

SOIL Classification

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Augers

STANDARD

- ▶ ASTM D420 ▶ ASTM D1452
- ▶ AASHTO T86 ▶ AASHTO T202

16

AUGERS

Augers are used for general exploration in soil investigation to obtain samples that are representative of each layer of material. Made of special plated steel, they have a 'T' handle with a 1 m shaft which has to be ordered separately. See accessories, code 16-T0005/1.

16-T0005/A

Hand auger head, 80 mm diameter.
Weight 2 kg (approx.).

16-T0006/A

Hand auger head, 100 mm diameter.
Weight 2.5 kg (approx.).

16-T0007/A

Hand auger head, 150 mm diameter.
Weight 3 kg (approx.).

16-T0008/A

Spiral soil auger head, 40 mm diameter.
Weight 3 kg (approx.).

16-T0008/B

Dutch soil auger head, Edelman model, 70 mm diameter, for soft fine soils.
Weight 2 kg (approx.).

16-T0008/C

Gravel auger head, 150 mm diameter.
Weight 1.3 kg (approx.).

16-T0010/6

Stainless steel sample tube, 38 x 230 mm (diameter x length).
Weight 0.3 kg (approx.).

Accessories

16-T0005/1

T-handle with 1 m shaft.

16-T0005/2

Shaft extension rod, 1 m long.

16-T0005/3

Chisel, 300 mm long.



16-T0005/A, T0006/A and T0007/A with 16-T0005/1 T-handle



16-T0007/A, 16-T0008/A, 16-T0006/A, 16-T0008/C, 16-T0005/A, 16-T0010/6, 16-T0008/B

STANDARD

- ▶ ASTM D420 ▶ ASTM D1452
- ▶ AASHTO T86

16-T0010/G

SOIL PROSPECTING KIT

This set comprises the most popular auger and sampler components, housed in a practical carrying case. It consists of:

16-T0005/A

Hand auger head, 80 mm diameter

16-T0006/A

Hand auger head, 100 mm diameter

16-T0007/A

Hand auger head, 150 mm diameter

16-T0008/A

Spiral soil auger head, 40 mm diameter

16-T0008/B

Dutch soil auger head, Edelman model, 70 mm diameter

16-T0008/C

Gravel auger head, 150 mm diameter

16-T0010/6

Stainless steel sample tube, 38 x 230 mm (diameter x length), 6 pcs. included

16-T0010/7

Plastic end cap for sample tubes (16-T0010/6), 12 pcs. included

16-T0010/3

Jarring link

16-T0010/8

Hand extruder for sample tubes (16-T0010/6)



16-T0010/G

16-T0005/2

Six shaft extension rods, 1 m long

16-T0005/1

'T' handle with 1 m shaft

16-T0005/5

Two Stillson wrenches

- Case dimensions: 1050 x 480 x 190 mm
- Weight: 50 kg (approx.)



Detail of 16-T0010/8, Hand extruder with 16-T0010/6 Sample tube

SAMPLING DEVICE

This apparatus is designed for taking undisturbed 38 mm diameter samples in soft and fine soils. Comprises a 'T' handle with shaft, shaft extension rod, jarring link and a 38 mm diameter, 230 mm long stainless steel sample tube.

The sample is obtained by percussion - the upper assembly is lifted with a sliding action inside the jarring link and then dropped down, driving the sample tube into the soil.

16-T0010

Sampling device to take undisturbed 38 mm diameter soil samples. Weight: 7 kg (approx.)

Accessories and spares

16-T0010/6

Stainless steel sample tube, 38 x 230 mm (diameter x length).

16-T0010/7

Plastic end cap for 16-T0010/6 sample tubes.

16-T0010/8

Hand extruder for 38 mm diameter sample tubes.

AUGER POWER HEAD

The auger head is used in conjunction with sampling tubes to obtain disturbed or undisturbed soil samples.

Two models are available:

16-T0009/L

Auger power head, 2 hp, two-stroke engine, drilling capacity up to 200 mm dia., complete with 80 mm diameter auger.

16-T0009/M

Auger power head, 4.5 hp, four-stroke engine, reverse gear, drilling capacity up to 400 mm dia. Auger not included.

Accessories

Augers and extension rods for 16-T0009/M

16-T0009/M1

Auger shaft, 100 mm diameter x 1000 mm long.

16-T0009/M2

As above but 150 mm diameter.

16-T0009/M3

As above but 200 mm diameter.

16-T0009/MEX

Extension rod 1000 mm long.

Note: Augers of 100 to 200 mm diameter for 16-T0009/L and 250 to 400 mm diameter for 16-T0009/M are also available on request.



Models 16-	T0009/L	T0009/M
Piston displacement, cc	44.9	135
Engine	2 hp, two-stroke	4.5 hp, four-stroke
Fuel	Fuel mixture	Gasoline
Ignition	Electronic	Electronic
Augers	80 x 800 mm (diameter x length) included	Not included - see accessories
Maximum drilling diameter, mm	200	400
Maximum drilling depth, m	1.4	2.0
Operation	One operator	Two operators
Weight, kg (approx.)	10.5	27.0

Penetrometers | Lab vanes | Water level indicators

POCKET PENETROMETERS

Penetrometers are used to quickly and easily obtain an approximate measurement of shear strength for cohesive and semi-cohesive soils.

16-T0171 STANDARD POCKET PENETROMETER

With a range of 0 to 5 kgf/cm² (0-490 kPa), this penetrometer is designed for measuring field classification values for cohesive soils in terms of consistency, shear strength and approximate unconfined compressive strength.



16-T0171

Specifications

- Measurement range: 0 to 5 kgf/cm² (0-490 kPa)
- Dimensions: 20 x 173 mm (diameter x length)
- Weight: 0.5 kg (approx.)



16-T0163

16-T0163 HEAVY DUTY POCKET PENETROMETER

This penetrometer has a range of 0 to 10 kgf/cm² (0-980 kPa) and is constructed of stainless steel with three interchangeable tips: 4.5 mm diameter for very hard soil, 6.35 mm for medium and soft soil and 8.98 mm for soft soil. The penetration stem allows relatively deep penetration into the soil (up to 6 cm), reducing errors and uncertainties typical of more shallow measurements.

Supplied complete with plastic case.

Specifications

- Measurement range: 0 - 10 kgf/cm² (0-980 kPa)
- Dimensions (assembled): 20 x 210 mm (diameter x length) (approx.)
- Weight: 0.5 kg (approx.)

DIAL PENETROMETERS

We offer a range of three different versions of dial penetrometer that can satisfy any requirement, depending upon the application. They feature a 60 mm diameter dial and a peak hold device with a zero reset button. The 16-T0161 version is also used for evaluating the angle of internal friction " ϕ " of sandy soils and the cohesion " C " in clay soils. Supplied in a plastic case.

- Weight: 255 g (approx.).

16-T0160

Dial penetrometer, range 0- 6 kgf/cm² (0-588 kPa), plunger diameter 6.35 mm, for soft soil.

16-T0161

Geopocket dial penetrometer, dual scale. 0- 6 kgf/cm² (0-588 kPa) and 0 - 11 kgf/cm² (0-1079 kPa), with interchangeable plungers 6.35, 10, 15, 20 and 25 mm diameter.

16-T0162

Dial penetrometer, range 0-14 kgf/cm² (0-1373 kPa), plunger diameter 6.35 mm, for medium and hard soil.



16-T0160



16-T0161



16-T0162

HAND VANE TESTERS

Two versions of hand vane tester are available:

16-T0175/A, particularly suitable for field use, for taking measurements at the ends of sample tubes, and

16-T0174, featuring more professional specifications, recommended for field applications where surface and deep measurements are required.

**16-T0175/A
POCKET SHEAR VANE DEVICE**

This hand vane includes three vane adaptors: a standard 25 mm diameter vane, range 0- 10 N/cm² (0-100 kPa); a sensitive vane adaptor, range 0- 2 N/cm² (0-20 kPa) and a high capacity vane adaptor, range 0- 25 N/cm² (0-250 kPa). Complete with plastic case. Weight: 300 g (approx.).



16-T0175/A



Spare Parts

16-T0175/1
High capacity vane adaptor 0-2 N/cm² (small version)

16-T0175/2
Sensitive vane adaptor 0-25 N/cm² (big version)

16-T0175/3
Standard vane 0-10 N/cm²

**16-T0174
FIELD INSPECTION VANE TESTER**

Field inspection vane tester, range 0 - 24 N/cm² (0-240 kPa), with 3 interchangeable vanes and extension rod.

The field inspection vane tester is designed for taking field surface and deeper measurements, and is supplied complete with three interchangeable vanes and an extension rod for deeper measurements.

Specially designed to measure the undrained shear strength (CU) of cohesive soils. During operation the vane is driven 5 to 6 cm into the soil and then turned with the handle. Deep measurements (e.g. at the top of undisturbed samples) can be obtained. Supplied complete with plastic case.

Specifications

- Vane dimensions: 32 x 16, 40 x 20, 50.8 x 25.4 mm (height x diameter)
- Measuring range: 0 - 24 N/cm² (0 - 240 kPa)
- Max torque value: 3.5 N·m
- Extension rod: 500 mm long
- Overall dimensions (assembled): 310 x 105 mm
- Weight: 1.3 kg (approx.)

Accessories and spares

16-T0174/1
Extension rod, 500 mm long. (Additional)



16-T0174

**16-T0174/A
FIELD INSPECTION KIT**

This determination refers to ASTM D2573 concerning the in-situ determination using field vane apparatus.

This set consists of the 16-T0163 heavy duty pocket penetrometer, and the 16-T0174 Field inspection vane tester which have been previously described.



16-T0174/A

Ideal for geo-technicians, geologists and agronomists, the instrument is contained in a practical carrying case.

Specifications

- Case dimensions: 385 x 290 x 105 mm
- Weight: 2 kg (approx.)

WATER LEVEL INDICATORS

Used for determining the water level in boreholes, wells and other open underground structures. Drum mounted, with an ON/OFF indicator and audio signal when the probe touches water. The sensing portion of the probe has a stainless steel tip with plastic shielding to prevent false readings. A probe diameter of 10 mm allows an easy passage through 1/2" tubing. The cable is marked at 1 cm intervals.



16-E0096, /A, /B

Specifications

- Battery operated: 9 V DC
- Weight: 6 kg (approx.)

16-E0096
Water level indicator, 50 m cable.

16-E0096/A
As above but 100 m cable.

16-E0096/B
As above but 200 m cable.

Dynamic penetrometers

STANDARD

▶ ASTM D6951

16-T0012/A

TRL* DYNAMIC CONE PENETROMETER (DCP)

**Manufactured under license of TRL, Transport Research Laboratory, UK*

This apparatus has been designed for the rapid in-situ measurement of the structural properties of existing road pavements constructed with unbound materials. Continuous measurements can be made down to a depth of approximately 850 mm or, when extension shafts are used, to a recommended maximum depth of 2 m*. Where pavement layers have different strengths, the boundaries can be identified and the thickness of the layers determined. Correlations have been established in earlier work (Van Vuuren, Klein and Van Herden, Smith and Pratt) between the TRL penetrometer and CBR (California Bearing Ratio) so that results can be interpreted and compared with CBR specifications. Supplied complete with a carrying case.

Dynamic cone penetrometer

16-T0012/A includes:

- 8 kg dropping weight with 575 mm drop
- 2 penetration tips 60° cone, 20 mm diameter
- clevis block
- drive road 1 m long
- vertical scale
- 2 wrenches

All contained in a carrying case.
Case dimension: 1200x350x200 mm.
Weight approx.: 30 Kg

***Note:** The maximum depth of 2 m can be obtained adding the following extensions:

- No. 1 Extension 16-T0012/2
- No. 1 Extension 16-T0012/3
- No. 3 Extensions 16-T0012/4



16-T0012/A complete test set

Accessories

16-T0012/1D
Disposable 60° Conical point (Pack of 10)

16-T0012/1DA
Adaptor for disposable cone

16-T0012/2
Upper Extension Shaft M16/M12 Adaptor

16-T0012/3
Lower shaft for 16-T0012/A penetrometer used for extensions application

16-T0012/4
Extension Shaft 400 mm

16-T0012/14
4.6 kg Dropping Weight

Spares
16-T0012/1
Spare 60° Conical point

16-T0012/8
Spare hammer shaft

16-T0012/9
Spare standard shaft

16-T0012/10
Spare clevis block complete



16-T0013 assembled



16-T0013

STANDARD

▶ DIN 4094

16-T0013 LIGHTWEIGHT DYNAMIC PENETROMETER

This penetrometer is used to establish the thickness of different stratifications when investigating the suitability of a site for bridge, road or other construction works. In general if the ground is not too compacted, penetration tests with this apparatus can be carried out to depths of about 8 to 12 m. Supplied complete with a carrying case.

Specifications

- The apparatus includes:
- Anvil with driving rod
 - 10 kg rammer, rammer fall 50 cm
 - 11 sounding rods
 - 1 grooved rod
 - 2 drive points, 90°, 500 and 1000 mm²

- Lifting device for sounding rods
- Couplings
- Case dimensions: 1160 x 370 x 220 mm
- Weight: 71 kg (approx.)

Accessories and spares

16-T0013/8
Drive conical point, 500 mm² area, 25.2 mm diameter, 90° angle.

16-T0013/9
Drive conical point, 1000 mm² area, 35.6 mm diameter, 90° angle.

16-T0013/4
Sounding rod, 22 mm diameter.

16-T0013/7
Threaded nipple to connect sounding rods.

16-T0013/10
Spare expendable conical point, 500 mm² area, 25.2 mm diameter, 90° angle

16-T0013/11
Spare expendable conical point, 1000 mm² area, 35.6 mm diameter, 90° angle

STANDARD

► DIN 4094

16-T0013/E

**MOTOR OPERATED
20-30 KG DROP WEIGHT
DYNAMIC PENETROMETER**

The apparatus comprises: a four-stroke engine which drives - through a flexible shaft - the lifting mechanism; a 20 kg weight; a 10 kg supplementary weight; 10 rods; 5 cones each of 500 and 1000 mm² sizes and a rod lifting device. The heaviest part of this apparatus is the 20 kg dropping weight so it is very simple to use and easy to carry on site. The apparatus satisfies DIN 4094 standards for medium weight test apparatus with 30 kg mass x 20 cm drop height. We suggest the accessory 16-T0013/E1 to make the apparatus easier to use.

Supplied complete with carrying case for sounding rods.

Specifications

- Engine: 1.9 kW, four-stroke
- Driving rate: up to 45 blows/min
- Drop height: 20 cm
- Drop weight: 20 or 20 + 10 kg
- Total net weight: 70 kg (approx.) (without sounding rods and accessories)



16-T0013/E during operation



16-T0013/E with 16-T0013/E1

Accessories and spares

16-T0013/E1

Tripod for hanging the lifting mechanism.

16-T0013/8

Drive conical point, 500 mm² area, 25.2 mm diameter, 90° angle.

16-T0013/9

Drive conical point, 1000 mm² area, 35.6 mm diameter, 90° angle.

16-T0013/4

Sounding rod, 22 mm diameter.

16-T0013/10

Spare expendable conical point, 500 mm² area, 25,2 mm diameter, 90° angle

16-T0013/11

Spare expendable conical point, 1000 mm² area, 35,6 mm diameter, 90° angle

Sample Extruders

STANDARD

▶ EN 13286-2 ▶ EN13286-47

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Two models are available:

16-T0082/A, hand operated, 60 kN capacity, vertical extrusion, suitable for compacted soil samples, and

16-T0083/A, motor operated, 60 kN capacity, horizontal extrusion, 900 mm ram stroke, suitable for extruding soil samples at various levels of compactness from Shelby tubes and other samplers. It can also be set for vertical extrusion.

**16-T0083/A
MOTORIZED SOIL EXTRUDER**

230 V, 50 Hz, 1 ph.

This extruder features one of the largest capacities available on the market (ram stroke 900 mm), and due to the large number of standard adaptors, is considered the most versatile extruder, ideal for central laboratories.

Sampling tubes are held in place by an adjustable "V" shaped bearing which can extrude either in a vertical or horizontal position. Both the hydraulic cylinder assembly and the receiving tray can easily be lowered alongside the machine to save space when not in use. The machine is supplied without tube adaptors which have to be ordered separately. See accessories.



16-T0083/A in vertical extrusion position

Specifications

- Power: 750 W
 - Maximum loading capacity: 60 kN
 - Maximum ram stroke: 900 mm
 - Maximum working ram speed: 6 mm/sec
 - Maximum external diameter of sample tubes: 160 mm
- Overall dimensions:
- Horizontal working position: 2730 x 409 x 1180 mm (wxdxh)
 - Vertical working position: 1025 x 409 x 1080 mm (wxdxh)
 - Weight: 160 kg (approx.)

Accessories

16-T0083/A4
Adaptor for extruding 101.6 mm OD Shelby tubes.

16-T0083/A5
Adaptor for extruding 100 mm OD Shelby tubes.

16-T0083/A6
Adaptor for extruding 88.9 mm OD Shelby tubes.

16-T0083/A7
Adaptor for extruding 83 mm OD Shelby tubes.

**16-T0082/A
HAND OPERATED VERTICAL SOIL EXTRUDER**

This hydraulic extruder can accommodate standard U4 tubes and a range of adaptors to extrude soil samples of 35, 38, 101.6, 106 and 152.4 mm diameter. It can also be used to remove Marshall, Proctor and CBR specimens. Appropriate accessories and adaptors are available and have to be ordered separately. See accessories.

Specifications

- Maximum loading capacity: 60 kN (6000 kgf)
- Maximum ram stroke: 480 mm
- Dimensions: 1140 x 300 x 370 mm
- Weight: 50 kg (approx.) (without accessories)



16-T0082/A

Accessories

16-T0082/1
Adaptor for extruding 35, 38, 101.6, 106 and 152.4 mm diameter samples. Total length 280 mm (approx.).

16-T0082/3
Adaptor for extruding 38 mm diameter samples only.

16-T0082/4
Frame and adaptor only for extruding three 38 mm diameter tubes from a U4 tube.

16-T0082/5
106 mm adaptor for extruding a soil sample from U4 tubes.

16-T0082/A16
Extension for extruding samples up to 450 mm long.

16-T0083/A during operation



16-T0082/1



16-T0082/A16 Extension fitted onto the 16-T0082/1

Sample Extruders | Pestle and Mortar | Color Charts

STANDARD

- ▶ ASTM D1883 ▶ ASTM D698
- ▶ BS 1377:4 ▶ BS 1924:2
- ▶ BS 598

**16-T0080
UNIVERSAL SPECIMEN
EXTRUDER**

Universal specimen extruder, for moulds of 100 - 152.4 mm diameter.

This extruder is used to remove 101.6 mm (4"), 152.4 mm (6"), 100 mm and 150 mm diameter specimens from Proctor, CBR and Marshall moulds. Constructed from steel, it has adaptors that fit easily within the mould's diameter.

Specifications

- Maximum loading capacity: 50 kN
- Maximum ram stroke: 197 mm (ram) + 68 mm (screw)
- Weight: 25 kg (approx.)



16-T0080

MELTING POT

Used to melt wax to seal the ends of soil samples and other materials, the melting pot can also be used to melt the capping compound for concrete cylinders, as specified on page 236.

55-D1403

Melting pot. 230 V, 50-60 Hz, 1 ph.

55-D1403/Z

As above but 110 V, 60 Hz, 1 ph.

SPECIFICATIONS

- Capacity: 5 liters (approx.)
- Temperature range: +30 to +130°C
- Power: 700 W
- Internal dimensions: 200 x 160 mm (diameter x height)
- External dimensions: 285 x 275 mm high (diameter x height)
- Weight: 2.7 kg (approx.)



55-D1403

STANDARD

- ▶ ASTM D421 ▶ BS 1924:1 ▶ BS 1337:2

PESTLE AND MORTAR

The pestle and mortar are used to gently break down soil samples into individual particles for chemical tests.

86-D1180/1

Porcelain mortar, 125 mm diameter (approx.). Weight 700 g (approx.).

16-D1179/A

Rubber headed pestle. Weight 60 g (approx.).



16-D1860/B

SOIL COLOR CHARTS

Using Munsell Soil Color Charts is an affordable way of evaluating and classifying soil color in the field and in the laboratory. The soil classification method that has been developed around the Munsell color system is an established and accepted way of building accurate soil descriptions. The book of charts is laid out in a way that makes soil color evaluations quick and easy, and using it enables practitioners from a wide range of professions to share reliable and consistent information about the color of soils at a particular site with colleagues anywhere around the world.

Specifications

- Dimensions: 200 x 120 x 60 mm
- Weight: 500 g (approx.)

Laboratory planetary mixers

16



76-B0702, 5L capacity



B0075/B



76-B0072

We offer three versions: 5, 10, and 20 liters capacity (respectively models 76-B0702, 76-B0072 and 76-B0075/B). They all feature a robust construction with a bowl and whisk that are easy to fit and remove. When lifting the cover, a safety switch turns the mixer off for operator safety conforming to CE directives. A planetary mixing action ensures a complete and uniform mixing of the materials. All models are supplied complete with whisk.

