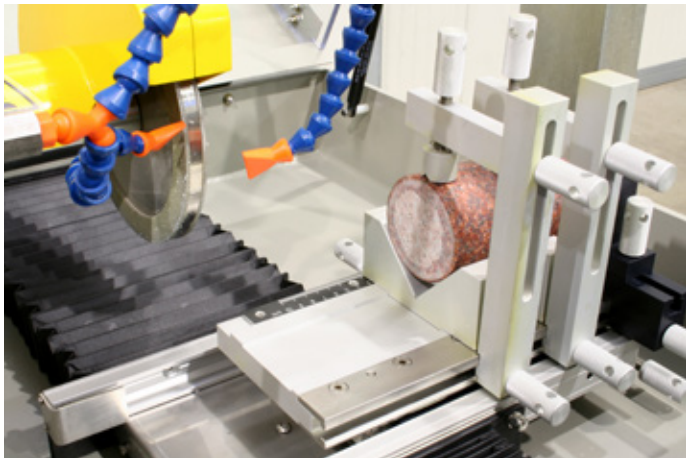
32-D0536/A
Laboratory core trimmer and cut-off machine complete with water inlet. 230 V, 50 Hz, 1 ph.

32-D0536/AY
As above but 220 V, 60 Hz, 1 ph.

32-D0536/AZ
As above but 110 V, 60 Hz, 1 ph.



32-D0536/A, detail of spindle with clamping mechanism and cutting blade 32-D0536/2



32-D0536/A, detail of spindle with clamping mechanism and double-faced cup wheel 32-D0536/A3 during surface grinding of cylindrical specimen ends

Accessories

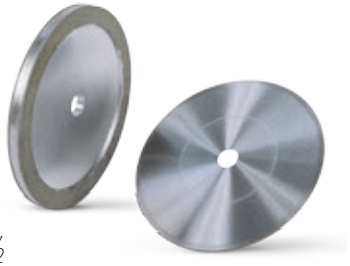
32-D0536/1
Cooling recirculating pump complete with reservoir.
230 V, 50 Hz, 1 ph.

32-D0536/1Y
As above but 220 V, 60 Hz, 1 ph.

32-D0536/1Z
As above but 110 V, 60 Hz, 1 ph.

32-D0536/2
Diamond cutting blade, 230 mm diameter x 2.8 mm thick. Maximum cutting area 110 x 70 mm.

32-D0536/A3
Double-faced diamond cup wheel, 230 mm diameter x 16 mm thick. Used for finishing/grinding sample ends parallel and at right angles to the axis.



32-D0536/A3, 32-D0536/2

STANDARD

▸ EN 12390-2 ▸ ASTM D4543

SPECIMEN GRINDING MACHINES

Our product range includes 3 different models which have been developed to grind and polish concrete specimens but can also be used with the suitable accessory, for rock samples, natural stones, ceramic materials etc.

All models are described below. For complete information please see page 234

55-C0202
Grinding machine for concrete cubes, cylinders and rock cores. Bench model version, manual table displacement.
230V/50Hz/1Ph

55-C0201/B
Grinding machine for concrete cubes, cylinders and rock cores with automatic radial displacement of the grinding head.
380V/50Hz/3Ph

55-C0201/C
Grinding machine for concrete cubes, cylinders and rock cores, with automatic radial displacement of the grinding head, including head return.
380V/50Hz/3ph

Accessories for rock samples

32-D0534/B
Core face preparation jig capable of clamping up to four core samples from 20 to 55 mm dia.