For mixing asphalt samples, the mixers have to be fitted with the suitable Isomantle heater (see page 347).



76-B0702/6, 76-B0072/8, 76-B0075/6



76-B0072/9, 76-B0075/9

Note: for more detailed information see page 347

Ordering information

76-B0702

Laboratory digital planetary mixer, 5 L capacity, complete with whisk. 230 V, 50-60 Hz, 1 ph.

76-B0704

As above but 110 V, 60 Hz, 1 ph.

76-B0072

Laboratory planetary mixer, 10 L capacity, complete with whisk. 230 V, 50 Hz, 1 ph.

76-B0072/Y

As above but 220 V, 60 Hz, 1 ph.

76-B0072/Z

As above but 110 V, 60 Hz, 1 ph.

76-B0075/B

Laboratory planetary mixer, 20 L capacity, complete with whisk. 230 V, 50 Hz, 1 ph.

76-B0075/BY

As above but 220 V, 60 Hz, 1 ph.

76-B0075/BZ

As above but 110 V, 60 Hz, 1 ph.

Accessories and spares

76-B0702/9

Mixing hook for 76-B0702 mixers.

76-B0072/9

Mixing hook for 76-B0072 mixers.

76-B0075/9

Mixing hook for 16-B0075/B mixers.

76-B0702/2

Spare bowl for 76-B0702 mixers.

76-B0072/6

Spare bowl for 76-B0072 mixers.

76-B0075/1

Spare bowl for 76-B0075/B mixers.

76-B0702/6

Spare whisk for 76-B0702 mixers

76-B0072/8

Spare whisk for 76-B0072 mixers.

76-B0075/6

Spare whisk for 76-B0075/B mixer

STANDARD

▶ NF P94-093

16-T0004

SOIL CUTTER

Ideal for breaking up lumps of clay to prepare soil specimens for compaction. Made of anodised aluminium and stainless steel.

Specifications

- Power: 2800 W
- Capacity: 13 liters
- Dimensions: 815 x 590 x 500 (w x d x h)
- Weight: 110 kg (approx.)
- 400 V, 50 Hz, 3 ph



Soil Lathes | Trimmers | Cutters and Tools

16-T0028/B

SOIL LATHE/TRIMMER AND EXTRUDER FOR SOIL SAMPLES
from 35 to 110 mm diameter

Soil samples from 35 to 110 mm diameter can be trimmed and extruded with this simple yet complete device. To reduce samples initially, an open wire saw is required. See accessory 16-D1689.

Specifications

Lathing capacity: from 35 x 70 mm to 100 x 200 mm (diameter x height)
Trimming and extruding capacity: from 35 x 70 mm to 50 x 100 mm (diameter x height)
Vertical clearance: adjustable up to 240 mm
Overall dimensions: 270 x 320 x 580 mm (w x d x h)
Weight: 12 kg (approx.)



16-T0028/B

Accessories

16-D1689

Open wire saw.

16-D1690

Wire saw.

16-D1691

Trimming knife.



16-D1689, 16-D1690, 16-D1691



16-T0026/A with cutter

SOIL DIE-CUTTER/SAMPLER

16-T0026/A

This versatile sampler can be used to prepare soil samples from 35 to 100 mm diameter and up to 200 mm high for consolidation, shear, triaxial and other tests. Various circular, cylindrical and square cutters are available, which are pushed into the sample core and then extruded with the extrusion dolly. See the table for details.

Specification Cutters

- Upper plate size: 120 mm diameter
- Maximum vertical clearance: 620 mm (approx.)
- Weight: 22 kg (approx.)

Extrusion dolly model	Application	Type of cutter	Sample size, mm
26-WF0320/3	Consolidation (Oedometer)	Ring	50.47 x 20 (diameter x height)
26-WF0321/3	Consolidation (Oedometer)	Ring	63.5 x 20 (diameter x height)
26-WF0325/3	Consolidation (Oedometer)	Ring	71.4 x 20 (diameter x height)
26-WF0326/3	Consolidation (Oedometer)	Ring	75 x 20 (diameter x height)
26-WF0335/3	Consolidation (Oedometer)	Ring	112.8 x 25 (diameter x height)
27-WF0215/B7	Shearbox	Square	60 x 60 x 20 (w x d x h)
27-WF0216/B7	Shearbox	Square	100 x 100 x 20 (w x d x h)
27-WF0217/B7	Shearbox	Ring	50 x 20 (diameter x height)
27-WF0218/B7	Shearbox	Ring	60 x 20 (diameter x height)
27-WF0219/B7	Shearbox	Ring	63.5 x 20 (diameter x height)
27-WF0222/B7	Shearbox	Ring	100 x 20 (diameter x height)
28-WF0420/9	Triaxial	Cylinder	35 x 70 (diameter x height)
28-WF4031/G	Triaxial	Cylinder	38 x 76 (diameter x height)
28-WF4051/G	Triaxial	Cylinder	50 x 100 (diameter x height)
28-WF4071/G	Triaxial	Cylinder	70 x 140 (diameter x height)
28-WF4101/G	Triaxial	Cylinder	100 x 200 (diameter x height)

Carbide Meters

MOISTURE DETERMINATION BY CARBIDE METERS

We offer two series of carbide moisture meters:

UNIVERSAL AND SPEEDY

All of the models can be used for soils, sand and fine aggregates. The operating principle is identical for all models: the sample is introduced into the bottle with the reagent and the water in the sample reacts with calcium carbide and produces a gas, the pressure of which is indicated on the manometer and easily converted into the percentage of moisture.

UNIVERSAL CARBIDE METERS 19-T0019 SERIES

Four versions are available - the specifications are detailed in the table below.

Accessories

19-T0019/1
Moisture tester reagent ampules. Pack of 100.

19-T0019/2
Calibration kit for Universal carbide meters, including manometer and accessories.

Note: when the 19-T0019/1 reagent is for export there are limitations on the method of transportation. The reagent has to be shipped separately in special packs according to international regulations for dangerous materials.



19-T0019



19-T0019/F



19-T0019/G



19-T0019/H

Model 19-	Description	Comprising	Sample mass / Moisture range (up to)	Case dimensions	Weight (approx.)
T0019	Classic moisture meter with analog manometer and digital balance	Digital balance, 20 carbide ampules, hammer, chisel, digital timer and other accessories	20 g/10% 50 g/4% 100 g/2%	520 x 340 x 140 mm	6 kg
T0019/F	Classic moisture meter, long bottle version, with analog manometer and digital balance	As above	20 g/20%	520 x 340 x 140 mm	6 kg
T0019/G	Digital moisture meter with 0-3 bar high-resolution digital manometer and digital balance	As above	20 g/10% 50 g/4% 100 g/2%	520 x 340 x 140 mm	6 kg
T0019/H	Digital moisture meter with 0-3 bar high-resolution digital manometer, digital balance and log printer for printing test certificates	As above, plus log printer	20 g/10% 50 g/4% 100 g/2%	520 x 340 x 140 mm	8 kg

Carbide Meters | Desiccators

SPEEDY MOISTURE METERS

We offer two models:

- 47-T0024/A**, 6 g capacity, 0-20% humidity measuring range,
- 47-T0023/A**, 20 g capacity, 0-20% humidity measuring range.

Both are supplied complete with an electronic balance and other accessories as shown.

Specifications

- Case dimensions: 510 x 380 x 200 mm
- Weight: 5.5 kg (47-T0024/A) and 6 kg (47-T0023/A)(approx.)

47-T0023/A

Speedy moisture tester, 20 g capacity, 0-20% humidity range, 0.2% gauge divisions. Complete with electronic balance, accessories and carrying case.

47-T0024/A

As above but 6 g capacity.

Accessories and spares

47-T0020/B

Speedy calibration kit.

19-T0019/1

Moisture tester reagent ampules (pack of 100)

as alternative

47-T0021

Moisture tester reagent powder. 0.4 kg box.



47-T0024/A with 47-T0021



47-T0023/A and 47-T0021



47-T0020/B

Important note

When the 47-T0021 reagent is for export there are limitations on the method of transportation. The reagent has to be shipped separately in special packs according to international regulations for dangerous materials.

DESICCATOR CABINET

19-D1113/A

Made from transparent plastic for a clear view of the contents. The unit includes adjustable stainless shelves. 450 x 480 x 450 mm (w x d x h). Weight: 30 kg (approx.).



86-D1113/A

Accessories

(for glass desiccators and cabinet)

86-D0819

Silica gel (desiccator salts), 1000 g bottle.

19-D0602/B

Moisture determination balance, 160 g capacity, 1 mg resolution. 230 V, 50-60 Hz, 1 ph. (for more details and information see page 10)



19-D0602/B

DESICCATORS

These desiccators are designed for cooling samples dried in an oven to avoid absorption of moisture from the air.

We offer three standard borosilicate glass models 86-D1110 to 86-D1111 and, as an alternative for larger samples, the Desiccator cabinet 19-D1113/A. Both versions have to be used with the 86-D0819 desiccator salts. See accessories.

Glass desiccators

86-D1110

Desiccator, 200 mm diameter, complete with perforated plate. Weight 5 kg approx.

86-D1110/A

As above but 250 mm diameter. Weight 5.5 kg approx.

86-D1111

As above but 300 mm diameter. Weight 8.5 kg approx.



86-D1110

Gas Jars | Pyknometers | Hydrometers

PARTICLE DENSITY

Both ASTM and BS Standards describe different methods and apparatus for determining particle density which relates to the type of soil as follows:

Gas jar method, BS1377:2, suitable for most soils including those containing gravel-sized particles;

Small pyknometer method, BS 1377:2 and ASTM D854, suitable for soils consisting of clay, silt and sand-sized particles;

Pyknometer method, BS 1377:2, suitable for soils containing particles up to medium gravel size.

The above determinations also require other general laboratory equipment which are described by the Standards.

STANDARD

▶ BS 1377:2

GAS JAR METHOD

This method applies to soils containing up to 10% of particles retained on a 37.5 mm sieve and requires a gas jar and shaker.

22-D0445

End-over-end shaker, used to rotate two gas jars(22-D1132) at approximately 50 rpm.230 V, 50-60 Hz, 1 ph. Weight: 20 kg (approx.).

22-D1132

Glass gas jar, 1 liter capacity, supplied complete with rubber bung and glass cover. Weight: 1.3 kg (approx.).

STANDARD

- ▶ EN 1097-7 ▶ BS 1377:2
- ▶ ASTM D854 ▶ AASHTO T100
- ▶ NF P94 054

SMALL PYKNOMETER METHOD

This method involves determining the particle density of soils consisting of clay, silt and sand-sized particles (BS 1377:2) and the specific gravity of soils that pass the 4.75 mm sieve (ASTM D854), using small pyknometers.

86-D1125

Specific gravity bottle, 25 ml capacity, complete with capillary vent stopper.

86-D1126

As above but 50 ml capacity.

86-D1127

As above but 100 ml capacity.

86-D1128

As above but 250 ml capacity (as required ASTM).



86-D1125, 86-D1126, 86-D1127



22-D1132



22-D0445 with 2 glass jar 22-D1132

STANDARD

▶ BS 177:3 ▶ BS 812

PYKNOMETER METHOD

This method applies to soils containing particles up to medium gravel size and uses a large pyknometer.

48-D0441/A

Large glass pyknometer, 1 liter capacity, complete with non-corrodible metal cone and rubber seal. Weight: 500 g (approx.).



48-D0441/A

Accessories

Listed here are some of the items that are more commonly required for particle density / specific gravity determination:

86-D1110

Glass desiccator, 200 mm diameter. Complete with plate



86-D1112/A, 86-D1110

86-D1110/A

As above but 250 mm diameter.

86-D1111

As above but 300 mm diameter.

86-D1112

200 mm diameter with vacuum attach. and plate

86-D1112/A

As above but 250 mm diameter.

86-D1113

As above but 300 mm diameter.

Safety cage for desiccators

86-D1113/1

Safety cage conforming to BS 1377:2. Weight: 2 kg(approx.).

86-D0819

Silica gel (desiccating salts), 1000 g bottle.



86-D1112/A with two 86-D1126 Pyknometers, Vacuum pump, 86-D1113/1 Safety cage and accessories.

STANDARD

▶ EN 1097-7 ▶ BS 1337:2

WATER BATH

The water bath is used to maintain particle density test specimens at a consistent temperature. It can be used with the adjustable tray and the cover with a cooling coil, if required. See accessories.

76-B0066/B

Digitally-controlled water circulating bath, temperature range ambient to +60°C. 230 V, 50-60 Hz, 1 ph.

76-B0066/BZ

As above but 110 V, 60 Hz, 1 ph.

For full description and specifications, see page 343

Accessories

76-B0066/1

Cover with cooling coil, for connection to mains water.

76-B0066/2

Adjustable tray.



76-B0066/B



76-B0066/1

STANDARD

▶ ASTM D422 ▶ AASHTO T88

PARTICLE SIZE DISTRIBUTION BY THE HYDROMETER METHOD.

Hydrometers are used for determining the particle size distribution of very fine materials such as silt and clay.

We offer a complete set containing all the items required to perform the analysis on six samples, but each item can also be purchased individually.

The Standards specify that a water bath is not necessary in cases where the test is performed in a temperature-controlled environment but our standard set includes a glass water bath with heater, thermostat and circulating unit which is suitable for ambient temperatures of 20°C maximum.



22-T0059/A set

22-T0059/A

ASTM Hydrometer test set 230 V, 50-60 Hz version

22-T0059/Z

Same as above but 110 V, 60 Hz

This set includes:

22-D1006/A - Six hydrometer cylinders

22-T0060/31 - Rubber bung for cylinders 22-D1006/A

22-T0060/A* - Soil hydrometer, 151 H, 0.995 to 1.038 g/ml

82-D1199 - Glass thermometer, 0-50°C, 0.5°C divisions

22-T0058/A - Constant temperature glass water bath, complete with heater, thermostat and circulating unit. Capacity up to 6 hydrometer cylinders. Dimensions 600 x 300 x 380 mm (w x d x h). 230 V, 50-60 Hz, 1 ph., or

22-T0058/AZ - Same as above but 110 V, 60 Hz

22-T0060/1 - High speed stirrer, 11000 rpm, with cup and baffle. 230 V, 50-60 Hz, 1 ph., or

22-T0060/1Z Same as above but 110 V, 60 Hz

86-D0802 - Sodium hexametaphosphate, 1000 g

86-D1073 - Beaker, 250 cc

22-T0060/B* Soil hydrometer, 152 H, 5 to 60 g/l is available as an alternative to the 22-T0060/A model.

All the above components can be purchased individually.

STANDARD

▶ NF P94-057 ▶ BS 1377:2

NF-BS HYDROMETER ITEMS (BASIC COMPONENTS)

22-D1007/A

Hydrometer cylinder, 2500 cm³ capacity, 85 ±5 mm diameter, graduated at 500, 1500 and 2000 cm³ (only NF P94-057).

Weight: 1 kg (approx.)

22-T0062/A

Soil hydrometer. 0.995 to 1.030 g/ml.

22-D1007/A1

Hand stirrer, 600 mm long (only NF P94-057).



22-T0060/1, 86-D0802, 22-D1007/A, 22-T0062/A, 22-D1007/A1



76-B0066/2 with two 86-D1127

Pipettes | Cone penetrometers

STANDARD

▶ BS 1377:2

22

PARTICLE SIZE DISTRIBUTION BY THE PIPETTE METHOD

Pipettes are used for determining the particle size distribution of very fine soils. The following few basic items are required to perform the test.

22-T0062/1

Andreasen pipette, 10 ml capacity. Weight: 300 g (approx.).

22-T0062/2A

Pipette stand with scale in millimetres. Weight: 10 kg (approx.).

22-T0062/3

Sedimentation cylinder, 500 ml capacity, with rubber bung. Weight: 300 g (approx.).

22-T0058/A

Constant temperature water bath, complete with heater, thermostat and circulating unit. 230 V, 50-60 Hz, 1 ph.

22-T0058/AZ

As above but 110 V, 60 Hz, 1 ph.

22-T0062/5

Conical beaker 1000 ml.



22-T0062/1, 22-T0062/2A, 22-T0062/3, 22-T0058/A

SOIL INDEX PROPERTIES

Types of index tests include:

- Liquid limit
- Cone penetrometer and Casagrande methods
- Shrinkage limit and Linear shrinkage
- Plastic limit

STANDARD

- ▶ BS 1377:2 ▶ NF P94-052-1
- ▶ EN 17892-12
- ▶ CEN ISO/TS 17892-06
- ▶ CEN ISO/TS 17892-12

LIQUID LIMIT: CONE PENETROMETER METHOD

Cone penetrometers are used to determine the moisture content at which clay soils pass from a plastic to a liquid state (the liquid limit). The result can also be used to evaluate the undrained shear strength (CEN ISO/TS 17892-12).

Two versions are available:

22-T0029/D

Digital liquid limit penetrometer with micrometric vertical adjustment.

22-T0029/E

Semi-automatic digital liquid limit penetrometer with vertical micrometric adjustment and electronic release mechanism. 230 V, 50-60 Hz, 1 ph.

22-T0029/EZ

As above but 110 V, 60 Hz, 1 ph.

Penetration cones and sample cups have to be ordered separately. See accessories. Weight: 8.5 kg (approx.).



22-T0029/E and 22-T0029/D with accessories

MAIN FEATURES

- » Cast iron base with levelling feet
- » 0.01 mm precision digital penetration measurement gauge
- » Micrometric vertical adjustment device
- » Automatic zeroing
- » Electronic release mechanism (22-T0029/E model only)

Accessories

Penetration cones

22-T0029/1

Penetration cone 30° tip and 80g of weight, to EN 17892-12, CEN ISO/TS 17892-6 and -12 and BS 1377-2

22-T0029/4

Penetration cone 30° tip and 60g of weight, to EN 17892-12, CEN ISO/TS 17892-6 and -12

22-T0029/7

Penetration cone 30° tip and 100g of weight, to CEN ISO/TS 17892-6

22-T0029/8

Penetration cone 30° tip and 400g of weight, to CEN ISO/TS 17892-6

Cone test gauges

22-T0029/2

Cone test gauge 2.5 mm thickness for 30° tip angle to EN 17892-12

22-T0029/5

Cone test gauge 1 mm thickness for 60° tip angle to EN 17892-12, CEN ISO/TS 17892-6 and -12

22-T0029/9

Cone test gauge 1.75 mm thickness for 30° tip angle to BS 1377-2, CEN ISO/TS 17892-6 and -12

Cups

22-T0029/3

Penetration sample cup. 55 mm diameter, 40 mm deep

86-D1332

Penetration sample cup. 75 mm diameter, 50 mm deep



22-T0029/1

22-T0029/4

22-T0029/7

22-T0029/2

22-T0029/8

22-T0029/5

Casagrande apparatus

**LIQUID LIMIT:
CASAGRANDE METHOD**

STANDARD

- ▶ ASTM D4318 ▶ AASHTO T89
- ▶ EN 17892-12 ▶ BS 1377:2
- ▶ NF P94-051-1
- ▶ CEN ISO/TS 17892- 06 & 17892-12
- ▶ UNI 10014 ▶ UNE 7377

Different versions are available conforming to the various Standards. They are identical in shape and differ mainly in the type of base. Furthermore, all models are available in either manually or motor operated versions. The grooving tools, which must also comply with the different Standards, are not included and have to be ordered separately. See the table below.

Weights:

- Hand operated versions: 2 kg (approx.)
- Motorized versions: 4 kg (approx.)



22-T0030/AE



22-T0031/AE

22

CASAGRANDE Liquid limit models		
Hand operated	Motorized	Standards
22-T0030/AE	22-T0031/AE (230V,50Hz,1ph)	EN 17892-12
	22-T0031/AEY (220V,60Hz,1ph)	ASTM D4318
	22-T0031/AEZ (110V,60Hz,1ph)	AASHTO T89
22-T0030/E	22-T0031/E (230V,50Hz,1ph)	UNI 10014
	22-T0030/G	UNE 7377
22-T0030/G	22-T0031/E (230V,50Hz,1ph)	BS 1377-2
	22-T0031/G (230V,50Hz,1ph)	NF P94-051

GROOVING TOOL			
Plastic type (pack of 10)	Steel type	Curved type	Standards
22-T0032/AP	22-T0032/AE	22-T0033	EN 17892-12 ASTM D4318 AASHTO T89 UNI 10014 UNE 7377
22-T0032/P	22-T0032	Not required	BS 1377-2
22-T0032/AP	22-T0032/A	Not required	NF P94-051



22-T0032/AP



22-T0032/P



22-T0033, 22-T0034/1



22-T0032/AE

Accessories and spares

22-T0034

Spare brass cup conforming to EN, ASTM, BS, NF, UNI and UN

22-T0034/1

Brass cup, roughened version

Shrinkage | Plastic limit

22

STANDARD

- ▶ ASTM D427 ▶ AASHTO T92
- ▶ BS 1377:2 ▶ NF P94-060-1
- ▶ UNE 103-108 ▶ UNI 10014

SHRINKAGE LIMIT

22-T0035

Shrinkage limit test set, including carrying case.

This test is performed to determine the maximum moisture content at which the soil stops shrinking when dried. We offer the following test set which comprises:

22-T0035/1

Two shrinkage dishes, 45 mm diameter x 12.7 mm high

22-T0035/2

Crystallizing dish, 57 mm diameter x 31 mm deep

22-T0035/3

Shrinkage prong plate, manufactured from transparent acrylic and fitted with 3 metal prongs

86-D1171

Evaporating dish

86-D1630

Flexible spatula

86-D1001

Graduated cylinder, 25 ml
Supplied complete with a plastic carrying case.

All the above items can also be purchased individually.

Specifications

- Case dimensions: 300 x 280 x 120 mm
- Weight: 950 g (approx.)



22-T0035

STANDARD

- ▶ BS 1377:2

LINEAR SHRINKAGE

22-T0037

Brass linear shrinkage mould.
Internal dimensions:
140 mm long, 12.5 mm radius.
Weight: 300 g (approx.).

The purpose of this test is to determine the linear shrinkage of the fraction of a soil sample passing a 425 µm test sieve by measuring the change in length of the bar of soil as it dries out.



22-T0037

STANDARD

- ▶ ASTM D4318 ▶ AASHTO T90
- ▶ BS 1377:2 ▶ NF P94-051
- ▶ UNE 103-104 ▶ UNI 10014

PLASTIC LIMIT

22-T0041/A

This test is for determining the moisture content of a soil at the boundary between the plastic and semi-solid states.

The set comprises:

22-T0040/1

Glass plastic limit plate, 300 x 300 mm

22-T0040/2

Stainless steel rod, 3 mm diameter

86-D1171

Mixing dish, 120 mm diameter

86-D1630

Flexible spatula

86-D1329/A

Six moisture content tins, 75 mm diameter x 30 mm high

All contained in a plastic case.
All above items can also be purchased individually.

Specifications

Case dimensions: 500 x 380 x 125 mm
Weight: 2 kg (approx.)



22-T0041/A

Chemical tests

WATER TESTING KITS

24-D1870/A Acidity test kit

For determining, by titration, the total acidity of water caused by mineral and organic acids.

Case dimensions: 250 x 120 x 55 mm
Weight: 480 g (approx.)

24-D1870/B Chloride test kit

For determining, by titration, the chloride content in water and waste water.
Case dimensions: 190 x 120 x 60 mm
Weight: 445 g (approx.)

24-D1870/C Hardness test kit

For determining the total hardness of water.
Case dimensions: 190 x 120 x 60 mm
Weight: 424 g (approx.)

24-D1870/E Alkalinity test kit

For determining the total alkalinity of water.
Weight: 1.5 kg (approx.)



24-D1870/B

24-D1870/A

24-D1870/E



24-D1870/C

STANDARD

► BS 812:117 ► BS 1377:3

CHLORIDE CONTENT: RAPID METHOD

Quantab chloride titrators can be used for estimating the chloride content of aqueous solutions. Two models are available:

48-D0543

Quantab chloride titrator, range 0.005% to 0.1% NaCl. Pack of 40 strips.

48-D0543/A

Quantab chloride titrator, range 0.05% to 1% NaCl. Pack of 40 strips.
Weight: 10 g (approx.)



48-D0543, 48-D0543/A

STANDARD

► BS 812:117 ► ASTM C88
► AASHTO T104 ► EN 1367-2

SULPHATE CONTENT: RAPID METHOD

Sulphate test strips, detection range 200 to 1600 mg/l. Pack of 100. Useful for the preliminary assessment of sulphate ions in aqueous solutions.
Weight: 10 g (approx.)



24-D0852

STANDARD ► BS 1377:3

SULPHATE CONTENT: LABORATORY METHOD

24-D1840 Ion exchange apparatus

Used for determining the sulphate content of ground water and aqueous soil extracts. The apparatus consists of an ion exchange column 400 mm long and 10 mm diameter, a swan-neck outlet and a 1500 ml round-bottomed flask to give a constant head. The apparatus is supplied assembled on a stand.
Dimensions: 200 x 100 x 600 mm
Weight: 5 kg (approx.)

Accessories

24-D1840/1
Ion exchange resin, 500 g.



24-D1840

Chemical tests

STANDARD

► ASTM D1067 ► BS 1377:3

PH METERS

We propose the following different models, suitable for field and laboratory use, as follows:

24-D1847

Pocket digital pH meter, battery operated.

Specifications

- pH range: 0.00 to 14.00
- Resolution: pH 0.01
- Accuracy at 20°C: +/- 0.2 pH
- pH calibration: manual, 2 points
- Battery life , 3000 hours use approx.
- Dimensions: 66 x 50 x25 mm
- Weight approx.: 70 g

Accessories

24-D1847/7

Calibration kit of pH 4 and pH 7, 5 pieces each.



24-D1847



24-D1848 Complete set

24-D1848

Portable digital pH, mV, temperature meter, complete with stand for laboratory use. Battery and mains operated.

Specifications

- pH range: 0.00 to 14.00, accuracy ± 0.01 + 1 digit, resolution 0.01 pH
- mV range: ± 1999, accuracy ± 1 + 1 digit, 1 mV
- temp. range: 0-100°C, accuracy ± 0.2°C + 1 digit, resolution 0.1°C
- pH calibration: pH 4.00 – 7.00
- 9 V battery, and mains adapter
- Dimensions: 96 x 120 x 46 mm
- Weight approx.: 260 g

Accessories

24-D1845/2

Combination pH electrode

24-D1845/3

pH 4.00 buffer solution, 500 ml

24-D1845/4

pH 7.00 buffer solution, 500 ml

24-D1845/5

pH 9.18 buffer solution, 500 ml

24-D1845/7

Electrode storage solution, 500 ml

24-D1845/8

Electrode cleaning solution, 500 ml

24-D0448

Magnetic stirrer

Note Supplied complete with pH4 and pH7 solutions, combined electrode, 9 V battery, Pt 100 temperature probe, stand for electrode and carrying case.

MAGNETIC STIRRERS

Used for titration and stirring. All the models in this range have variable speeds and include a magnetic Teflon coated follower. 81-B0145/D version features a hot plate which can be useful for particular applications.

24-D0448

Magnetic stirrer, mixing capacity 1 liter. 230 V, 50-60 Hz, 1 ph

24-D0448/B

Magnetic stirrer, mixing capacity 2.5 liters. 230 V, 50-60 Hz, 1 ph

81-B0145/D

Hot plate with magnetic stirrer. 230 V. 50-60 Hz, 1 ph

Code	24-D0448	24-D0448/B	81-B0145/D
Rotation speed, rpm	100 to 1200	100 to 1200	100 to 1200
Power, W	-	-	700
Dimensions, mm	120 x 120 x 45	180 x 180 x 70	170 x 230 x 150
Max temperature, °C	-	-	400
Weight approx. kg:	0.6	1.6	3



81-B0145/D



24-D0448

PAPERS

24-D1858/1

pH strips 1 to 11 pH. 5 meter dispenser

24-D1858/2

pH indicator papers 0 to 14 pH. 5 meter dispenser

24-D1859/1

Litmus paper red 5 to 8 pH. Pack of 100 strips



pH Papers



24-D1848

SOIL MECHANICS

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27 Direct/Residual shear

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29 Automatic triaxial testing

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In all aspects of civil engineering and particularly in soil mechanics, during the design stage the engineer must ensure that the analysis of soil properties relates directly to the relevant foundation or structure.

Using procedures involving extracting, examining and testing representative samples the engineer can create a model very close to the real situation.

In recent years we have seen a significant contribution to experimental analysis resulting from more sophisticated testing procedures, updating of many International Standards and publication of good testing manuals and procedures.

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CONSOLIDATION

The typical consolidation test determinates the rate and magnitude of consolidation of a soil specimen restrained laterally and subjected to a number of successive increments of vertical loads.

The complete line includes front loading oedometer, Constant rate of strain cells and hydraulic consolidation cells starting from the analogue configuration up to the fully automatic PC-controlled systems.

Front-loading oedometer

- **Standard front-loading oedometer**, manual application of vertical load using dead weights.
 - Electronic version: displacement transducers connected to automatic data acquisition system **GEODATALOG8** (see page 84)
 - Analog version: dial gauge or digital dial gauge
- **ACE^{EmS} Fully automatic oedometer** : comes loaded with the new environmentally friendly Electromechanical Servoactuation (EmS) technology. Silent, compact and high-performing, enabling you to expand your laboratory gradually and seamlessly

Constant rate of strain

In addition to the most common incremental loading consolidation, different tests can be performed measuring the magnitude and rate-of-consolidation of saturated cohesive soils using continuous controlled-strain axial compression allowing also the base excess pressure. Consolidation test using CRS cells can be performed more quickly, without compromising results accuracy, compared to the standard incremental loading test. Using CRS cells it is possible to monitor continually the excess pore pressure so tests can run at maximum speed further increasing test specimen throughput. The CRS Cell is used in conjunction with other equipment (Load frame, pressure system, pore pressure and accessories).

For this reason, different options are available:

- Upgrading kit for **ACE^{EmS}**
- Activation kit for **AUTOTRIAX2**
- Standard Triaxial System with **GEODATALOG8**

Hydraulic consolidation

Incremental loading consolidation test can also be performed with a different device that applies vertical force using hydraulic pressure. This type of cell overcomes the complexity usually associated with hydraulic oedometers and allows more information to be gathered from the soil sample. (e.g. low permeability by hydraulic pressure).

- **Hydrocon**: Specific for saturated soil test; two testing modes are available - manual and electronic - with automatic data acquisition **GEODATALOG8**. During the test back and axial pressure are applied and vertical settlement, pore pressure and variation of volume are measured.
- **Hydrocon Unsaturated (SWCC)**: specific for unsaturated soil test; electronic testing mode with automatic data acquisition **GEODATALOG8** is available; Its base is fitted with a High Air Entry Stone (HAES) which enables a soil/water characteristic suction curve to be obtained. In addition to Hydrocon model air pressure is also applied.



Automatic Computerized Oedometer 26-WF31E20



An advanced system featuring the automated PC-controlled of the complete consolidation test

STANDARD

- BS 1377:5 ▸ ASTM D2435
- ASTM D3877 ▸ ASTM D4546
- NF P94-091 ▸ EN 17892:5



FEATURES and ADVANTAGES

- » Versatile fully automatic Oedometer soil consolidation testing machine featuring incremental loading, swelling, CRS (constant rate of strain), CHG (controlled hydraulic gradient) and unconfined test.
- » Environmentally friendly and quiet the ACE EmS benefits from the new Electromechanical Servoactuation (EmS) technology requiring no dead weights or large

- and noisy air compressors, thus drastically reducing noise levels.
- » Small footprint featuring a benchtop shorter than 50 cm.
- » Modular and expandable, gradually connect up to 60 units via LAN port using the same PC software SOILMASTER allowing you to build your laboratory without interruption - resulting in excellent return on investments.

- » Highly performant with load capacity of up to 20 kN, equivalent to 10,000 kPa on 50.47mm Oedometer consolidation cell.
- » Optimized PID closed-loop control delivering fast, smooth and accurate loading and precise load holding through the multiple test steps.



Modular and expandable, gradually connect up to 60 units via LAN port using the same PC software SOILMASTER

Optional local user interface with 6" touch screen high resolution color display allowing full control of a single unit, without a PC, including full test execution. USB pen drive included for unlimited storage, TXT format data output



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

Front Loading Oedometer

STANDARD

- ▶ BS 1377:5 ▶ ASTM D2435
- ▶ ASTM D3877 ▶ ASTM D4546
- ▶ NF P94-091 ▶ EN 17892:5

The oedometer consolidation test determines the rate and magnitude of consolidation of a soil specimen restrained laterally and subjected to a number of successive vertical load increments

26-WF0302

- Front loading oedometer
- Overall dimensions: 500 x 200 x 750 mm (height without hanger x width x length)
- Weight: 21 kg approx.



MAIN FEATURES

- » Rigid aluminum alloy frame
- » 3 lever arm position: 9:1, 10:1, 11:1.
Max loading 1848 kg corresponding to 9.061 MPa (92.40 kgf/cm²) on a 20 cm² specimen
- » Can be fitted with traditional dial gauge or linear transducer for connection to the Geodatolog 8 data acquisition and processing system

Three oedometers (26-WF0302) complete with cells, dial gauges (30-WF6401), weight set, mounted on a consolidation bench (26-WF0312)

Consolidation cells, dial gauge/displacement transducer, weight sets and bench are not included and have to be ordered separately. See Accessories



Consolidation cells and spare parts

Suitable for both fixed ring oedometer consolidation and falling head permeability tests. The cell is constructed of aluminum and comes complete with all the parts illustrated in the exploded view.

Code	Specimen Dimensions (dxh) mm	Specimen area cm ²	Cell dim. (dxh) mm	Weight kg	Calibration disc code	Upper porous disc	Lower porous disc	Cutting ring
26-WF0320	50.47 x 20	20.00	139 x 74	1.3	26-WF0320/9	26-WF0320/4	26-WF0325/10	26-WF0320/3
26-WF0321	63.50 x 20	31.67	139 x 74	1.3	26-WF0321/9	26-WF0321/4	26-WF0326/10	26-WF0321/3
26-WF0325	71.40 x 20	40.00	139 x 74	1.3	26-WF0325/9	26-WF0325/4	26-WF0325/10	26-WF0325/3
26-WF0326	75.00 x 20	44.16	139 x 74	1.3	26-WF0326/9	26-WF0326/4	26-WF0326/10	26-WF0326/3
26-WF0335	112.80 x 25	100.00	200 x 74	3.0	26-WF0335/9	26-WF0335/4	26-WF0335/10	26-WF0335/3

Consolidation bench

26-WF0312
Bench for up to three oedometers.
Weight 30 kg

Weight sets

26-WF0230/C2
Weight set, 64 kg in total, comprising: 2 x 0.25, 1 x 0.5, 1 x 1, 1 x 2, 1 x 4 and 7 x 8 kg weights.

26-WF0230/D2

Weight set, 80 kg in total, comprising: 2 x 0.25, 3 x 0.5, 1 x 1, 1 x 2, 3 x 5 and 6 x 10 kg weights.

Single slotted weights

See page 56



Exploded view of consolidation cell 26-WF0320

Analog measuring device

30-WF6401

Dial gauge, 12 mm travel, 0.002 mm resolution.

As alternative

82-D1262/B

Digital dial gauge, 25 mm travel, 0.001 mm resolution.

Electronic measuring devices

30-WF6207

Linear potentiometric transducer, 10 mm travel.

Note: in case displacement transducer is supplied complete with data acquisition system, then a traceable calibration certificate is on request.

Data acquisition and processing System

30-WF6008

Note: For more information on the Geodatalog 8, Geo-Analysis Template see page 84

30-WF6008/T1

Consolidation Geo-Analysis template conforming, to BS 1377:5

30-WF6008/T8

Consolidation Geo-Analysis template conforming, to ASTM D2435.

30-WF6016/T8A

Consolidation Geo-Analysis template conforming, to ASTM D4546.

Permeability

26-WF0338/A

Permeability attachment with 50 ml graduated burette



Three oedometers 26-WF0302, complete with cells, 30-WF6207 displacement electronic transducers connected to 30-WF6008 GEODATALOG, and 26-WF0312 consolidation bench.

26-WF0338/A fitted to the 26-WF0302 with cell 26-WF0320

Weight application guide

This information is intended to make it easy to select the weight set that is appropriate for the cell size, the beam ratio and the maximum load applied.

Cell model	26-WF0320 Beam ratio 1:10		26-WF0321 Beam ratio 1:11		26-WF0325 Beam ratio 1:10		26-WF0326 Beam ratio 1:9		26-WF0335 Beam ratio 1:10	
For max. pressure	32 kg/cm ²	64 kg/cm ²	20 t/ft ²	40 t/ft ²	16 kg/cm ²	32 kg/cm ²	16 kg/cm ²	32 kg/cm ²	8 kg/cm ²	16 kg/cm ²
Weight set 26-WF	0230/C2	0230/C2	0230/C2	0230/C2	0230/C2	0230/C2	0230/D2	0230/D2	0230/D2	0230/D2
Add. weight 27-WF	-	8 x 0275/A	-	8 x 0275/A	-	8 x 0275/A	-	8 x 0277/A	-	8 x 0277/A
Total weight kg	64	128	64	128	64	128	80	160	80	160

Constant Rate of Strain cells (CRS)

STANDARD

► ASTM D4186

This cell is used to measure the magnitude and rate-of-consolidation of saturated cohesive soils using continuous controlled-strain axial compression. The specimen is restrained laterally and drained axially to one surface. The axial force and base excess pressure are measured during the deformation process.

Three different models are available:

26-WF0360/A

Constant rate of Strain (CRS) suitable for external load cell

26-WF0360/AS

Constant rate of Strain (CRS) suitable for submersible load cell

26-WF0360/AD

Adapter for triaxial cell model 28-WF4070

For a complete test configuration (Pressure system, pore pressure, Displacement transducer, Volume change and other accessories) visit our website or ask for the cooperation of our specialists.

Common FEATURES

- » Continuous monitoring of test parameters (axial load, pore pressure, axial compression) and detailed plotting of the consolidation curve
- » Max working pressure 3500 kPa
- » Specimen size: 63.5 x 25.4 mm (d x h)
- » Relatively short time to perform consolidation test
- » Particularly suitable for cohesive saturated soils

26-WF0360/A Specific FEATURES

- » To be used with external load cell
- » Typically used as additional accessories for Ace EmS or in a standard triaxial system
- » Easily upgradable for using submersible load cell



CRS - Constant rate of Strain Cell (26-WF0360/A) to be used with external load cell

26-WF0360/AS Specific FEATURES

- » To be used with submersible load cell
- » Typically used as additional accessories for automatic Triaxial System AUTOTRIAX 2 or in a standard triaxial system



CRS - Constant rate of Strain Cell (26-WF0360/AS) to be used with Submersible load cell

26-WF0360/AD Specific FEATURES

- » To be used with Submersible load cell
- » To be used as adapter for banded triaxial cell (model 28-WF4070)
- » Typically used as additional accessories for automatic Triaxial System AUTOTRIAX 2



CRS – Constant Rate of Strain (26-WF0360/AD) fitted on lower base of banded triaxial cell.



The CRS-fitted ACE EmS combined with the HYDROMATIC pressure volume/controller system:

- allows real saturation of soil samples,
- significantly reduces test time resulting in higher specimen test throughput,
- monitors the excess pore pressure throughout the test, and;
- provides complete control via PC software

Hydraulic consolidation cells

The Hydrocon hydraulic consolidation apparatus are used to determine the magnitudes and rates of consolidation of soil specimens saturated and unsaturated of relatively low permeability by hydraulic pressure.

Two models are available:

26-WF0345

Hydrocon, hydraulic consolidation cell for 100 mm diameter samples

26-WF0346

Hydrocon SWCC consolidation cell for 100 mm diameter unsaturated samples.

Common FEATURES

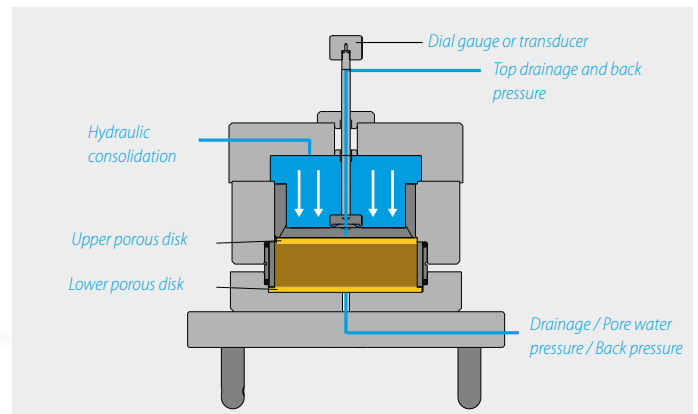
- » Hydraulic loading
- » Maximum working pressure: 3500 kPa
- » No weights required
- » Suitable for 100 mm dia. samples
- » Suitable for compacted clay
- » Compact design, occupies less space than conventional oedometers
- » Possibility to measure both pore and back pressure during testing
- » Possibility to make permeability measurement by generating a vertical flow of water through the sample
- » Overall dimensions: 260 x 450 mm (d x h)
- » Weight: 5 kg. approx.