32-D0534/C
Core face preparation jig capable of clamping two core samples from 50 to 100 mm dia

32-D0534/B

CONCRETE, ASPHALT, ROCK AND MASONRY SAW

This universal saw, when completed with the suitable accessory, can be used to cut concrete, asphalt and rock cores, as well as irregular rock samples in order to obtain geometrically defined samples. It can be fitted with 300 to 450 mm dia. blades. For complete information please see page 234

55-C0210/D
Concrete, asphalt and masonry saw, complete with water pump for cooling the blade and double filtering system. Blade and accessories to cut cores, rock and other buiding materials not included. See accessories.
380 V, 50 Hz, 3 ph

55-C0210/DZ
As above, but 220V/60Hz/3Ph

Accessories for rock pieces

32-C0211/4
Diamond blade, 350 mm dia., for hard rock

32-C0211/5
Diamond blade, 450 mm dia., for hard rock

55-C0210/5
V-shaped support for cylinders and cores up to 160 mm dia.

32-C0210/6
Locking clamp device for irregular pieces.

55-C0210/D fit with 32-C0211/4 diamond blade and 32-C0210/6 device for irregular pieces

UNIVERSAL ADVANCED SAW

Our line of Universal laboratory saws also include a high performance model: MULTISAW. Developed in specifically for road laboratory, it can be used, equipped with the suitable blade, for rock samples. For further information see page 353 or visit our web site

STRENGTH AND DEFORMABILITY TESTS

UNIAXIAL AND TRIAXIAL TESTS

Most of the information obtained from laboratory tests on rock are primarily related to the stress and strain characteristics of the tested materials. The tests most generally performed on cylindrical rock samples are the evaluation of the compressive strength and strain:

- under uniaxial conditions
- under triaxial conditions

Uniaxial test

The uniaxial test is performed by applying increasing vertical stress at a constant rate of between 0.5 and 1.0 MPa/s. Axial and radial strains are measured with high precision (about $5x10^{-6}$). Subsequent load-unload cycles are also carried out to obtain an accurate evaluation of the compressibility properties.

Triaxial test

The triaxial test is performed on prepared rock specimens which are contained in a rubber sealing membrane and placed within a triaxial chamber. They are then subjected to a constant isotropic confining pressure (generally between 5 and 60 MPa). A vertical stress is subsequently applied; tests and measurements are carried out in the same way as for uniaxial tests.

CONTROLS propose the complete range (three different configurations) of testing systems for the determination of Elastic Modulus / Poisson's ratio and strength of rock cores in uniaxial and triaxial conditions. Three different configurations are available to satisfy every sophistication and budget requirement:

ADVANCED AUTOMATIC STRESS PATH UNIAXIAL AND TRIAXIAL TEST SYSTEM

The system is based on ADVANTEST ROCK and SERCOMP ROCK Servo-hydraulic units and it features the full automation of triaxial testing including stress path (multi - stage) and post-peak softening analysis.

AUTOMATIC UNIAXIAL AND TRIAXIAL TEST SYSTEM

This configuration is based on the AUTOMAX MULTITEST for axial load and SERCOMP-S for confining pressure. The whole system performs either uniaxial or triaxial automatic tests under load/stress control.

SEMI-AUTOMATIC UNIAXIAL AND TRIAXIAL TEST SYSTEM

This configuration is based on automatic WIZARD AUTO compression machine for axial loading and a manually-operated pump for confining pressure. It performs either uniaxial or triaxial tests under load/stress control.

	ADVANCED automatic stress path triaxial and uniaxial test system	Automatic Uniaxial and Triaxial test system	Semi-automatic Uniaxial and Triaxial test system. Basic test apparatus
Axial load	ADVANCED **AUTOMATIC** Fully integrated system	**AUTOMATIC** Axial load and confining pressure are independent (2 controllers)	**MANUAL** Axial load and confining pressure are independent (2 units)
Confining pressure			
Possibility to perform loading & unloading cycles (axial loading)	YES automatically	YES automatically	NO
Automatic stress path test and failure envelope determination	AUTOMATIC MULTI stage stress path	AUTOMATIC SINGLE stage stress path	MANUAL SINGLE stage stress path
Possibility to perform post-peak softening analysis	YES	NO	NO
Full PC control with integrated software	YES	NO	NO

STANDARD

- ASTM D2664 ▸ ASTM D2938
- ASTM D3148 ▸ ASTM D5407
- ASTM D7012
- EN 14580 ▸ EN 1926
- ISRM Suggested Method