26-WF0345 HYDROCON Specific FEATURES

- » Specific for saturated soil sample according to BS 1377:6 without lateral drainage
- » Two testing modes available: manual or with automatic data acquisition
- » 3 lines pressures (axial load, upper and lower drainage)



26-WF0345 Hydrocon, hydraulic consolidation cell for 100 mm diameter samples

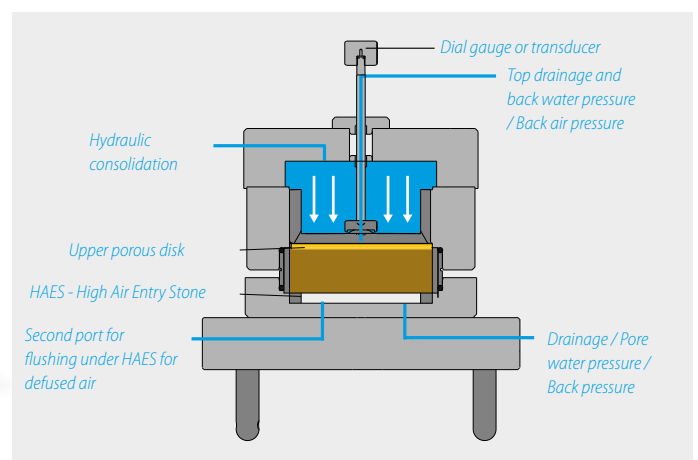


26-WF0346 HYDROCON SWCC Specific FEATURES

- » Specific for unsaturated soil sample
- » Testing mode with automatic data acquisition
- » 4 lines pressures (axial load, upper and two lower drainage air and water)
- » 3 bar High Air Entry stone included
- » Additional High Air Entry Stone (1, 5, 15 Bar) available as option



26-WF0346 Hydrocon SWCC consolidation cell for 100 mm diameter unsaturated samples.



For a complete test configuration (Pressure system, pore pressure, Displacement transducer, Volume change and other accessories) visit our website or ask for the cooperation of our specialists.

DIRECT/RESIDUAL SHEAR

In the traditional direct shear test, the soil specimen (either undisturbed, remoulded or compacted) is placed in a rigid metal box that is composed of two halves that can slide horizontally and be subjected to a normal constant stress. The main limitation of the conventional shear box is that it is not possible to apply the shearing action for a large displacement of the soil specimen. To overcome this problem, ring shear apparatus, also known as Bromhead Apparatus, has been developed. In the ring shear apparatus, the specimen is annular shaped and subjected to a normal constant stress and an unlimited rotational displacement.

The product range includes :

Direct/residual shear machines - Small shear box

DIGISHEAR Digital direct/residual shear machine: it can be fitted in two different versions:

- Analog version: two dial gauges and one load ring
- Electronic version: two displacement transducers and load cell connected to automatic data acquisition system, the typical solution where central data acquisition is used.

AUTOSHEAR Digital direct/residual shear machine with built-in data acquisition, fitted with electronic measurement

SHEARMATIC EmS Fully automatic direct/residual shear machine comes loaded with the new environmentally friendly Electromechanical Servo-actuation (EmS) technology. Silent, compact and high performing, enabling you to expand your laboratory gradually and seamlessly.

Direct/residual shear machines - Large shear box

SHEARMATIC 300 ideal for soil and other materials that contain large particles of up to 20 mm. Sample size up to 300 mm square can be tested, with inserts allowing the testing of smaller sample sizes.

Residual shear machine – Ring shear

TORSHEAR EmS Fully automatic ring shear machine comes loaded with new environmental friendly Electromechanical Servo-actuation (EmS) technology. Silent compact and Highly performing, enabling you to extend your laboratory gradually and seamlessly.

Automatic Shear testing machine

27-WF21E80



Versatile fully automatic Direct/Residual soil testing machine featuring direct, residual shear testing and consolidation test



STANDARD

- ▶ ASTM D3080 ▶ AASHTO T236
- ▶ BS 1377:7
- ▶ BS EN ISO 17892-10
- ▶ NF P94-071



Detail of Shearmatic EmS fitted with Consolidation accessories and consolidation cell for automatic performance of the consolidation test

FEATURES AND BENEFITS

- » Fully automatic, standalone Direct / Residual Shear soil testing system managed by local user interface with 6" touch screen high resolution color display that can also accurately perform Oedometric Soil Consolidation tests using appropriate consolidation cells.
- » High-performing with maximum vertical and horizontal force of up to 10 kN, infinite variable speed from 0.00001 to 15.00000 mm/min and adjustable number of cycles from 1 to 99.
- » Save time and ensure test accuracy with straight horizontal transmission of force facilitated by high stiffness load chain shear box, driving head and load cell, eliminating horizontal load measurement inaccuracies.
- » Fast, smooth and accurate loading delivered by integrated optimized PID closed-loop control with precise load ensured by a load cell directly mounted on the loading tip.
- » Totally flexible- choose to control unit either via the Integrated local user interface or via PC, tablet or smartphone.
- » Modular and expandable with optional dedicated software - gradually connects up to six units via LAN port using the same PC software allowing you to build your laboratory without interruption - resulting in excellent return on investments.
- » Environmentally friendly and quiet - the Shearmatic EmS benefits from the new Electromechanical Servoactuation (EmS) technology requiring no dead weights or large and noisy air compressors, thus drastically reducing noise levels.
- » Long-life and low maintenance with corrosion-free, techno-polymeric shear box carriage. Lightweight and easy to clean, the top-quality techno-polymeric material offers excellent resistance to corrosion, wear and tear and to chemicals often mixed with soil specimens.
- » Save space with its small footprint smaller than 1 m.

SHEARMATIC EmS

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

DIGISHEAR

Direct/Residual Shear testing machine

STANDARD

- ▶ ASTM D3080 ▶ AASHTO T236
- ▶ BS 1377:7 ▶ BS EN ISO17892-10 ▶ NF P94-071

27



DIGISHEAR 27-WF20D60 with accessories, fit in the analogical mode.

Accessories to fit the machine in analogical mode

Load

27-WF1002/ST

Load ring 2000 N cap. with adapter or, as alternative:

27-WF1003/ST

Load ring 5000 N cap. with adapter

Dial Gauge

30-WF6401

Dial gauge for vertical deformation, 12x0.002 mm

30-WF6402

Dial gauge for horizontal deformation, 30x0.01 mm

Or, as alternative:

82-D1262/B

Digital dial gauge, 25 mm travel 0.001 mm resolution

DIGISHEAR is supplied without shear box assembly, slotted steel weights and load/displacement measurement apparatus which can be analogical or electronic with data acquisition and processing. All these items have to be selected and ordered separately. See above and next page



27-WF1002/ST load ring with adapter



30-WF6401 Dial gauge for measuring vertical deformation, 12 mm x 0.002 mm resolution

27-WF20D60

DIGISHEAR Direct and residual shear testing machine with digital LCD display. 110-230 V, 50-60 Hz, 1 ph

MAIN FEATURES

- » Maximum shear force: 5 kN
- » Maximum vertical force: 5 kN, using the 10:1 cantilever device
- » Infinitely variable speed drive from 0.00001 to 15 mm/min
- » Compatible with shear boxes up to 100 mm diameter or square
- » Sturdy shear box techno-polymeric carriage untouchable by corrosion
- » Can be equipped in the analogical or electronic mode
- » Loading ram, shear box, load-measuring system are perfectly aligned to avoid distortions with the possibility of mechanical backlash adjustment
- » Digital control and display of speed. LCD row by 20 characters, easy to operate by the membrane keyboard
- » Can be equipped in the analogical or in the electronic mode with data acquisition and processing

Accessories to fit the machine in electronic mode

Load

27-WF0377/ST

Load cell, 5 kN cap. complete with adapters

Displacement

30-WF6207

Linear potentiometric transducer, 10 mm travel for vertical deformation, complete with mounting block

30-WF6208

Linear potentiometric transducer, 25 mm travel for horizontal displacement, complete with mounting block

Data acquisition unit

30-WF6008

GEODATALOG, 8 channels data acquisition unit, 110-240 V, 50-60 Hz, 1 ph, supplied complete with DATACOMM 2 software for PC data acquisition. See page 84

Template for data processing

30-WF6008/T2

Direct and residual shear Geo-Analysis template conforming to BS 1377:7,

or as alternative:

30-WF6008/T9

Direct and residual shear Geo-Analysis template conforming to ASTM D3080



GEODATALOG 8 data acquisition 30-WF6008

AUTOSHEAR

Direct/Residual Shear testing machine

STANDARD

- ▶ ASTM D3080 ▶ AASHTO T236
- ▶ BS 1377:7 ▶ BS EN ISO17892-10 ▶ NF P94-071

27-WF21A60

AUTOSHEAR Direct and residual shear testing machine with automatic built-in data acquisition, 110-230 V, 50-60 Hz, 1 ph

MAIN FEATURES

- » Maximum shear force: 5 kN
- » Maximum vertical force: 5 kN, using the 10:1 cantilever device
- » Infinitely variable speed drive from 0.00001 to 15 mm/min
- » Compatible with shear boxes up to 100 mm diameter or square
- » Sturdy shear box techno-polymeric carriage untouchable by corrosion
- » Loading ram, shear box, load-measuring system are perfectly aligned to avoid distortions with the possibility of mechanical backlash adjustment
- » User interface 6" touch-screen color display for numerical and graphical plotting of the readings
- » Three analog channels: one for load cell and two for displacement transducers
- » Number of cycles adjustable from 1 to 99
- » USB pen drive for unlimited storage capacity and TXT format data output
- » Optional PC control via LAN port and dedicated software

Accessories to fit the machine in electronic mode

Load

27-WF0377/ST

Load cell, 5 kN cap. complete with adapters

Displacement

30-WF6207

Linear potentiometric transducer, 10 mm travel for vertical deformation, complete with mounting block

30-WF6208

Linear potentiometric transducer, 25 mm travel for horizontal displacement, complete with mounting block

Template for data processing

30-WF6008/T2

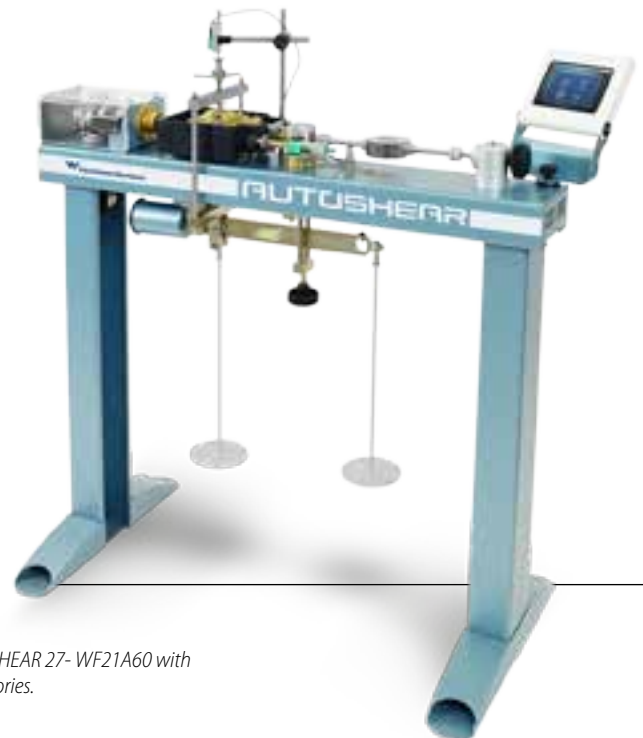
Direct and residual shear Geo-Analysis template conforming to BS 1377:7

or as alternative:

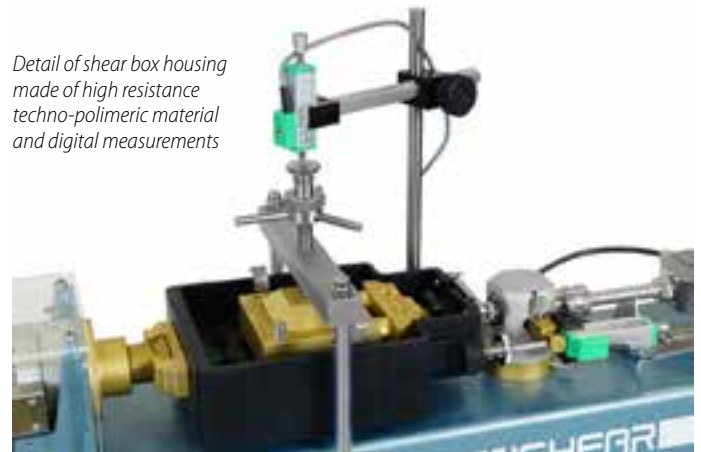
30-WF6008/T9

Direct and residual shear Geo-Analysis template conforming to ASTM D3080

AUTOSHEAR is supplied without shear box assembly, slotted steel weights and load/displacement measurement apparatus. All these items have to be selected and ordered separately. See above and next page



AUTOSHEAR 27- WF21A60 with accessories.



Detail of shear box housing made of high resistance techno-polimeric material and digital measurements

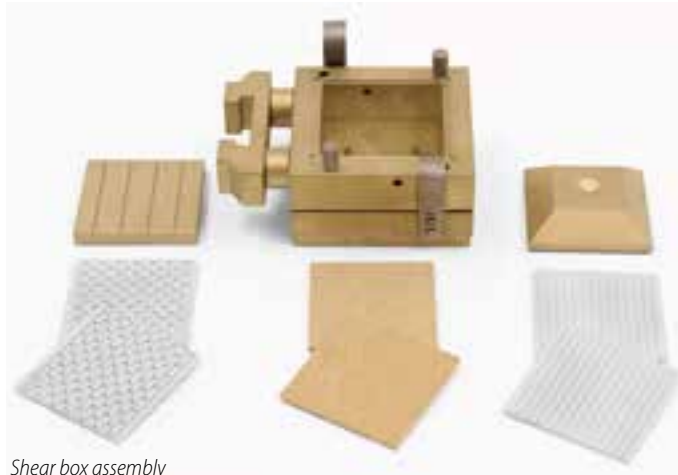


Detail of high stiffness load chain shear box - driving head - load cell

Direct/Residual Shear Testing Machines (Accessories)

Shear boxes and accessories

Manufactured from brass and designed to contain the water that surrounds the specimen. They consist of a square box with a rigid walled round or square hole complete with adapter loading pad, retaining plate, 2 grids, 2 perforated grids and 2 porous plates. Shear boxes are suitable for all Wykeham Farrance direct/residual shear testing machines. Weight approx.: from 2.5 to 4 kg



Shear box assembly



Sample cutter square and extrusion dolly

Shear box assemblies and accessories

	60-square	100- square	50-round	60-round	63.5- round	100- round
Shear box	27-WF0215/B	27-WF0216/B	27-WF0217/B	27-WF0218/B	27-WF0219/B	27-WF0222/B
Sample cutter*	27-WF0215/B7	27-WF0216/B7	27-WF0217/B7	27-WF0218/B7	27-WF0219/B7	27-WF0222/B7
Extrusion dolly*	27-WF0215/8	27-WF0216/8	27-WF0217/8	27-WF0218/8	27-WF0219/8	27-WF0222/8

Spare parts for shear box assemblies

Box code	WF0215/B	WF0216/B	WF0217/B	WF0218/B	WF0219/B	WF0222/B
Loading pad	27-WF0215/B2	27-WF0216/B2	27-WF0217/B2	27-WF0218/B2	27-WF0219/B2	27-WF0222/B2
Base plate	27-WF0215/B3	27-WF0216/B3	27-WF0217/B3	27-WF0218/B3	27-WF0219/B3	27-WF0222/B3
Porous plate**	27-WF0215/4	27-WF0216/4	27-WF0217/4	27-WF0218/4	27-WF0219/4	27-WF0222/4
Plain grid plate**	27-WF0215/B5	27-WF0216/B5	27-WF0217/B5	27-WF0218/B5	27-WF0219/B5	27-WF0222/B5
Perforated grid plate**	27-WF0215/B6	27-WF0216/B6	27-WF0217/B6	27-WF0218/B6	27-WF0219/B6	27-WF0222/B6

*Not supplied with the shear box. They have to be ordered separately.

** Two pieces are supplied with each shear box

Weight sets

27-WF0230/C3

Weight set, 37.5 kg in total, comprising: 2 x 0.25, 2 x 0.5, 2 x 1, 3 x 2, 3 x 4 and 2 x 8 kg weights.

27-WF0230/C4

Weight set, 34 kg in total, comprising: 2 x 1, 1 x 2 and 3 x 10 kg weights. (additional)

Single slotted weights

27-WF0270/A

Slotted steel weight, 0.25 kg ± 3 g.

27-WF0271/A

Slotted steel weight 0.5 kg ± 3 g.

27-WF0272/A

Slotted steel weight, 1 kg ± 5 g.

27-WF0273/A

Slotted steel weight, 2 kg ± 5 g.

27-WF0274/A

Slotted steel weight, 4 kg ± 5 g.

27-WF0275/A

Slotted steel weight, 8 kg ± 10 g.

27-WF0276/A

Slotted steel weight, 5 kg ± 5 g.

27-WF0277/A

Slotted steel weight, 10 kg ± 10 g.



Slotted steel weights



Extrusion dolly and sample cutter, round.

SHEARMATIC 300

Large shear testing machine

STANDARD

- ▶ ASTM D3080 ▶ BS 1377:7
- ▶ BS EN ISO 17892-10

MAIN FEATURES

- » Sample size up to 300 mm
- » 100 kN shear and consolidation force
- » Infinitely variable speed control from 0 to 11.00000 mm/min
- » Automatic hydraulic application of pre-set consolidation steps (up to 50)
- » Automatic test management from consolidation to failure: the operator is only requested to remove the clamping screws of the shear box
- » Straight connection between shear box, drive unit and load cell for the axial transmission of the horizontal force along the shearing plane, instead of the classic "swan neck"
- » Easy and immediate set up of the test parameters via the large digital graphic display
- » Possibility to set different speeds and travel (forward and reverse) in the residual shear tests
- » Each single step of axial force can be applied instantaneously or by means of a linear ramp in a pre-set time interval
- » Different and independent data recording for consolidation and failure



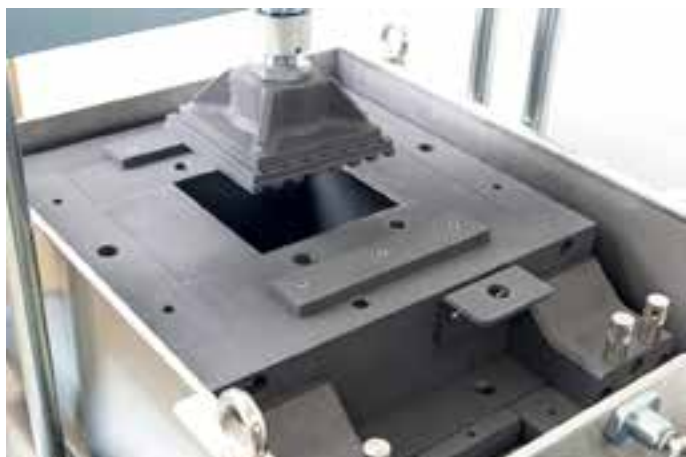
27

The SHEARMATIC 300 automatic machine is ideal for soil and other materials that contain large particles of up to 20 mm largest dimension. Sample size up to 300 mm square can be tested, with inserts allowing the testing of smaller sample sizes.

Two models available with different type of Shear box: in coated steel or in stainless steel for testing highly corrosive materials

Technical specification

- Sample size: up to 300 mm. Can be reduced to 150 mm using sample insert. See accessories.
- Shear and vertical force: 100 kN
- Speed range: infinitely variable from 0 to 11.00000 mm/min
- Maximum travel: 75 mm
- Steps of consolidation: up to 50
- Power: 2000 W
- Overall dimensions: (wxdxh) 1470x758x1570 mm approx.
- Weight approx.: 800 kg



Detail of Large shear box of Shearmatic 300 fitted with 150 mm insert. (model 27-WF2304/1)

Ordering information

SHEARMATIC 300 stainless steel shear box

27-WF2304/INOX

SHEARMATIC 300, large automatic shear box apparatus, 100 kN cap., with stainless steel shear box assembly for 300 mm square samples. 220 V, 50 Hz, 1 ph

27-WF2304/INOXZ

Same as above but 110 V, 60 Hz, 1 ph

SHEARMATIC 300 coated steel shear box

27-WF2304

SHEARMATIC 300, large automatic shear box apparatus, 100 kN cap., with coated steel shear box assembly for 300 mm square samples. 220 V, 50 Hz, 1 ph

27-WF2304/Z

Same as above but 110 V, 60 Hz, 1 ph

Accessories

27-WF2304/1

150 mm squared sample insert of coated steel for 300 mm shearbox to be used with model 27-WF2304

27-WF2304/1S

150 mm squared sample insert of stainless steel for 300 mm shearbox to be used with model 27-WF2304/inox

27-WF2304/2

Two additional platens 300x300 mm made of coated steel for non-granular material

27-WF2304/2S

Two additional platens 300x300 mm made of stainless steel for non-granular material

Template for data processing

30-WF6008/T2

Direct and residual shear Geo-Analysis template conforming to BS 1377:7

or as alternative:

30-WF6008/T9

Direct and residual shear Geo-Analysis template conforming to ASTM D3080



Automatic Ring shear machine

27-WF22E02

Fully automatic ring shear machine featuring residual shear testing



TORSHEAR

STANDARD

- ▶ ASTM D6467 ▶ ASTM D7608
- ▶ BS 1377:7
- ▶ BS EN 17892-10



Detail of 40 cm² stainless steel ring shear box fitted with easily removable sintered porous stones with specialized pattern design.