Advanced Automatic Uniaxial and Triaxial Test system

ADVANCED SERIES

ADVANTEST ROCK

ADVANTAGES

» Unique technology based on servo-controlled proportional valve optimized for construction materials for load, stress and displacement controlled tests, with superior performances: fast reaction time, excellent sensitivity to minor variations, extremely wide oil flow range

» Full PC control with integrated software modules tailored for a different test methods and materials

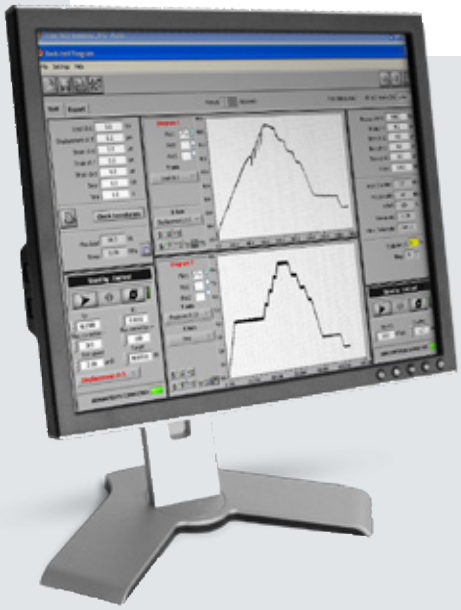
» Automatic multi-stage stress path testing procedure for the entire failure envelope determination

» The failure envelope is obtained with a single test by an automatic stepwise procedure: from a single specimen it is possible to plot the complete failure path

» Possibility to perform post-peak softening analysis

» Also suitable for load, stress, displacement and strain-controlled testing on concrete, fiber reinforced and shotcrete specimens (with the relevant options and accessories)

» Extremely flexible system ideal for research purposes



The ADVANTEST ROCK Servo-hydraulic control console manages strain-controlled load-unload ramps automatically and includes a dedicated software module for testing rock under triaxial conditions, applying confining pressures at definable values. The system includes the SERCOMP 7 ROCK for control of confining pressure, a compression frame (to be selected), and the various accessories

This is one of the many **ADVANCED** products from the CONTROLS Group range.

To get more info visit **www.controls-group.com** or link directly to the QRCode

Hoek cell and 3 external displacement transducers for automatic triaxial test with multistage stress path and post peak analysis

AUTOMAX Multitest
Automatic Uniaxial and Triaxial test system

STANDARD

▸ ASTM D2664 ▸ ASTM D2938 ▸ ASTM D3148 ▸ ASTM D5407
▸ ASTM D7012 ▸ EN 14580 ▸ EN 1926 ▸ ISRM Suggested method

AUTOMAX Multitest Automatic system for Uniaxial and Triaxial tests, including Compression frame,Sercomp-S console, Hoek cell and accessories

The Automatic configuration for determining the elastic modulus and strength characteristics of rock specimens under uniaxial and triaxial conditions is based on the AUTOMAX Multitest for axial load and SERCOMP-S for confining pressure. The complete system includes a suitable compression frame (to be selected conforming to the user requirements-see page 180, 181), and the selected Hoek cell (see page 108). Both consoles are operated independently and the failure envelope is obtained by few individual tests (single - stage) with automatic application of axial load and confining pressure at different levels.

The confining pressure into the Hoek cell, applied by SERCOMP-S is also measured by AUTOMAX Multitest for simultaneous plot of all test quantities, e.g. stress, strain and cell pressure.

For a typical configuration of an Automatic Uniaxial/Triaxial test system please visit our website or ask for the technical assistance of our specialists.