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

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

FEATURES AND BENEFITS

- » Fully automatic standalone ring shear soil testing system managed by local user interface with 6" touch screen high resolution color display for performing torsional ring shear test in drained condition to determine the residual shear strength of cohesive soil.
- » Environmentally friendly and quiet - the Torshear EmS benefits from the new Electromechanical Servoactuation (EmS) technology. It requires neither dead weights nor large and noisy air compressors
- » It requires neither dead weights nor large and noisy air compressors
- » Lightweight and compact system is easy to handle, can be located on a standard bench, has a small footprint and maximizes the use of space in your laboratory. Smart and easy-to-use system with removable load cells and displacement transducers simplifies testing, maintenance and calibration.
- » Modular and expandable — the optional dedicated software allows you to gradually connect up to six units via LAN port using the same PC enabling you to build your laboratory without interruption and resulting in excellent return on investments.
- » High-performing with maximum vertical stress 1,200 kPa and maximum shear stress 1,000 kPa, infinite variable speed from 0.00001 to 1000°/min, with pre-shearing stage selectable and adjustable number of cycles of shearing.
- » Less than 800 mm wide, the system can be placed on a standard laboratory bench, without the need for a separate stand.

Consolidation bench

27-WF0226 CONSOLIDATION BENCH FOR SHEAR BOXES

Used to apply a constant load on a sample placed on a shear box to reduce the testing time when more than one sample has to be tested and only one shear machine is available.



MAIN FEATURES

- » 3 loading jokers and hangers
- » 3 lever-arm loading devices with a load amplification ratio of 10:1
- » Holds up to 3 shear boxes
- » Can be equipped with analog or digital mode
- » Dimensions (wxdxh): 2310 x 500 x 1215mm
- » Weight. 120 kg approx..

ACCESSORIES

Analog measuring device

30-WF6401
Dial gauge, 12 mm travel, 0.002 mm resolution.

Electronic measuring devices

30-WF6207
Linear potentiometric transducer, 10 mm travel.

Data acquisition and processing system

See page 84

Weight sets

See page 56



Detail of shear box case fitted in analog mode



Detail of shear box case fitted in electronic mode

Laboratory vane apparatus

27-WF1730 LABORATORY VANE APPARATUS

The laboratory vane apparatus is based on an original concept of the Transport and Road Research Laboratory of the United Kingdom. This test method covers the miniature vane test in very soft to stiff saturated fine-grained clay-type soils.

MAIN FEATURES

- » Includes one vane 12.7 x 12.7 mm
- » Supplied with four calibrated springs
- » The test can be performed directly on the sample or in the sample contained in the sampling tube using holding sampling tubes attachments
- » Motorizing attachment is also available conforming to ASTM or BS standard
- » Weight. 11 kg approx.



27-WF1730 Laboratory vane apparatus

ACCESSORIES

Alternative Vanes

Model	D	H
27-WF1732	25.4	25.4
27-WF1733	12.7	25.4
27-WF1734	12.7	19



Detail of motorizing attachment



Motorizing attachment

Model	Standard	Speed [°/min]	Voltage
27-WF1730/2	BS 1377:7	6 to 12°	220V,50Hz, 1ph
27-WF1730/2Y	BS 1377:7	6 to 12°	220V,60Hz, 1ph
27-WF1730/3	ASTM D4648	60 to 90°	220V,50Hz, 1ph
27-WF1730/3Y	ASTM D4648	60 to 90°	220V,60Hz, 1ph
27-WF1730/4	ASTM D4648	60 to 90°	110V,60Hz, 1ph

Holding sampling tubes attachment

27-WF1736
Attachment to hold sample tubes of 38 and 100 mm dia.



TRIAXIAL SYSTEMS

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The stress-strain behavior of soil is typically investigated with a triaxial test on undisturbed, remoulded or compacted specimens which are subjected to different stress levels and variable drainage conditions, simulating as closely as possible the site conditions and the effects of constructions, excavations, embankments, landslides, wave propagation, and seismic events.

Types of triaxial test: test descriptions

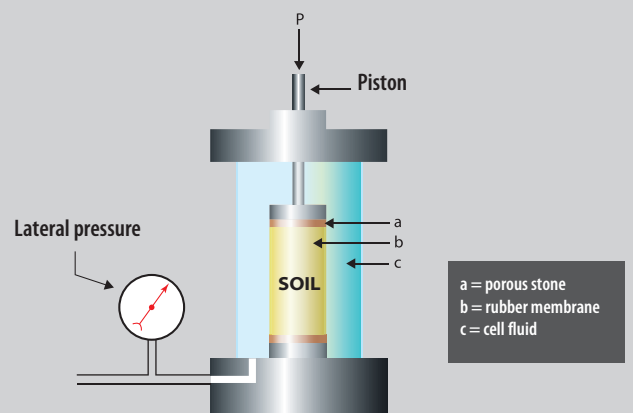
TOTAL STRESS - UNCONSOLIDATED UNDRAINED (UU) TEST

STANDARD

▶ ASTM D2850 ▶ BS 1377:7 ▶ EN17892-8 ▶ NF P94 070 ▶ NF P94 074

With this method the shear strength is measured in terms of total stress. The soil specimen is not allowed to consolidate and maintains its original structure and water content, so that its compressive strength depends only on the level of geostatic stress in the field.

Tests are often carried out on three specimens from the same sample, each subjected to a different confining pressure. Provided that the soil is fully saturated, the shear strength will be the same for each test and is known as "undrained shear strength".



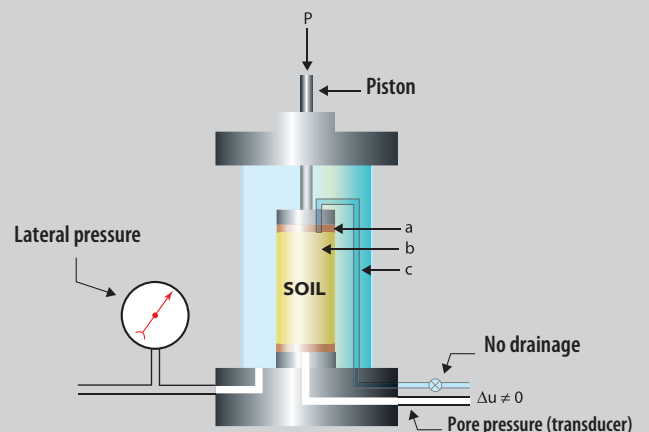
EFFECTIVE STRESS - CONSOLIDATED UNDRAINED (CU) TEST

STANDARD

▶ ASTM D4767 ▶ BS 1377:8 ▶ EN 17892-9 ▶ NF P94 070 ▶ NF P94 074

With this test method the shear strength is measured in terms of effective stress. The specimen is saturated and allowed to consolidate (i.e. to change its structure and water content) at the required confining pressure. At the end of consolidation, the specimen is subjected to a controlled application of load, during which no drainage is allowed and pore pressure is measured. The effective stresses are calculated as the difference between the total stress and the pore pressure.

Since the shear strength is affected by the effective stresses, by testing a set of three specimens at different confining pressures, it is possible to define the failure envelope according to Coulomb's model and define the parameters c' and ϕ' .

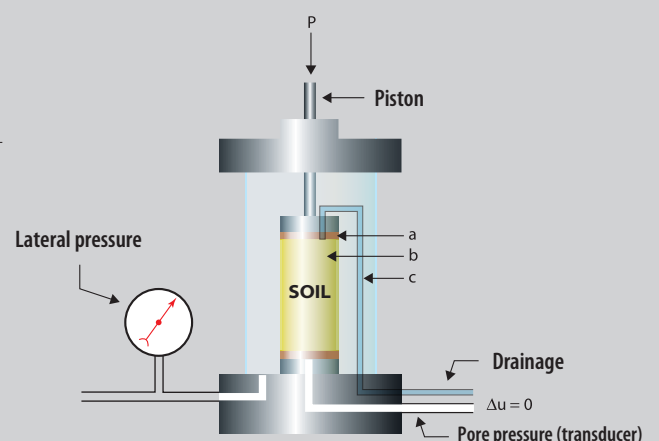


EFFECTIVE STRESS - CONSOLIDATED DRAINED (CD) TEST

STANDARD

▶ ASTM D7181 ▶ BS 1377:8 ▶ EN 17892:9 ▶ NF P94 070 ▶ NF P94 074

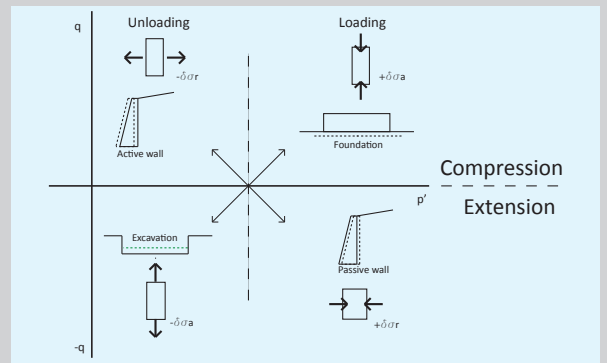
This test method is the same as the CU test except that the failure stage is carried out very slowly to prevent any change in the pore pressure inside the specimen, which is allowed to drain. Calculation of the total and effective stresses and failure envelope are also the same as for the CU test.



STRESS PATH TEST

Events on site such as excavation, construction or natural occurrences can produce changes in the magnitude and ratio of the principal stresses (major and minor). In a stress path test the horizontal and vertical pressures applied to the specimen are managed independently, which allows the behaviour of a soil subjected to anisotropic loading and unloading to be replicated and measured in the laboratory.

This test can only be accurately and reliably performed with an automatic servo-controlled closed-loop system.



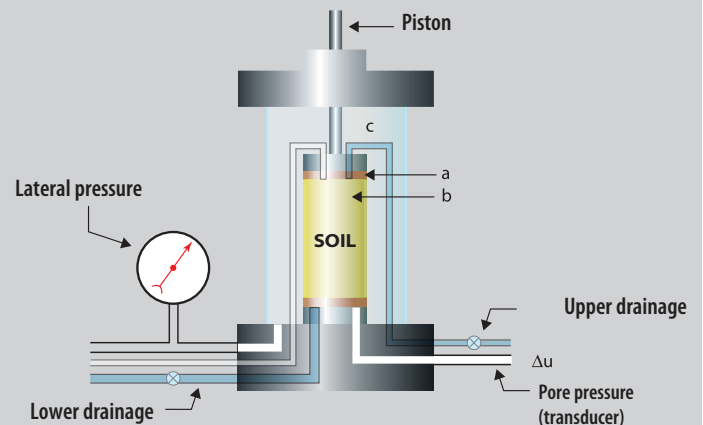
PERMEABILITY TEST IN A TRIAXIAL CELL

STANDARD

▶ ASTM D5084 · BS 1377:6 · CEN-ISO/TS17892-11

The triaxial permeability test involves saturating and consolidating the specimen to the required effective stress in the same way as for a CD or CU test, but instead of a failure stage, water is allowed to flow through the specimen under a pre-defined difference of pressure and the rate of flow is measured. From this measurement the soil permeability is calculated.

Three independent pressure systems are used for this test; for the confining pressure, the drainage line to the top of the specimen and the drainage line to the base of the specimen.



UNSATURATED SOIL TEST

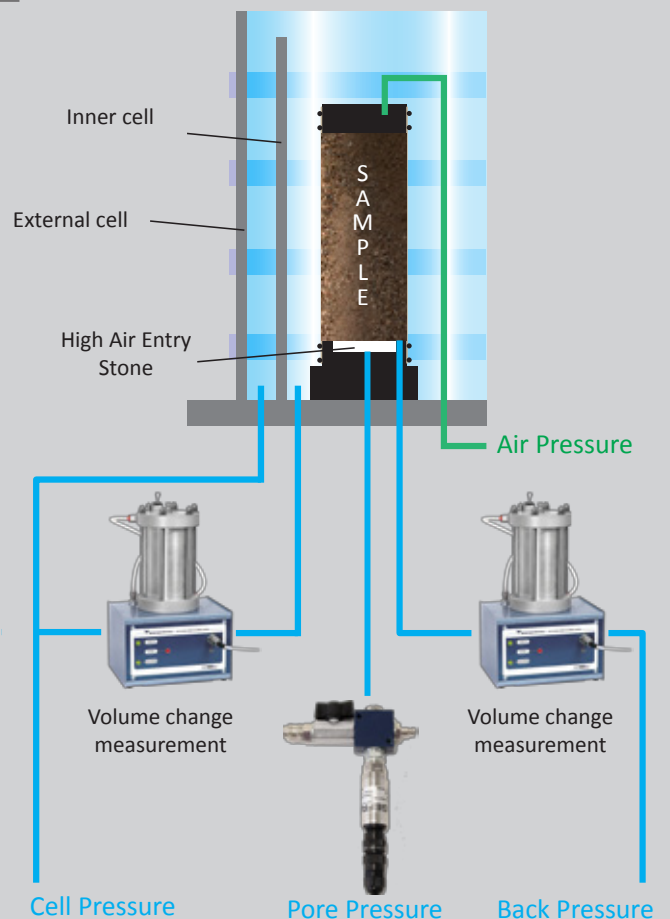
An unsaturated testing system is used when effective stress testing is required that recreates in-situ conditions of specimens that exist in a naturally unsaturated state (for example soil that is higher than the water table).

In an unsaturated soil, the voids between soil particles are filled with both air and water, and surface tension forces create a negative pore water pressure (or suction) which pulls the soil particles together and increases the strength of the soil. Saturating the soil (replacing the air in the voids with water) results in a positive pore water pressure which pushes the soil particles apart and reduces the overall strength. Because of this, it is not desirable to saturate unsaturated or partially saturated material, but neither can it be tested using conventional triaxial systems because the negative suction causes problems with the equipment.

The solution to this problem is to use what is known as the axis translation method, which involves applying an air pressure via the top cap (in the same way as a water back pressure in a saturated test). This raises the pressure inside the sample to a positive value which, in turn, applies a positive pressure to the porous stone and to the pore water pressure transducer.

A special triaxial cell is used for the test, with a double wall which allows the total change in sample volume to be measured, and a high air entry stone in the base pedestal that allows water to pass but not air.

Using the axis translation method with the double-wall cell allows effective stress testing to be carried out on unsaturated material.



TRIAXIAL SYSTEMS

With 75 years of expertise, Wykeham Farrance is the soil testing specialist. We have recently launched a new generation of Triaxial Systems, which are strictly compliant with International Standards. The following pages detail our 4 triaxial systems with increasing levels of sophistication. Coupled with a wide range of accessories presents a vast array of more than 8,000 configurations, which satisfies any customer requirement.



■ **Triaxial System with analog measurements** is the ideal basic solution to perform standard triaxial tests, such as effective and total stress, for laboratories that don't require digital measurement. All the data acquisition and test management are made in manual mode.



■ **Triaxial System with automatic built-in data acquisition** is the simplest compact solution for standard triaxial testing (effective and total stress). It can be equipped with standard air/water interface pressure system or with automatic pressure/volume controllers. No requirement for external data acquisition and/or PC.



■ **Triaxial System with automatic external data acquisition** is the expandable compact solution for standard triaxial testing (effective and total stress) and for many other soil tests. It can be equipped with standard air/water interface pressure system or with automatic pressure/volume controllers. Data acquisition can be shared with other soil testing equipment (e.g. consolidation and shear) acquisition and/or PC.

■ **Fully Automatic PC controlled Triaxial System AUTOTRIAX 2:** the advanced triaxial testing system that can automatically and contemporaneously run up to 6 independent tests without human intervention.

Standard triaxial system with analog measurements

STANDARD

- ▶ BS 1377:7 ▶ BS 1377:8 ▶ BS 1377:6 ▶ ASTM D2850
- ▶ ASTM D4767 ▶ ASTM D7181 ▶ ASTM D5084
- ▶ EN 17892: 8 ▶ EN 17892: 9

Standard triaxial system with analog measurement is the ideal basic solution for performing standard triaxial tests such as effective and total stress laboratories that don't require digital measurement. All the data acquisition and test management are made in manual mode.

Power supply is only required for air compressor and for triaxial load frame during failure stage.

Standard triaxial configuration with analog measurement can be easily extended in subsequent steps, in order to perform additional triaxial tests or it is also suitable for future upgrade to digital measurement system.

TEST

- Total Stress (UU)
- Effective Stress (CU,CD)
- Permeability
- Unconfined
- CBR
- Others



MAIN FEATURES

- » Fully analog data measurement using dial gauge, load ring, double burette and pore pressure manometer;
- » Measuring with dedicated manometer, ensuring a negligible change in volume of the circuit of the pore pressure, as required by the Standards;
- » Pressure system using air/water interface and triaxial panel with air pressure regulators;
- » Easily extended with dedicated accessories to perform additional tests such as permeability, unconfined, CBR, etc.;
- » Easily upgradable to digital measurement system

SYSTEM COMPONENTS

- Load frames: TRIAX or TRITECH	page 68
- Triaxial cell: Standard or Banded	page 71
- Pressure System: Air/water interface	page 77
- Analog measuring system	page 78
- De - airing System	page 82

More than 400 system configurations are available depending on type of test, sample size, pressure system. Please contact us for full details.

Standard triaxial system with built-in digital data acquisition

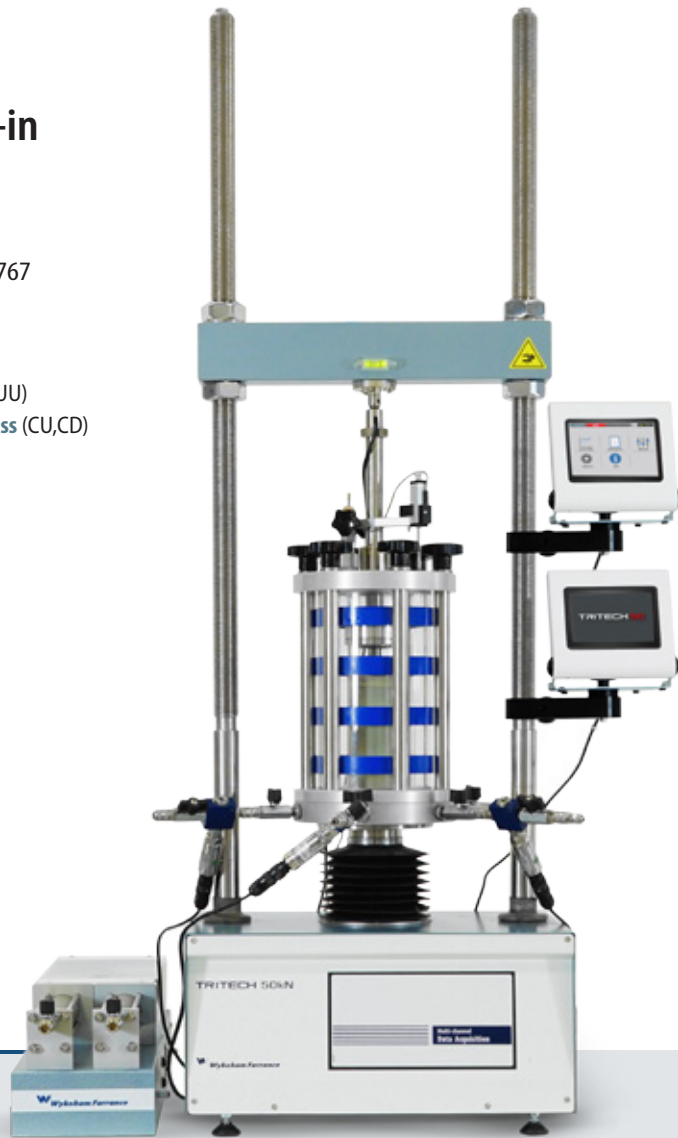
STANDARD

- ▶ BS 1377:7 ▶ BS 1377:8 ▶ BS 1377:6 ▶ ASTM D2850 ▶ ASTM D4767
- ▶ ASTM D7181 ▶ EN 17892: 8 ▶ EN 17892: 9

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Standard triaxial system with built-in digital data acquisition measurement is the ideal compact solution for performing standard triaxial tests such as effective and total stress for educational customers not needing external data acquisition and PC. All data is saved to a flash memory stick.

- TEST**
- Total Stress (UU)
 - Effective Stress (CU,CD)
 - Unconfined
 - CBR
 - Others



MAIN FEATURES

- » On-board (via USB) automatic data acquisition for all the sensors required (vertical displacement, axial force, cell pressure, back pressure, pore pressure, volume change);
- » User friendly 6" touch screen color panel for local control of load frame and monitoring of the four channels in real time;
- » PC not strictly required for test management: tests can be easily managed from the 6" touch screen;
- » Compact configuration with small footprint;
- » Additional control mode, including machine and data acquisition via remote PC and software;
- » Additional package for data processing and reporting, fully compliant with ASTM and BS-EN standards

Additional FEATURES with Hydromatic Standalone solution

- » Easier installation and saving space: compressed air apparatus, control panels and ancillary air/water systems no longer required;
- » Closed loop automatic control and management of cell and back pressure;
- » User friendly 6" touch screen color panel for local control of pressure and measurement in real time of pressure and volume change;
- » Ergonomic and versatile support of the control panel to be adjusted according the user's preferences.

SYSTEM COMPONENTS

- Load frames: TRIAX 4C or TRITECH 4C page 69
- Triaxial cell: Standard or Banded page 71
- Pressure System:
Air/water interface or HYDROMATIC STANDALONE page 76
- Digital measuring system page 79
- Template for data processing and reporting page 85
- De - airing System page 82

More than 2000 system configurations are available depending on type of test, sample size, pressure system. Please contact us for full details.

Standard triaxial system with external/expandable data acquisition

STANDARD

- BS 1377:7 ▸ BS 1377:8 ▸ BS 1377:6 ▸ ASTM D2850 ▸ ASTM D4767
- ASTM D7181 ▸ ASTM D5084 ▸ EN 17892: 8 ▸ EN 17892: 9

Standard triaxial system with external digital data acquisition measurement is the ideal expandable solution for performing standard triaxial tests such as effective and total stress in commercial laboratories needing central data acquisition to be shared with others machines.

TEST

- Total Stress (UU)**
- Effective Stress (CU,CD)**
- Permability**
- Unconfined**
- CBR**
- Unsaturated**
- Others**



MAIN FEATURES

- » Expandable solution, suitable not only for standard triaxial testing (effective/total stress) but also for other types of soil testing;
- » Data acquisition shared with other soil testing equipment: the transducers can be grouped and combined by the user for matching different applications;
- » PC software for remote calibration of the channels and fully comprehensive data acquisition management;
- » Multiple and flexible triaxial configuration (e.g. one frame and three cells) to perform simultaneously saturation, consolidation and monotonic shear;
- » Additional package for data processing and reporting, fully compliant with ASTM and BS-EN Standards.

Additional FEATURES with Hydromatic Standalone solution

- » Easier installation and saving space: compressed air apparatus, control panels and ancillary air/water systems no longer required;
- » Closed loop automatic control and management of cell and back pressure;
- » User friendly 6" touch screen color panel for local control of pressure and measurement in real time of pressure and volume change;
- » Ergonomic and versatile support of the control panel to be adjusted according the user's preferences;
- » LAN connection to the GEODATALOG8: pressure and volume measurements can be easily synchronized with the other readings and transmitted at the same time to a PC

SYSTEM COMPONENTS

- Load frames: TRIAX or TRITECH page 68
- Triaxial cell: Standard or Banded page 71
- Pressure System: Air/water interface or HYDROMATIC STANDALONE page 76
- Digital measuring system page 79
- Template for data processing and reporting page 85
- De - airing System page 82

More than 2500 system configurations are available depending on type of test, sample size, pressure system. Please contact us for full details.



Automatic PC Controlled triaxial system

The optimization of advanced technologies in hardware and software components for high efficiency triaxial tests



AUTOTRIAX^{EmS}

STANDARD

- ▶ BS 1377:7 ▶ BS 1377:7 ▶ BS 1377:8 ▶ BS 1377:6
- ▶ ASTM D2850 ▶ ASTM D4767 ▶ ASTM D7181 ▶ ASTM D5084
- ▶ EN 17892: 8 ▶ EN 17892: 9

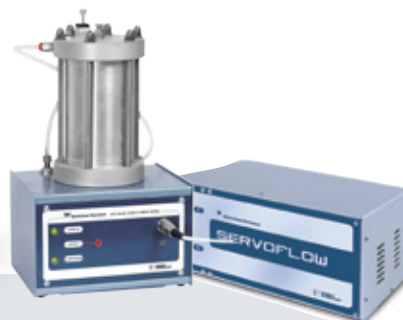


This is one of the many **ADVANCED** products of **CONTROLS** Group range.

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

FEATURES and BENEFITS

- » 24/7 testing without interruption, maximizing productivity and reducing demands on your staff.
- » Multitasking, user friendly Windows-based, the PC software complies with relevant standards.
- » Automatic execution of up to six independent triaxial tests from start to finish with only one PC
- » Real time display of all the transducers and calculated data for all live tests, with plots of measured and calculated data selectable by the user.
- » Automatic control in real time of standard and non-standard tests (e.g. stress path tests)
- » Ability to install software and fit additional accessories as required will enable the Autotriax EmS to perform many types of tests.
- » The modular concept of the Autotriax EmS for easy expansion and upgrade.
- » External factors and inconsistencies between different operators are minimized; test procedures are always repeatable and compliant.
- » High-speed PC closed loop control for continuous monitoring and instantaneous reaction of systems components.



AUTOTRIAX2

DATA ACQUISITION AND CONTROL UNITS

- It manages pressure/volume controller, load frames, cell and back pressures, solenoid valves and transducers
- Transmits data and information between the software and all the active components
- Calibration data of connected transducers are saved in the firmware of the units
- Four different versions are available to offer maximum flexibility
- The modular design concept allows easy extension of the system

HYDRUMATIC

PRESSURE AND VOLUME CONTROLLER

- Generates water pressure regulated under closed-loop control up to 3500 kPa or 1700 kPa
- Powers up to two hydraulic pressure lines and measures both the associated volume changes
- Measure pressure and volume change with high-resolution, respectively 0.1 kPa and 0.001 cc
- High volume capacity 250 cc
- No air compressor required

SERVOFLOW

AIR PRESSURE CONTROLLER AND WATER VOLUME CHANGE FOR UNSATURATED SOIL TESTS

- Automatic control of air pressure for unsaturated soil testing
- Low air consumption
- Measures the total volume change of an unsaturated soil sample in the double-wall triaxial cell
- Up to 1000 kPa air pressure regulation
- Volume change has a physical capacity up to 100cc, but thanks to automatic switching it can measure automatic volume change continuously

Deviator and shear stress plotted against axial strain during a monotonic shear stage (left), a saturation cell pressure increments with the graph showing the pore water pressure responding as the cell pressure is increased to the target



DEVICE MANAGEMENT SOFTWARE

Designed for setting up the configuration and allocation of the components of each triaxial system

TEST SOFTWARE

EFFECTIVE and TOTAL STRESS

Automatic or manual control of saturation, consolidation (for effective stress tests) and shear stage, according to ASTM and BS.

STRESS PATH MODULE ⁽¹⁾⁽²⁾

Activation code for stress path stages, with independent control of axial and radial stresses.

K₀ MODULE ⁽¹⁾⁽²⁾

Activation code for K₀ stages, with closed-loop control of the cross-sectional area of the soil sample.

PERMEABILITY MODULE ⁽¹⁾

Activation code for automatic or manual control of triaxial permeability stages.

UNSATURATED SOIL MODULE ⁽¹⁾

Activation code for automatic or manual control of unsaturated soils – axis translation method.

CRS – CONSTANT RATE OF STRAIN ⁽¹⁾

Activation code for automatic or manual control of Constant Rate of Strain

CBR – CALIFORNIA BEARING RATIO ⁽¹⁾

Activation code for CBR test

UNCONFINED ⁽¹⁾

Activation code for Unconfined test

(1) An additional license must be purchased to unlock this module

(2) A vacuum top cap and submersible load cell must be used for tests with stages in extension



Triaxial system components and accessories:

Triaxial load Frames

WYKEHAM FARRANCE's electro-mechanical TRITECH machines are the original high-performance load frames for triaxial tests. Introduced by the company over 50 years ago, they have undergone continuous development and are the ideal solution for advanced and research laboratories that want to perform high quality tests at high levels of productivity. High performance series, 50 and 100 kN cap., in two versions: standard (28-WF4005 and 28-WF4010) and with built-in data acquisition (28-WF4005/4C and 28-WF4010/4C), particularly suitable for advanced and research laboratories.

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TRITECH

28-WF4005, 28-WF4005/4C, 28-WF4010, 28-WF4010/4C

Common FEATURES

- » Ideal solution for advanced and research laboratories that require high productivity levels and high quality tests
- » Designed for soil testing laboratories conducting UU, CU, CD and stress path* (compression/extension) tests
- » Due to the variable speed range, unconfined, CBR and Marshall tests can also be performed
- » Suitable for automatic PC-controlled triaxial testing (see AUTOTRIAX EmS system)*
- » Maximum compression capacity: 50 kN or 100 kN
- » Speed range from 0.00001 to 99.99999 mm/min
- » Maximum sample diameter (for triaxial testing): 150 mm
- » The quality of the design avoids vibrations that may affect the specimen
- » Large high-contrast 4 x 20-character display with 6-key membrane keyboard*

*Only for model 28-WF4005 and WF4010

Ordering information

28-WF4005

Tritech50, Triaxial load frame 50 kN capacity 110-240 V, 50-60 Hz, 1 ph

28-WF4010

Tritech100, Triaxial load frame 100 kN capacity 110-240 V, 50-60 Hz, 1 ph

28-WF4005/4C

Tritech50, Triaxial load frame 50 kN capacity with 4 channels built-in data acquisition 110-240 V, 50-60 Hz, 1 ph

28-WF4010/4C

Tritech100, Triaxial load frame 100 kN capacity with 4 channels built-in data acquisition 110-240 V, 50-60 Hz, 1 ph



TRITECH 50 and TRITECH 100 fitted with banded triaxial cell submersible load cell and pore pressure transducer

Models	28-WF4005	28-WF4010	28-WF4005/4C	28-WF4010/4C
4 built-in channels			●	●
Maximum sample diameter, mm	150	150	150	150
Minimum testing speed, mm/min	0.00001	0.00001	0.00001	0.00001
Maximum testing speed, mm/min	99.99999	99.99999	99.99999	99.99999
Maximum compression force, kN	50	100	50	100
Maximum tensile force, kN	5	5	5	5
Minimum vertical clearance, mm	335	390	335	390
Maximum vertical clearance, mm	1100	1140	1100	1140
Horizontal clearance, mm	364	498	364	498
Platen diameter, mm	158	158	158	158
Platen travel, mm	100	100	100	100
Dimensions, mm (h x w x d) (approx.)	1460 x 505 x 380	1830 x 600 x 520	1460 x 655 x 380	1830 x 750 x 520
Power, W	600	680	600	680
Weight, kg (approx.)	98	120	98	120

Triaxial load Frames

Standard triaxial system with built-in digital data acquisition measurement is the ideal compact solution for performing standard triaxial tests such as effective and total stress for educational customers not needing external data acquisition and PC. All data is saved to a flash memory.

TRITECH

28-WF4005/4C , 28-WF4010/4C

Additional FEATURES

- » Wide 6" waterproof touch screen color graphic display allowing machine control, stream on screen data plot and tabulation;
- » Double control mode including machine and data acquisition via local touch screen display or from remote PC (not included) and software (included);
- » USB port to connect a memory stick (included with the machine) for test data storage;
- » Effective sampling rate up to 50 / sec;
- » LAN communication;
- » Automatic test start and stop according to preset conditions;
- » Local and remote transducers calibration through the dedicated software;
- » Graphical and numerical display of readings;
- » Multi-jointed display support.

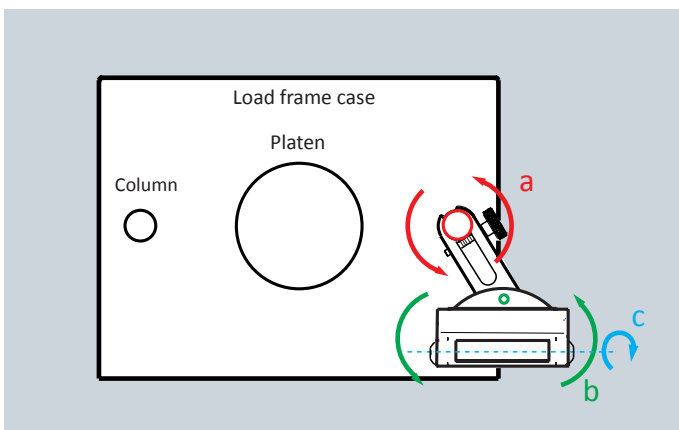
TRITECH 50 e TRITECH 100 with 4 built-in channels fitted with banded triaxial cell submersible load cell and pore pressure transducers



Detail of the Trittech legendary gearbox, The system is designed to minimize the vibration and allow smooth transmission



The touchscreen controller is mounted on an ergonomic, multi-jointed support that allows its position to be adjusted in four different ways: changing the height of the support; rotating the support (a); swiveling the touchscreen (b); tilting the touchscreen (c)



Triaxial system components and accessories:

Triaxial load Frame

WYKEHAM FARRANCE's electro-mechanical TRIAX machines have been specifically designed for triaxial applications and are ideal for commercial laboratories that need a versatile machine capable of performing a wide range of tests.

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TRIAX

28-WF4001 and 28-WF4001/4C

Common FEATURES

- » Ideal solution for commercial laboratories a machine to perform high quality triaxial tests in addition to unconfined and general purpose compression tests.
- » Designed for soil testing laboratories to perform UU, CU and CD triaxial tests on samples from 38 to 70 mm diameter.
- » Maximum load frame capacity: 50 kN
- » Maximum testing load depending on the selected test speed (variable from 40 to 7 kN). The choice of the opportune load cell capacity shall take into account this value
- » Speed range from 0.00001 to 50.8 mm/min
- » Large high-contrast 4 x 20-character display and 6-key membrane keyboard*
- » Maximum sample diameter (for triaxial testing): 70 mm

*Only for model 28-WF4001



TRIAX fitted with standard triaxial cell, dial gauge and load rings; TRIAX with 4 built-in channels fitted with standard triaxial cell, external load cell and displacement transducer.

TRIAX

28-WF4001/4C

Additional FEATURES

- » Wide 6" waterproof touch screen color graphic display allowing machine control, stream on screen data plot and tabulation;
- » Double control mode including machine and data acquisition via local touch screen display or from remote PC (not included) and software (included);
- » USB port to connect a memory stick (included with the machine) for test data storage;
- » Effective sampling rate up to 50 / sec;
- » LAN communication;
- » Automatic test start and stop according to preset conditions;
- » Local and remote transducers calibration through the dedicated software;
- » Graphical and numerical display of readings;
- » Multi-jointed display support.

Model	28-WF4001	28-WF4001/4C
4 built-in channels		●
Maximum sample diameter, mm	70	70
Minimum testing speed, mm/min	0.00001	0.00001
Maximum testing speed, mm/min	50.8	50.8
Maximum load frame capacity, kN	50	50
Minimum vertical clearance, mm	390	390
Maximum vertical clearance, mm	725	725
Horizontal clearance, mm	380	380
Platen diameter, mm	158	158
Platen travel, mm	100	100
Dimensions, mm (h x w x d) (approx.)	1250 x 495 x 495	1250 x 645 x 495
Power, W	600	600
Weight, kg (approx.)	90	90

Ordering information

28-WF4001
Triax, Triaxial load frame 50 kN capacity 110-240 V, 50-60 Hz, 1 ph

28-WF4001/4C
Triax, Triaxial load frame 50 kN capacity with 4 channels built-in data acquisition 110-240 V, 50-60 Hz, 1 ph

Triaxial system components and accessories:

Standard Triaxial Cells

Standard triaxial cells essentially consist of a transparent polycarbonate chamber which has a top plate with a piston assembly fitted into it and a double flange base fitted to the bottom. Three (or six) simple thumb-screws are used to clamp the upper part of the cell to the base, which makes assembly and disassembly a very quick and simple operation.

Main FEATURES

- » Maximum working pressure of 1700 kPa
- » Light alloy construction, stainless steel ram and O-ring seal
- » Suitable for submersible and/or external load cell
- » Four on/off no-volume changes valves fitted as standard
- » For sample sizes between 35 and 100 mm dia.
- » Suitable for total and effective stress tests
- » Rapid assembly design
- » Cells are designed to accommodate a specimen with a height twice its diameter
- » Pedestal, top caps, porous disc, rubber membranes and sealing rings are not included. See accessories.



Ordering information

28-WF0410/B

Standard triaxial cell for 35, 38 and 50 mm diameter samples

28-WF0411/B

Standard triaxial cell for 35, 38, 50 and 70 mm diameter samples

28-WF0416/B

Standard triaxial cell for 70 and 100 mm diameter samples

ACCESSORIES

Pedestal

Cell code 28- Sample diameter, mm	28-WF0410/B	28-WF0411/B	28-WF0416/B
35	28-WF0410/A1	28-WF0411/A1	
38	28-WF0410/A2	28-WF0411/A2	
50	28-WF0410/A3	28-WF0411/A3	
70		28-WF0411/A4	28-WF0416/A1
100			28-WF0416/A2

Test	28-WF0410/B	28-WF0411/B	28-WF0416/B
Effective stress/Total stress	●	●	●

Model	28-WF0410/B	28-WF0411/B	28-WF0416/B
Nominal size diameter mm	50	70	100
For spec. size diameter mm	35 to 50	35 to 70	35 to 100
Max. working pressure [kPa]	1700	1700	1700
Max. height [mm]	450	500	560
Inlet points for top/bottom drainage, cell pressure, and pore pressure	4	4	4
Quick coupling for two drainage lines on the base	Included	Included	Included
Diameter mm (including valves)	270	310	340
Weight approx.[kg]	5	8	15



Detail of standard triaxial cell fitted with submersible load cell

Top Cap and Accessories

	Sample dimension	35	38	50	70	100
1	Top cap	28-WF0420/A3	28-WF0422/A3	28-WF0425/A3	28-WF0428/A3	28-WF0432/A3
2	Pair of porous discs	28-WF0420/A4	28-WF4034	28-WF4054	28-WF4074	28-WF4104
3	Membrane, 10 pieces	28-WF0420/A5	28-WF4035	28-WF4055	28-WF4075	28-WF4105
4	O Rings, 10 pieces	28-WF0420/7	28-WF4036	28-WF4056	28-WF4076	28-WF4106
5	Membrane stretcher	28-WF0420/8	28-WF4031/A	28-WF4051/A	28-WF4071/A	28-WF4101/A
6	O Ring placing tool	28-WF0420/10	28-WF4031/B	28-WF4051/B	28-WF4071/B	28-WF4101/B
7	Two part split former	28-WF0420/A6	28-WF0422/A6	28-WF0425/A6	28-WF0428/A6	28-WF0432/A6
8	Two part split mould	28-WF0420/13	28-WF4031/D	28-WF4051/D	28-WF4071/D	28-WF4101/D
9	Lateral filter drains, pack of 50	28-WF0420/A9	28-WF4031/E	28-WF4051/E	28-WF4071/E	28-WF4101/E
10	Filter discs, pack of 100	28-WF0420/5	28-WF4031/F	28-WF4051/F	28-WF4071/F	28-WF4101/F
11	Hand sampler	28-WF0420/9	28-WF4031/G	28-WF4051/G	28-WF4071/G	28-WF4101/G

28-WF4005/39

Platen adapter to fit standard triaxial cell (model 28-WF0410/B) onto TRITECH50

28-WF0410/B5

Piston locking device to hold the triaxial cell ram on triaxial cell model 28-WF041X/B



Standard triaxial cell, fitted with submersible load cell, displacement transducer



Triaxial cell and sample preparation accessories

Triaxial system components and accessories:

Banded triaxial cells

Banded triaxial cells essentially consist of a transparent chamber which is banded to prevent excessive expansion during the test. The design of the cell ensures vertical alignment of the loading ram by clamping the Perspex wall separately from the cell top. From 28-WF4070 to 28-WF4150 cells can be fitted with an upgrading kit so that tests can be performed using local strain transducers and bender elements.



Ordering information

28-WF4050
Banded triaxial cell for 38 and 50 mm diameter samples

28-WF4070
Banded triaxial cell for 38, 50 and 70 mm diameter samples

28-WF4100
Banded triaxial cell for 38, 50, 70, 100 mm diameter samples

28-WF4150
Banded triaxial cell for 38, 50, 70, 100, 150 mm diameter samples.