Determination of the Elastic Modulus using surface-mounted strain gauges

Hoek cell supported by holding device

To get more info visit
www.controls-group.com
or link directly to the QRCode

Semi-automatic Uniaxial and Triaxial test system

STANDARD

- ASTM D2664
- ASTM D2938
- ASTM D3148
- ASTM D5407
- ASTM D7012
- EN 14580
- EN 1926
- ISRM Suggested method

To get more info visit
www.controls-group.com
or link directly to the QRCode

Semi-automatic Uniaxial and Triaxial test system based on WIZARD Auto compression machine , manually-operated pump 32-D0558, Hoek cell NX type and Datalog 8 channels 82-P9008

The Semi-Automatic configuration for determining the elastic modulus and strength characteristics of rock specimens is based on the compression machine with WIZARD Auto control system for axial loading and manually-operated pump for confining pressure. It performs either uniaxial or triaxial tests under load/stress control (no strain).

Both systems are operated independently and the failure envelope is obtained by a series of individual tests (single - stage) with manual adjustment of the axial load and manual application of the confining pressure at different levels.

The complete system includes WIZARD Auto compression machine (to be selected conforming to the user requirements-see page 182 to 190), the 32-D0558 Low friction pressure maintainer, the selected Hoek cell (see page 108), Datalog 8 Multipurpose Datalogger, Strain gauges and various other accessories.

For more detailed information, including the typical configuration of the complete system, please visit our website or ask for the technical assistance of our specialists.

MANUAL LATERAL PRESSURE SYSTEM

32-D0558

Low fiction manual pressure maintainer for lateral pressure in the Hoek triaxial cells, including pump and precision pressure gauge.

- Max. working pressure: 70 MPa
- Weight approx.: 15 kg

DATALOG8 FEATURES

- » 6" touch screen colour graphic display
- » 8 independent input channels
- » Display of readings and graphs in real time
- » Compatible with load cells, pressure transducers, strain gauges, LDT/LVDT/potentiometric displacement transducers
- » Effective resolution: 131,000 points
- » Sampling rate up to 500 readings per second per channel via LAN and up to 10 readings per second per channel in local mode
- » Unlimited storage capacity with USB pen drive
- » Network configuration of up to 8 units (64 independent channels)
- » Simultaneously data sampling of all channels in accordance to the programmable logging mode
- » LAN/Ethernet connection to PC via dedicated software (not included)

Accessories for Uniaxial and Triaxial tests

STANDARD

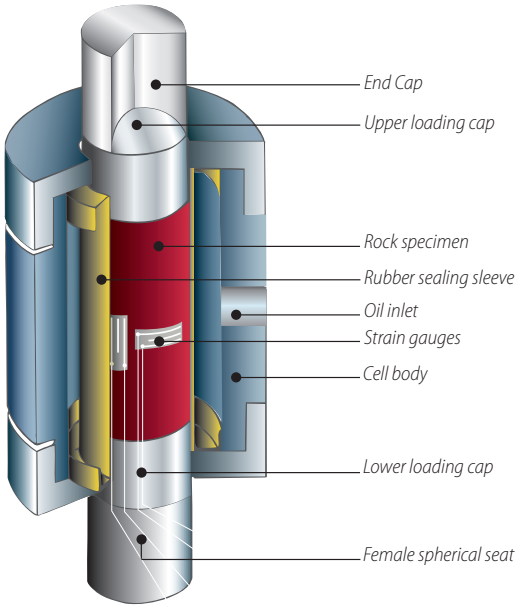
▸ ASTM D5407 ▸ ASTM D7012
▸ ISRM Suggested method

HOEK CELLS

The Hoek cells are offered in five models of different sizes, each one consisting of: a cell body, two end cups, upper and lower loading caps with spherical coupling, two female spherical seating and a rubber sealing sleeve.

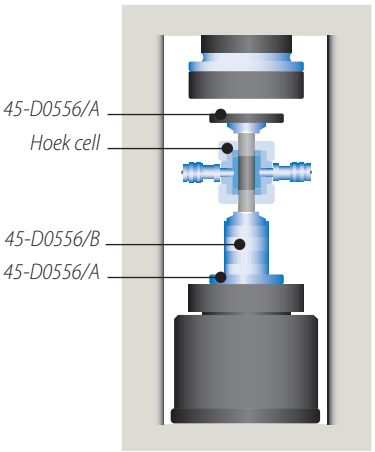
Measurements of axial and radial strain are carried out with the use of electric strain gauges, both in vertical and horizontal direction, directly glued on the lateral surface of the specimen. The wiring connections are passed within the rubber sleeve through the cell body and loading cap. Each strain gauge must be connected to a proper device (see 82-P0398) to complete and balance the Wheatstone bridge.