Main FEATURES

- » Maximum working pressure of 2000 kPa or 3500 kPa (28-WF4050; 28-WF4070)
- » Light alloy construction, stainless steel ram and O-ring seal
- » Built-in cell ram clamp
- » Five on/off no-volume changes valves fitted as standard
- » For sample sizes between 38 and 150 mm diameter
- » Suitable for submersible and/or external load cell
- » Rapid assembly design
- » Cells are designed to accommodate a specimen with a height twice its diameter
- » Pedestal, top caps, porous disc, rubber membranes and sealing rings are not included. See accessories.
- » Suitable perform stress path tests and dynamic test using a vacuum attachment (28-WF4070; 28-WF4100; 28-WF4150)
- » Can be upgraded with an advanced kit making them compatible with mini on sample transducers and bender elements (28-WF4070; 28-WF4100; 28-WF4150)

ACCESSORIES

Pedestal

Cell code Sample diameter mm	28-WF4050	28-WF4070	28-WF4100	28-WF4150
38	28-WF4031/5	28-WF4031/7	28-WF4031/10	28-WF4031/15
50	28-WF4051/5	28-WF4051/7	28-WF4051/10	28-WF4051/15
70		28-WF4071/7	28-WF4071/10	28-WF4071/15
100			28-WF4101/10	28-WF4101/15
150				28-WF4151/15



Model	28-WF4050	28-WF4070	28-WF4100	28-WF4150
Nominal size diameter (mm)	50	70	100	150
Diameter range (mm)	38 to 50	38 to 70	38 to 100	38 to 150
Max. working pressure (kPa)	3500	3500	2000	2000
Max. height [mm]	410	550	600	710
Inlet points for top/bottom drainage, cell pressure, and pore pressure	5	5	5	5
Quick coupling for two drainage lines on the base	Included	Included	Included	Included
Vacuum attachment for vacuum top cap for extension tests	o	Included	Included	included
Upgrading option for use of mini-on-sample transducers and bender elements	o	With 28-WF4070/ADV	With 28-WF4100/ADV	With 28-WF4150/ADV
Diameter including valves (mm)	350	400	440	520
Weight approx.[kg]	7	18	21	40

Test	28-WF4050	28-WF4070	28-WF4100	28-WF4150
Effective stress/Total stress	●	●	●	●
Stress path		●	●	●
Dynamic test		●	●	●
On sample/Bender elements		●	●	●

Top Cap and Accessories

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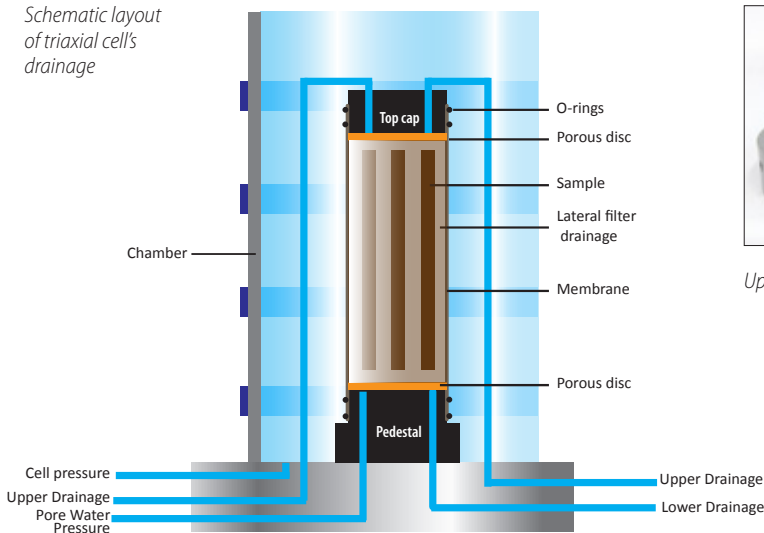


Triaxial cell and sample preparation accessories

	Sample dimension	38	50	70	100	150
1	Top cap	28-WF4032/A	28-WF4052/A	28-WF4072/A	28-WF4102/A	28-WF4152/A
2	Vacuum top cap*	28-WF4032/AV	28-WF4052/AV	28-WF4072/AV	28-WF4102/AV	28-WF4152/AV
3	Base disc	28-WF4033	28-WF-4053	28-WF4079	28-WF4103	28-WF4153
4	Pair of porous discs	28-WF4034	28-WF4054	28-WF4074	28-WF4104	28-WF4154
5	Membrane, 10 pieces	28-WF4035	28-WF4055	28-WF4075	28-WF4105	28-WF4155
6	O Rings, 10 pieces	28-WF4036	28-WF4056	28-WF4076	28-WF4106	28-WF4156
7	Membrane stretcher	28-WF4031/A	28-WF4051/A	28-WF4071/A	28-WF4101/A	28-WF4151/A
8	O Ring placing tool	28-WF4031/B	28-WF4051/B	28-WF4071/B	28-WF4101/B	28-WF4151/B
9	Two parts split mould	28-WF4031/D	28-WF4051/D	28-WF4071/D	28-WF4101/D	28-WF4151/D
10	Lateral filter drains, pack of 50	28-WF4031/E	28-WF4051/E	28-WF4071/E	28-WF4101/E	28-WF4151/E
11	Filter discs, pack of 100	28-WF4031/F	28-WF4051/F	28-WF4071/F	28-WF4101/F	28-WF4151/F
12	Hand sampler	28-WF4031/G	28-WF4051/G	28-WF4071/G	28-WF4101/G	-
13	Two part split former with vacuum attachment	28-WF4031/H	28-WF4051/H	28-WF4071/H	28-WF4101/H	28-WF4151/H

* Used for stress path and dynamic testing with dedicated triaxial cell with vacuum attachment

Schematic layout of triaxial cell's drainage



Upgrading kits, 28-WF4070/ADV, 28-WF4100/ADV, 28-WF4150/ADV

Triaxial system components and accessories:

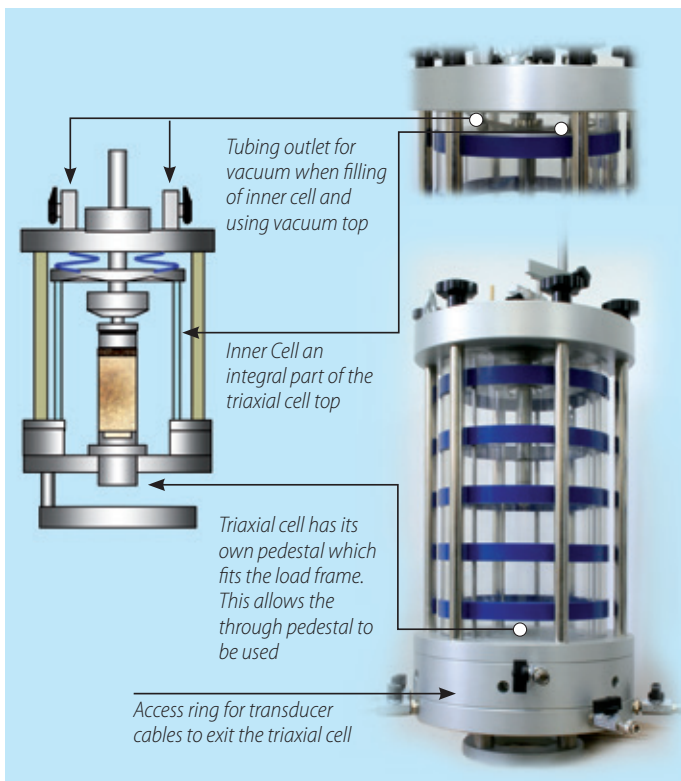
Double wall triaxial cell - Unsaturated Test

Double wall triaxial cell with inner wall, complete with access ring for transducer cables. The cell has to be completed with the base pedestal with High Entry Stone. See accessories. For detailed information and a complete test configuration please visit our website.

Main FEATURES

- » Ideal solution for measuring volume change in unsaturated soil test
- » To be used together with High Air Entry Stone mounted in the specific pedestal, for Axis translation method
- » Maximum working pressure up to 2000 kPa
- » Two models available up to 70 mm sample or up to 100 mm sample
- » Suitable for 50, 70 ,100 mm diameter sample
- » Including vacuum attachment for vacuum top cap for extension test suitable also for saturated soil sample
- » Different capacity of HAES from 1 bar up to 15 bar

Model	28-WF4170	28-WF4171
For spec. size diameter mm	50 to 70	50 to 100
Max. working pressure kPa	2000	2000
Max. height [mm]	690	795
Inlet points	5	5
Quick coupling for two drainage lines on the base	Included	Included
Vacuum attachment	Included	Included
Diameter mm (including valves)	478	535
Weight approx.[kg]	30	50



ACCESSORIES

Triaxial cell unsaturated pedestal.

Including 3 bar High Air Entry Stone (HAES).

Dia. mm	For cell 28-WF4170	For cell 28-WF4171
50	28-WF4170/50	28-WF4171/50
70	28-WF4170/70	28-WF4171/70
100	-	28-WF4171/100

Alternative High Air Entry Stones (HAES).

The 3 bar HAES included in the pedestal can be easily replaced with stones of 1, 5 or 15 max. pressure, as indicated in the following table.

Pedestal dia. mm	50	70	100
Max pressure			
1 bar	28-WF4150/1B	28-WF4170/1B	28-WF4171/1B
5 bar	28-WF4150/5B	28-WF4170/5B	28-WF4171/5B
15 bar	28-WF4150/15B	28-WF4170/15B	28-WF4171/15B

Components of pedestal set for unsaturated cell:

- 1) Pedestal for unsaturated test;
- 2) High Air Entry Stone HEAS) sealed on aluminum ring;
- 3) Aluminum compensation ring;
- 4) Aluminum plate for saturated soil test;
- 5) Porous stone for saturated soil test



Triaxial system components and accessories:

Pressure Systems

We propose three different systems:

- Oil/Water pressure apparatus
- Air/Water pressure system
- Hydromatic Standalone - pressure/volume controller

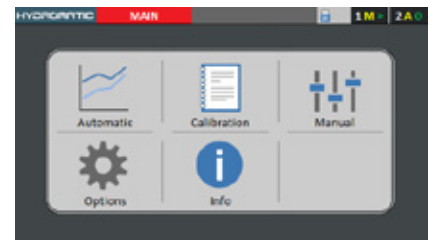
Each system has to be completed with the De-airing water system. See page 82

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HYDROMATIC

Standalone - pressure/volume controller

Hydromatic standalone is a general-purpose water pressure source and volume change controller. It is driven by a stepper motor, which enables the unit to measure the volume change.



Main Menu

Main FEATURES

- » Multi-positioning, ergonomic and removable 6" color touch screen controller
- » Powers one or two hydraulic pressure lines and measures the associated volume changes
- » Generates water pressure regulated under closed-loop control up to 3500 kPa or 1700 kPa
- » USB pen drive for local data storage
- » Connectable to the GEODATALOG 8 via LAN port allowing data transmission to PC by the DATACOMM 2 software
- » High resolution measurement of pressure (0.1 kPa) and volume change (0.001 cc)
- » High volume capacity, 250 cc
- » Lightweight with a small footprint,
- » No air compressor required

Ordering information

- 28-WF45DG**
HYDROMATIC standalone closed loop pressure/volume controller, 3500 kPa max. pressure. Powers two hydraulic pressure lines and measures the associated volume change. Supplied with pressure transducers and de-airing blocks. 110-240V, 50-60Hz, 1 ph
- 28-WF45SG**
HYDROMATIC standalone closed loop pressure/volume controller, same as above but powering one pressure line.
- 28-WF43DG**
HYDROMATIC standalone closed loop pressure/volume controller, 1700 kPa max. pressure. Powers two hydraulic pressure lines and measures the associated volume change. Supplied with pressure transducers and de-airing blocks. 110-240V, 50-60Hz, 1 ph
- 28-WF43SG**
HYDROMATIC standalone closed loop pressure/volume controller, same as above but powering one pressure line.



The Hydromatic body can be positioned vertically, for a compact arrangement of testing components



Auto Control: Automatic execution of pre-programmed steps of pressure and/or volume change

Note: on request traceable calibration certificates of pressure and volume measurement are available

Triaxial system components and accessories:

Pressure Systems

AIR/WATER PRESSURE SYSTEM AND CONTROL PANELS

Bladder air/water pressure cylinders

The system comprises the Distribution panel, Bladder cylinder (one for each pressure line) and Air compressor.

The cell, made from transparent acrylic tube, flanged between two light alloy discs, incorporate a rubber membrane and can operate continuously at a pressure up to 1000 kPa. The unit acts as a reservoir/interface between compressed air, used as a pressure source and water used as the pressurizing medium in the triaxial cell.



Main FEATURES

- » Used to deliver pressurized water up to 1000 kPa to triaxial cells by the pressure distribution panels.
- » High degree of accuracy
- » Bladder enables the use of de-aired water
- » Large reservoir to cope with long term tests and large samples
- » Dimensions: diameter 178 x 410 mm
- » Weight: 5.8 kg approx.

Pressure distribution panels

Two models available: 28-WF4330 for two pressure lines and 28-WF4331 for three pressure lines. They include precision air regulators, pressure outlets and quick release fittings.



28-WF4331 Three lines pressure

Ordering information

28-WF4320
Bladder air/water pressure cylinder

28-WF4330
Two lines pressure distribution panel, complete with air regulators and pressure outlets.

28-WF4331
Three lines pressure distribution panel, complete with air regulators and pressure outlets.

28-WF4330/2
Digital pressure gauge, range 0-2000kPa x 1kPa division

28-WF4191
Nylon tubing 8x6 mm (ID-OD) 10 m coil

Note: For a suitable laboratory air compressor and related accessories (Air filter, Nylon tubing etc.) see page 433

OIL/WATER PRESSURE SYSTEM

This apparatus provides an infinitely variable constant pressure using an adjustable spring type dead weight pressure feedback system connected in-line with a pump and an oil/water interchange vessel. The apparatus comprises: hydraulic pump, honed piston/spring assembly, cylindrical oil/water interchange vessel, pressure gauge, valves, 2 kg of oil.



Main FEATURES

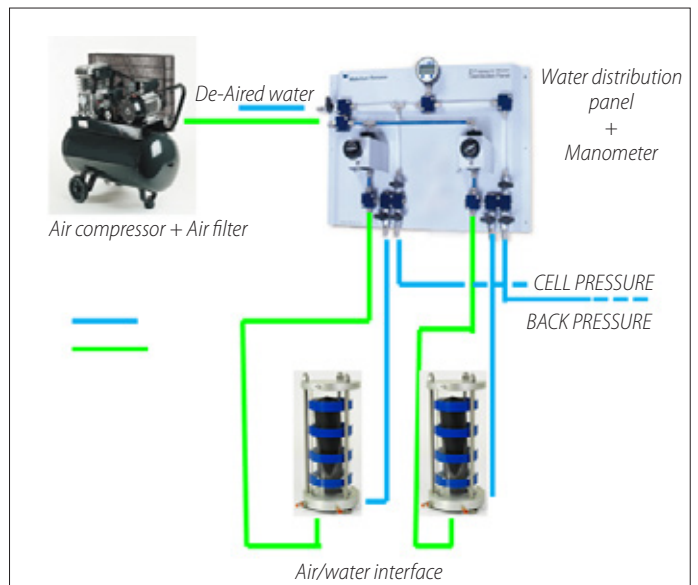
- » Generates and automatically controls the set pressure up to a maximum of 3500 kPa (500 p.s.i.) within $\pm 0.5\%$
- » Very stable over long periods
- » Required pressure set using precision hand wheel control
- » Stepless pressure increments
- » No weights nor calibration required
- » Dimensions: 310 x 300 x 400 mm
- » Weight approx.: 16 kg

Ordering information

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

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

Typical layout with air/water interface system for a standard triaxial system



Triaxial system components and accessories:

Manual measurement system for triaxial testing

LOAD – LOAD RINGS

They can be directly connected to the adapter fit on the crosshead of triaxial frames. Using the 28-WF1049 connector (see accessories) they can be adapted to our complete range of triaxial cells.

Supplied complete with calibration chart.

- High resolution dial gauge. 0.001 mm
- Accuracy: ±1%
- Dimensions: 182 mm diameter 214 mm high
- Weight approx.: 1.2 to 2.2 kg



Ordering information

Capacity [kN]	Model
1	82-T1000/1M
2	82-T1000/2M
5	82-T1000/5M
10	82-T1000/10M

Other capacities are available..

Accessories

28-WF1049

Connector for triaxial cells

AXIAL STRAIN - DIAL INDICATORS

50 mm dial diameter, clockwise rotation. Supplied complete with rear mounts for connection to load rings.

- Weight approx.: 200 g



Travel [mm]	Model
30	28-WF6402
50	28-WF6403

PORE PRESSURE – PRESSURE MANOMETER

Pore water pressure can be measured using a Pressure manometer with anti-twist device that can be fitted directly to the triaxial cell.



28-WF4451

Digital manometer 2000 kPa capacity x 1 kPa division for measuring pore water pressure in triaxial systems with manual measurement. Supplied with anti-twist device and de-airing block

VOLUME CHANGE - DOUBLE BURETTE VOLUME CHANGE APPARATUS

Comprising two measurement tubes, which have a 25 ml burette mounted internally and an acrylic tube externally. The burette tubes are connected directly to a reversing valve system, which is used to reverse the direction of travel of the interface in the measurement tubes without affecting the direction of flow of water to or from the triaxial cell. The unit also includes a by-pass valve system when volume change measurement is not required. Burettes are calibrated to Class A.



Ordering information

28-WF4400

Double burette volume change apparatus
Dimensions: 130x682x87 mm
Weight approx.: 3 kg

Accessories

28-WF4400/1

Red dye hydrocarbon soluble pack for 500 ml

Triaxial system components and accessories:

Electronic measurement system for triaxial testing

LOAD – EXTERNAL LOAD CELL

Used to measure the axial force applied to the specimen in the triaxial cells.

Complete with connector to the upper beam of our Triaxial load frames.



Ordering information

Cap. [kN]	Model
3.5	28-WF0370/T
10	28-WF0373/T
25	28-WF0374/T
50	28-WF0375/T
100	28-WF0376/T

VOLUME CHANGE – VOLUME CHANGE DEVICE

The apparatus provides an electrical signal directly proportional to the volume of water flowing through the unit. The apparatus comprises a piston connected to a 25 mm travel linear transducer and sealed against a precision-machined calibration chamber.

Technical specification
 - Capacity: 100 cc
 - Dimension: 260x280x400 (w x dxh)

28-WF4410
 Automatic volume change apparatus



LOAD – SUBMERSIBLE LOAD CELL

Submersible (internal) load cells have been designed to work inside the triaxial cells. They have a lower hysteresis and very good linearity together with a substantial over load safety feature.



Ordering information

Cap. [kN]	Triaxial cell model	Model
1	28-WF0410/B	28-WF6350
	28-WF4050	
5	Diam. Ram 15.5 mm	28-WF6352
		28-WF6354
10	Diam. Ram 15.5 mm	28-WF6351
		28-WF4070
		28-WF6353
5	Diam. Ram 25 mm	28-WF6355
		28-WF6356
10	Diam. Ram 25 mm	28-WF6357

PORE PRESSURE – PRESSURE TRANSDUCERS

Used for measuring soil pore water pressure

Cap. [kPa]	Model
1000	28-WF6300/A
2000	28-WF6301/A
3500	28-WF6302/A

Accessories

28-WF6310
 De-airing block



Pressure transducer with de-airing block

AXIAL STRAIN – DISPLACEMENT TRANSDUCERS

Used for measuring axial deformation on soil sample



Potenziometric transducer

Travel [mm]	Model
25	30-WF6208
50	30-WF6209
100	30-WF6210

Accessories

28-WF6220
 Mounting bracket for 28-WF4050 and 28-WF0410/B



28-WF6221
 Mounting bracket for 28-WF4070; 28-WF4100; 28-WF4150; 28-WF4170; 28-WF4171; 28-WF0411/B; 28-WF0416/B

In case all the sensors here presented, are supplied complete with data acquisition system, then a traceable calibration certificate is available on request. For ordering information add suffix 'C' to the relevant product code (e.g. 28-WF6208/C)

Triaxial system accessories:

Measurement of maximum shear modulus (Gmax) Bender elements

Bender elements allow the measurement of the maximum shear modulus (Gmax) of a soil sample and from this data to evaluate the stiffness of a soil. Gmax is generally associated with shear strain levels of about 0.001% and is a key parameter in small strain dynamic analysis, such as those to predict soil behavior or soil structure interaction during earthquakes, explosions or machine and traffic vibrations.

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Main FEATURES

- » Used for Gmax determination in soil sample
- » Compact and convenient smart-unit with LAN PC connection
- » Includes signal generator and receiver to measure S & P wave velocities giving more in-depth specimen analysis
- » Easy flight time calculations with intuitive software using dedicated algorithm
- » Versatile multi-wave generator (sine, haversine, morlet).
- » Obtain high resolution results with flexible Data Acquisition at up to 15 Mega Samples/Second
- » Use with Banded triaxial cells upgraded with suitable kits or standalone with optional accessories
- » Suitable for specimen with diameters ranging from 50 to 150mm
- » Multi-frequency test up to 100 kHz
- » Maximum working pressure of 3500 kPa

Ordering information

Diameter [mm]	Triaxial cell	Compression test only *	Compression / extension test **
50	28-WF4070	28-WF4057/PS	28-WF4058/PS
70	28-WF4070	28-WF4077/PS	28-WF4078/PS
	28-WF4100	28-WF4077/PS1	28-WF4078/PS1
100	28-WF4100	28-WF4107/PS	28-WF4108/PS
150	28-WF4150	28-WF4157/PS	28-WF4158/PS



* kit includes top cap, pedestal and pair of sintered ring porous stone
 **kit includes vacuum top cap, pedestal, pair of sintered ring porous stone

Accessories

28-WF4200

Compact and convenient smart-unit, includes signal generator and receiver to measure S & P wave velocities. LAN PC connection. PC Not included.