Hoek cells for triaxial tests



Technical specifications and ordering information

Hoek Cell Code	D.C.D.M.A. Reference	Specimen size d x h [mm]	Total height [mm]	Weight [kg]
32-D0553	AX	30.10x60	213	2.50
32-D0554	1.5 in.	38.10x75	264	4
32-D0555	BX	42.04x85	263	6.50
32-D0556	NX	54.74x100	304	13
32-D0557	HQ	63.50x127	310	15



Schematic view of the Hoek cell with load spread and distance pads within the compression platen of the testing frame

32-D0556/H

Spare rubber sleeves

For cell 32-	D0553	D0554	D0555	D0556	D0557
Sleeve code 32-	D0553/1	D0554/1	D0555/1	D0556/1	D0577/1

Accessories for compression test

32-D0556/A
Pair of load spreader for uniform load distribution

32-D0556/B
Distance pad to reduce the vertical clearance of the compression machine

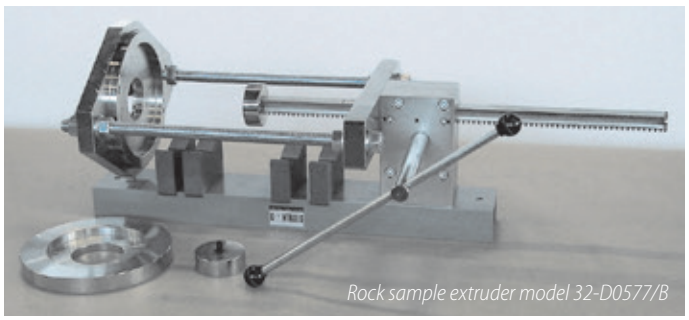
32-D0556/H
Hoek cell holder for all cells except 32-D0557 (not required)

ROCK SAMPLE EXTRUDER

Used to extrude the rock sample from its jacket thus avoiding to empty the confining fluid. It consists of a steel frame with a rack and pinion mechanism. Requires adaptors conforming to the Hoek cell size. See the following table.

32-D0577/B
Specimen extruder for Hoek cells series 45-D055x

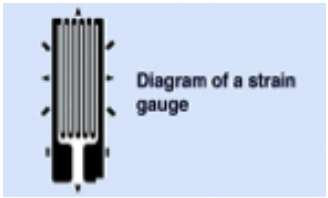
Adapter set code	For specimen size	For use with cell	Weight approx. [kg]
32-D0577/1	AX	45-D0553	1.7
32-D0577/2	1.5 in.	45-D0554	1.7
32-D0577/3	BX	45-D0555	1.5
32-D0577/4	NX	45-D0556	1.5
32-D0577/5	HQ	45-D0557	1.5



Rock sample extruder model 32-D0577/B

STRAIN GAUGES FOR UNIAXIAL AND TRIAXIAL TESTS

They provide a very accurate electrical signal, strictly proportional to the strain of the specimen submitted to load application, for determining the Elastic Modulus and strength characteristics. They can be applied to the specimen surface by a special adhesive-catalyst agent and other accessories all included in the 82-P0399/C Strain gauge application kit.



Rock sample fitted with 82-P0390 strain gauges

Technical specification and ordering information

Strain gauge Models	82-P0390	82-P0391	82-P0392	82-P0393
Grid width mm	4,53	3	2	1
Gauge length mm	9.53	20	30	60
Resistance ohm	120	120	120	120
Bridge	¼	¼	¼	¼
No. of gauges per package	5	10	10	10

82-P0399/C
Strain gauge application kit including: conditioner, neutralizer, acetone, tweezer, adhesive with catalyst agent, 100 m of bipolar cable, solder, soldering iron, scalpels, scissors, duct tape, sellotape, sandpaper and carrying case.

82-P0398

82-P0399/C

82-P0398
Compensation device for up to 4 Wheatsone bridges with ¼ or ½ bridge setup

82-P0399/1
Connecting terminals, 50 pairs sheet

STANDARD

- ASTM D7012
- ISRM Suggested method

COMPRESSION TEST DEVICE FOR ROCK SPECIMENS

This compression jig is strictly compliant to ASTM D7012 Rock core specimens Test Methods, in particular the spherical seat / compression plates / specimen diameters' ratios fall within the prescriptions.

The Rock core should have a diameter from 54.7 mm (NX type) to 63.5 mm (HQ type).

32-D9035
Compression device for rock core specimens, maximum capacity 1200 kN

Compression device for rock core specimens model 32-D9035 with rock specimen NX type

Compression device for rock specimens model 32-D9035 mounted inside a CONTROLS compression machine

FEATURES and ADVANTAGES

» Heavy duty / high stiffness compression device

» Max. load capacity: 1200 kN

» High stiffness structure and the high performance steel making this device particularly suitable for high strength rock specimen featuring brittle properties and explosive failure

» Platens dia.: 80 mm

» Platen hardness: ≥ 58 HRC

» Vertical clearance: 167 mm

» Overall dimensions:
249 mm dia. x 333 mm height

Splitting Tensile test

STANDARD

- ASTM D3967
- ISRM Suggested method

COMPRESSION/SPLITTING TEST DEVICE

We offer two compression device models for indirect tensile test (splitting test) conforming to ASTM D3967 and to ISRM Specifications.

32-D9032/H
Compression/Splitting device, conforming to ASTM D3967.
This apparatus, originally developed for testing in compression cement specimens, can also be used for splitting tensile test on rock disks with dimensions from 54 to 64 mm dia.

- Platens dia.: 75 mm
- Platen hardness: 60 HRC
- Total height: 234 mm
- Weight approx.: 13 kg

Following the ISRM Suggested recommendation, two versions are available according to the specimens size: NX type (dia. 54.74 mm) and HQ type (dia. 63.5 mm).

These models consist of two steel loading jaws, guiding pins and half ball bearing.

- Jaws hardness: 45 HRC
- Spherical seat with 25 mm half ball bearing
- Total height: 154 mm
- Weight approx.: 7 kg

32-D9032/NX
ISRM Splitting device for NX size

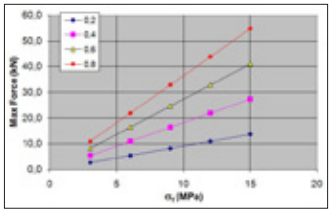
32-D9032/HQ
ISRM Splitting device for HQ size

32-D9032/H

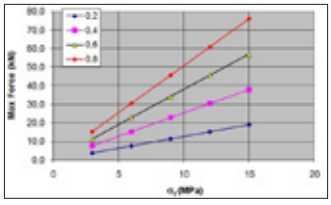
32-D9032/NX-/HQ

The typical failure loads of rock disks dia. 54 mm and 63.5 mm are plotted below in relation to the corresponding indirect tensile strength:

Rock core dia. 54 mm



Rock core dia. 63,5 mm



σ_t = Range of splitting tensile strength of rock samples (from ASTM D3967)

Rock permeability

CONSTANT PRESSURE APPARATUS

This apparatus, originally designed for soil mechanics test applications, can also be used to provide an infinitely variable constant pressure and is used in conjunction with the Hoek cell (see Hoek cells and sample extruder) fit with the permeability end caps, for the investigation of the permeability of rock at high confining pressure, in the laboratory. For more information see page 77.

Oil / water constant pressure apparatus model 28-WF4312 with Hoek cell, permeability end caps, burette, support base and metal / glass sleeve

Ordering information

28-WF4312
Oil and water constant pressure apparatus for pressures up to 3500 kPa. 230 V, 50-60 Hz, 1 ph

28-WF4314
As above but 110 V, 60 Hz, 1 ph

Permeability end caps

32-D0553/3
Permeability end cap, AX size, dia. 30.10 x 60 mm

32-D0554/3
Permeability end cap, 1.5 in. size, dia. 38.10 x 75 mm

32-D0555/3
Permeability end cap, BX size, dia. 42.04 x 85 mm

32-D0556/3
Permeability end cap, NX size, dia. 54.74 x 100 mm

32-D0557/3
Permeability end cap, HQ size, dia. 63,5 x 130 mm

For a typical configuration of a Rock permeability test set please visit our web site.

HYDROMATIC STAND-ALONE CLOSED LOOP PRESSURE/ VOLUME CONTROLLER

An alternative to oil and water systems described above, we offer the more advanced and sophisticated Hydromatic controller, used in particular for Soil Mechanic testing but also suitable for permeability rock testing (see page 76). In particular model 28-WF45SG can be used to provide 1 pressure line higher than atmospheric pressure, while model 28-WF45DG provides 2 lines. s

Durability

STANDARD

- ASTM D4644

SLAKE DURABILITY APPARATUS

This test method has been developed for assessing the deterioration of rocks over a period of time when subjected to water immersion. The apparatus consists of a motorized drive unit mounted on a baseplate and connected to two or four drums which rotate at a speed of 20 r.p.m.

The machine mounts a digital display for the visualization of the residual testing time (10 minutes for ASTM D4644). The tank assemblies are filled with water to a level 20 mm below the drum axis. The water level is indicated by a mark.

32-D0546/A

The test drums are manufactured from 2.00 mm mesh, 140 mm dia. x 100 mm long. Two drums are already included, while two additional ones can be ordered separately, see accessories.

- Overall dimensions (lxdxh) with two drums standard included: 733x413x305 mm
- Weight approx.: 22.5 kg
- Overall dimensions (lxdxh) considering the two extra drums (4 in total): 1151x413x305 mm
- Total weight considering the two extra drums (4 in total): 33.5 kg

FEATURES and ADVANTAGES

» Maximum 4 drums can be used simultaneously to improve testing productivity

» Complete with display showing the residual testing time (10 minutes as per ASTM prescription)

» Transparent water tanks with level mark to help correct water filling

» Compact machine for saving space in the laboratory

» Drums with quick-release drive units for rapid mounting / disassembling

Ordering information

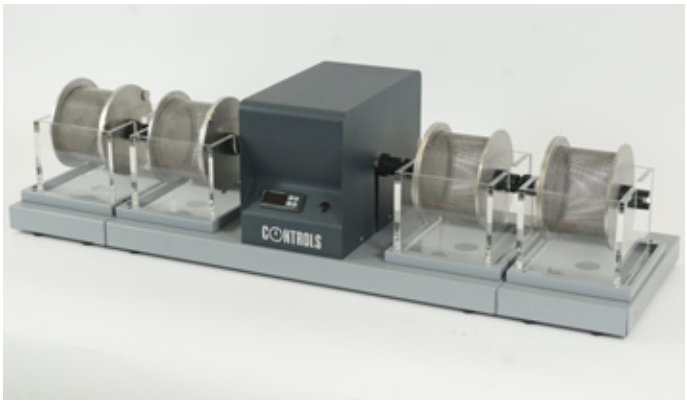
32-D0546/A
Slake durability apparatus to ASTM D4644 composed by motorized drive unit with 2 test drums (dia. 140mm x 100mm long, 2 mm mesh) rotating at 20 rpm, 2 transparent tanks, basement and digital timer.
230V/50Hz/1ph

32-D0546/AY
As above but 220 V/60Hz/1 ph

32-D0546/AZ
As above but 110V/60Hz/1ph

Accessories

32-D0546/A1
Additional pair of mesh drums complete with tank, basement and quick-release drive connection.



32-D0546/A complete with additional pair of rotating drums 32-D0546/A1