Bender elements setup offering the possibility to test specimen without using triaxial cell

For complete information and details, including complete test configurations, please ask for the co-operation of our specialist

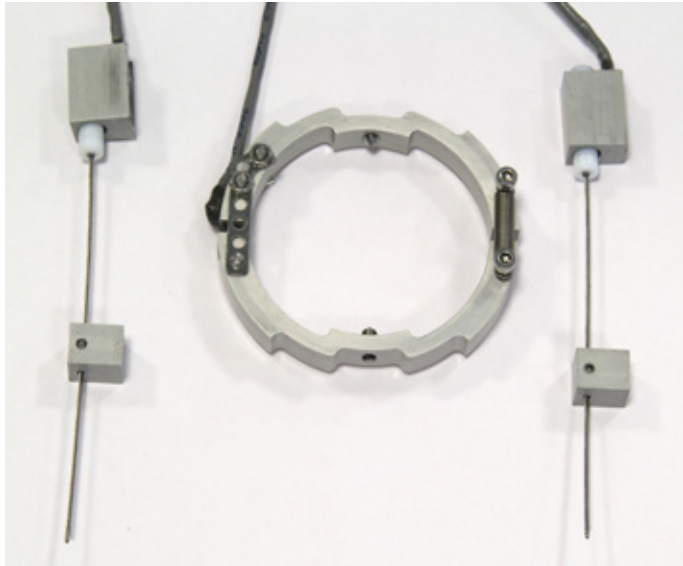


User friendly bender elements software

Triaxial system accessories:

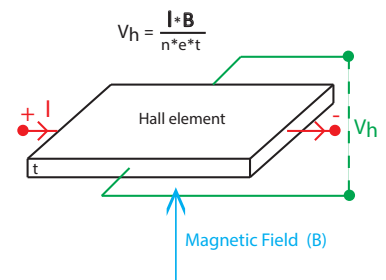
Local strain measurement – Mini On-sample

In conventional triaxial testing the stiffness of a soil specimen is determined by external measurement of displacement. Such measurement is subjected to errors caused by deflections of loading system and bedding of the porous stone onto the ends of the specimen. Local axial and radial strain transducers avoid these problems.



Main FEATURES

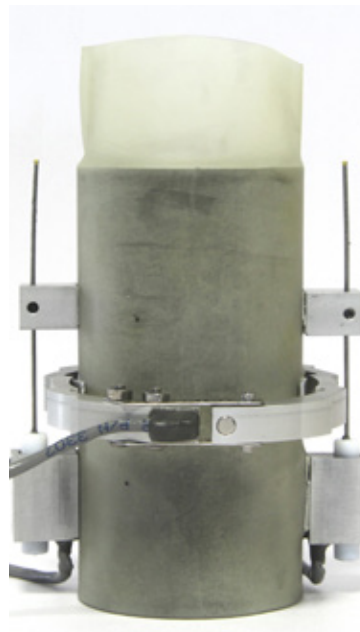
- » Suitable for specimen diameters from 38 to 150mm
- » Maximum working pressure of 3500 kPa
- » Light and compact construction with reduced dimensions
- » For use with Banded triaxial cells upgraded with suitable kits and Double wall triaxial cells
- » Axial and radial deformation measured directly on the triaxial test specimen
- » Suitable for static and dynamic data acquisition by triaxial systems



Local strain transducers are supplied in a kit which includes one radial and two axial transducers suitable for 38mm, 50mm, 70mm, 100mm and 150mm specimen diameters. Mounting accessories such as radial belt, mounting brackets and jig are also included.

Sample Diameter [mm]	Static tests	Dynamic tests
38	28-WF4039/KM	28-WF4039/KN
50	28-WF4059/KM	28-WF4059/KN
70	28-WF4079/KM	28-WF4079/KN
100	28-WF4109/KM	28-WF4109/KN
150	28-WF4159/KM	28-WF4159/KN

NOTE: The transducers mentioned above are also available with traceable calibration certificates 28-WF4XXX/KMC or 28-WF4XXX/KNC



Transducers mounted on a sample



Banded triaxial cell 28-WF4070 fitted with upgrading kit 28-WF4070/ADV for using bender elements and local strain transducers

Triaxial system accessories:

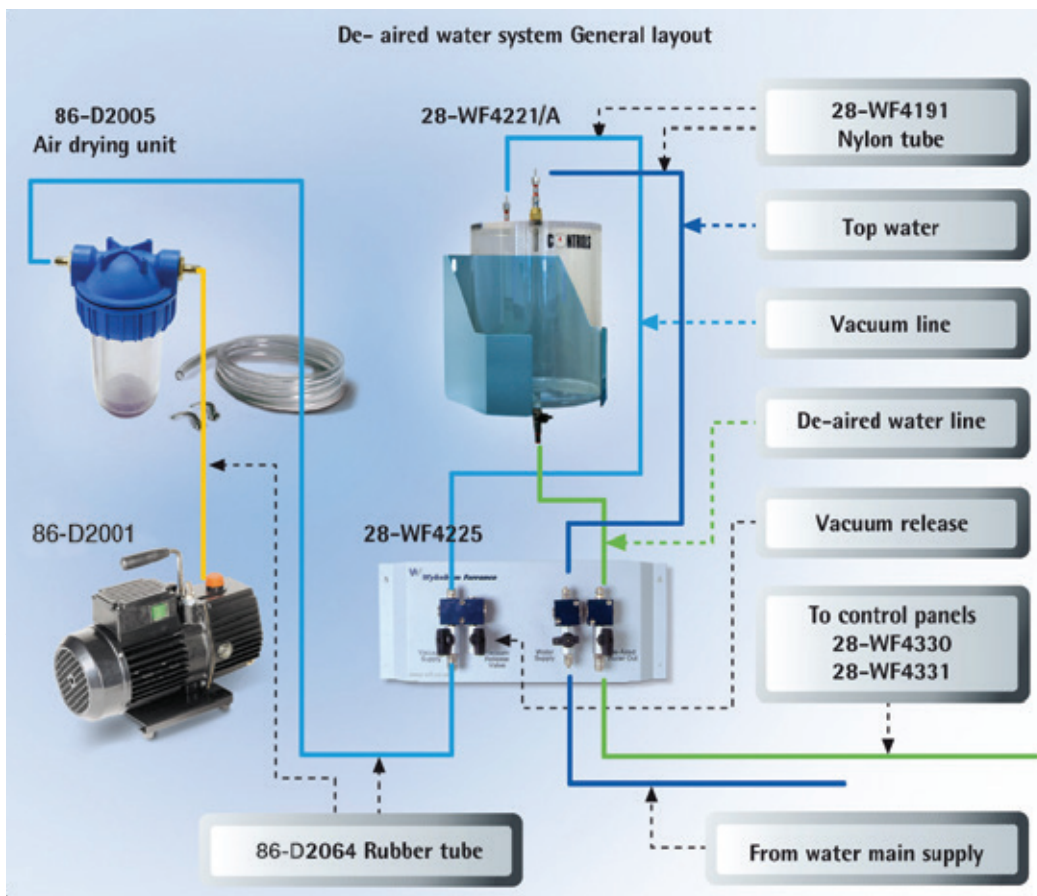
De-Airing water system

De-airing the water that will be used to fill triaxial cells, pressure systems and volume change measurement apparatus, is essential for properly saturating soil specimens.

The system comprises the following:

- A de-airing tank (two versions are available with 7 or 23 L capacity)
- Vacuum pump with air drying unit
- Valve panel
- Tubing and accessories

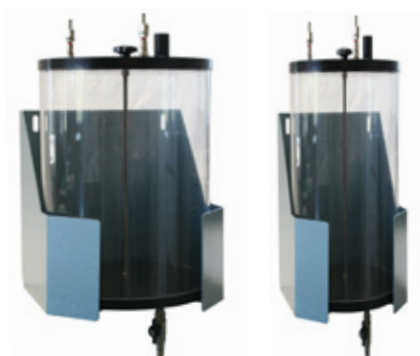
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DE-AIRING WATER TANK

Transparent acrylic cylinder fitted with a water spray inlet, an air inlet and a metal stand. Can be wall mounted

Models	28-WF4220/A	28-WF4221/A
Capacity	7 l	23 l
Dimensions	579 X200 X 209	619 x 320 x 311
Weight approx.:	6.4 kg	12 kg



VALVE PANEL

To control the water going in and out of the de-airing tank. For connecting the de-airing tank to the vacuum pump.
Dimensions: 510 x 200 x 30 mm
Weight approx.: 3 kg

28-WF4225

Valve panel for use with de-airing tank

TUBING

28-WF4191

Nylon tubing 6mm bore x 8mm outside diameter, 10 meter length

86-D2064

Rubber tube diameter 6.5 x 16.5 mm 2 m long, for vacuum pumps

VACUUM PUMP AND AIR DRYING UNIT

The vacuum pump 86-D2001 has to be used with the air drying unit (86-D2005) filled with silica gel desiccant (86-D0819). This is recommended to avoid/limit water vapour mixing with the oil in the pump. When the pump will be used intensively, use of the outlet mist filter (86-D2001/3) is also recommended, which collects any oil vapour issuing from the oil reservoir during operation.

VACUUM PUMP

Free air displ.: 75 l/min
Ultimate vacuum: 0.1 mbar
Dimensions: 300 x 150 x 240 mm
Weight approx.: 8.5 kg

AIR DRYING UNIT

Plastic frame with acrylic cylinder
Desiccant capacity : 500 g approx..
Dimensions: diameter 185 x 300 mm approx..
Weight (empty): 1 kg approx..

OUTLET MIST FILTER (OPTIONAL)

Weight approx.: 0.7 kg

Ordering information

Vacuum pump and Air drying unit

86-D2001

Portable vacuum pump, free air displacement 75 l/min, ultimate vacuum 0.1 mbar. 230V/50-60Hz/1Ph

86-D2001/Z

As above but 110V/60Hz/1Ph

86-D2005

Air drying unit. For use with Silica gel with indicator, 86-D0819 (OPTIONAL)

86-D2001/3

Outlet mist filter



Triaxial system accessories:

Determination of permeability of normal and contaminated soil sample

STANDARD

▶ ASTM D5084 ▶ BS 1377:6 ▶ CEN-ISO/TS 17892-11

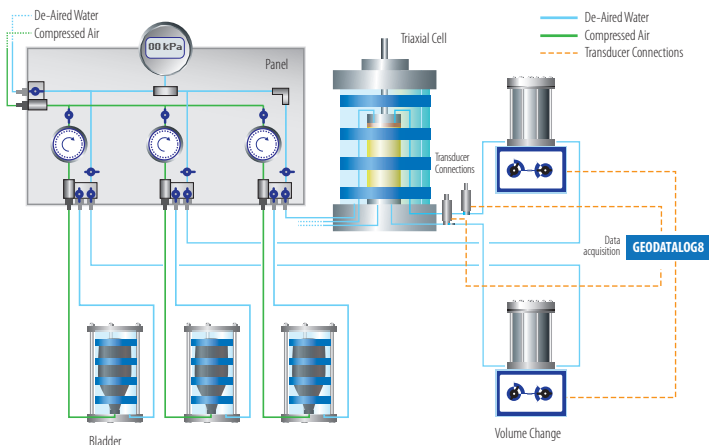
PERMEABILITY SYSTEM USING TRIAXIAL CELL

This system has been developed for the laboratory measurement of the hydraulic conductivity (coefficient of permeability) of water saturated porous materials. The test is performed using a triaxial cell fit with 5 no-volume change valves: 2 for upper drainage, 2 for lower drainage and 1 for water pressure. The cell is connected with three independent pressure systems for the cell fluid, the drainage line to the top of the specimen and the drainage line to the base of the specimen. The complete test system includes:

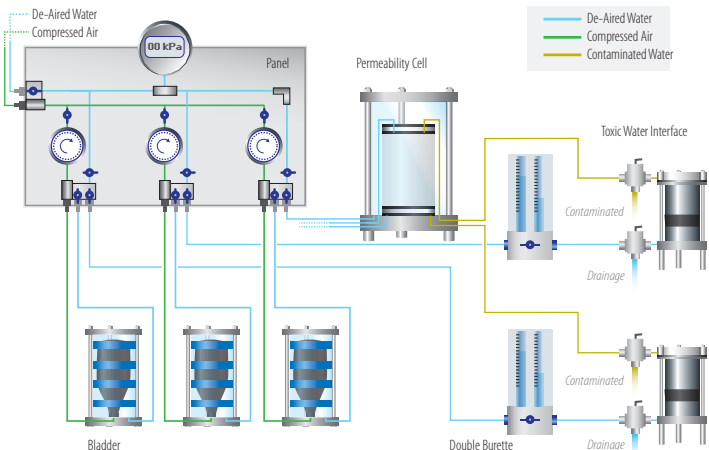
- Triaxial cell with accessories for 38, 50, 70 or 100 mm specimens
- Pressure control panel, three pressure lines
- Bladder type air/water pressure system
- De-airing water system and accessories

For a complete test configuration please visit our website.

Permeability tests in triaxial cell with data acquisition



Permeability tests in triaxial cell with contaminated water



PERMEABILITY CELL FOR CONTAMINATED SOIL SAMPLES

The permeability cell is available with stainless steel valves for use with contaminated soils. The toxic interface chamber 28-WF0194/3 is recommended to be fit between control panel and permeability cells to avoid toxic permeants from entering the control panel. This also prevents contact of air with the permeant, thus no toxic or corrosive vapours can escape into the laboratory.



Ordering information

28-WF0194/B

Permeability cell with stainless steel valves for use with contaminated soil
 - Dimensions: 300x355 mm (dxh) approx.
 - Weight approx.: 5 kg

28-WF0194/3

Toxic interface chamber
 Weight: approx. 3 kg

Accessories

Sample diameter mm	70	100
Pedestal	28-WF0194/B1	28-WF194/B2
Porous discs	28-WF4074	28-WF4104
Membranes	28-WF4075	28-WF4105
O-Rings	28WF4076	28-WF4106
O-Ring placing tool	28-WF4071/B	28-WF4101/B
Suction device	28-WF4071/A	28-WF4101/A
Two part split former	28-WF4071/D	28-WF4101/D

GEODATALOG 8

Data acquisition Unit

30



30-WF6008
GEODATALOG 8, MULTIPURPOSE, WITH DEDICATED SOFTWARE

GEODATALOG 8 is a multipurpose data logger which works directly connected to a PC. Data is automatically transferred to the PC in real time for live monitoring of the tests progress. GEODATALOG 8 records and monitors in real time the measurements requested for soil mechanics testing, as: consolidation, shear, triaxial, permeability and many others.

The data acquisition unit is supplied complete with general purpose DATACOMM 2 PC software for fully comprehensive data management of both GEODATALOG 8 and HYDROMATIC.

DATACOMM 2 software combines the active channels into customizable groups by the operator. Data acquisition for each group is an independent task which can be started/stopped automatically with specific acquisition and logging mode.

Software allows remote calibration of the connected sensors up to 10 points with polynomial fitting curve up to eight degrees.

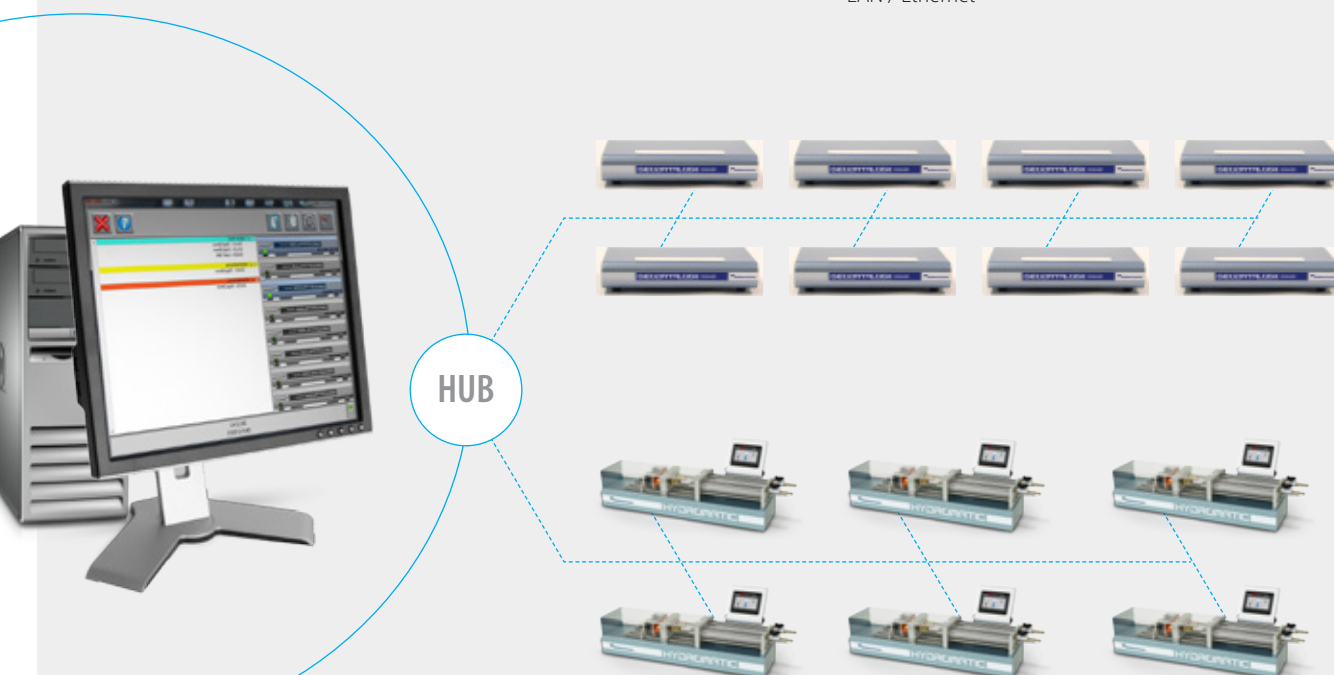
ASCII format data export is available in combination with our geotechnical Geo-Analysis-Templates suitable for post-processing and printout of test certificates according to the most important international Standards.

Main FEATURES

- » Up to 8 independent input channels.
- » Numerical and graphical display of readings via PC software.
- » Modular and flexible concept
Network configuration of up to 64 independent channels.
- » Possibility to synchronize pressure and volume data coming from HYDROMATIC with data from the other connected transducers
- » LAN / Ethernet connection to PC via dedicated software (included).
- » The transducers can be grouped and combined by the user for matching different applications.
- » Compatible with load cells, pressure transducers, strain gauges, LDT/LVDT/potentiometric displacement transducers.
- » It is possible to perform various tests (e.g. shear, consolidation, triaxial, ...) in parallel, each one having independent clock, channels and logging mode
- » Effective resolution: 131,000 points.
- » Sampling rate up to 500 readings per second per channel.

Technical Specification

- Requires connected PC
- Number of channels: 8
- Network mode: Up to 8 units
- Sampling rate: Up to 500 readings/second per channels
- Real resolution: 131,000 points
- Communication port: LAN / Ethernet
- Excitation (VEXC): from 1 V to 10 V for each couple of channels (up to 4)
- Datalogger input: 0-10 V; 0-20 mA
- Software: DATACOMM 2 (included)
- Dimensions approx lxdxh [mm]: 290x195x61
- Weight approx [kg]: 1.6 kg
- Power supply: 110-220V, 50-60 Hz, 1ph



Software and data processing

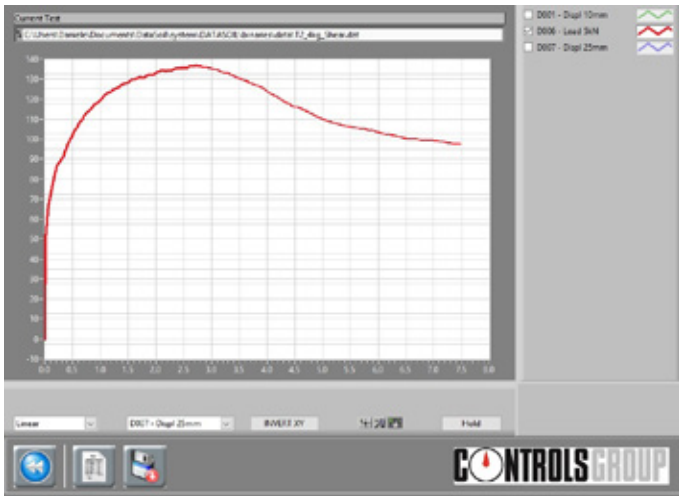
DATA COMM 2 software combines the active channels into customizable groups by the operator. Data acquisition for each group is an independent task which can be started / stopped automatically with specific acquisition and logging mode.

ASCII format data export is available for combination with our Geo-Analysis-Templates suitable for post-processing and printout of test certificates according to the most important international Standards. See data processing

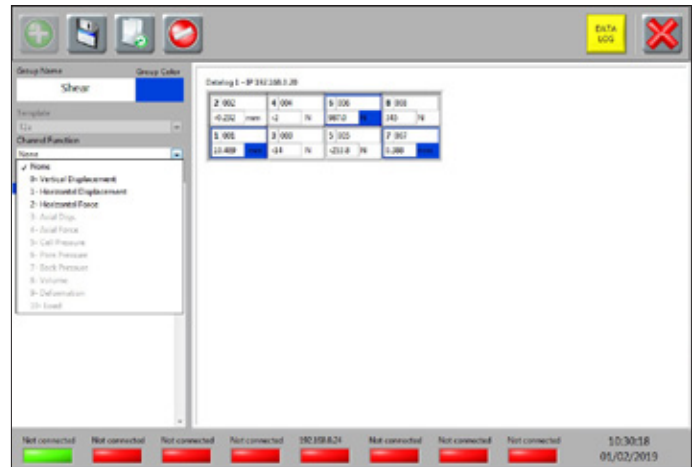


Software and data processing

30



Real time raw testing data coming from 5 kN load during direct shear test

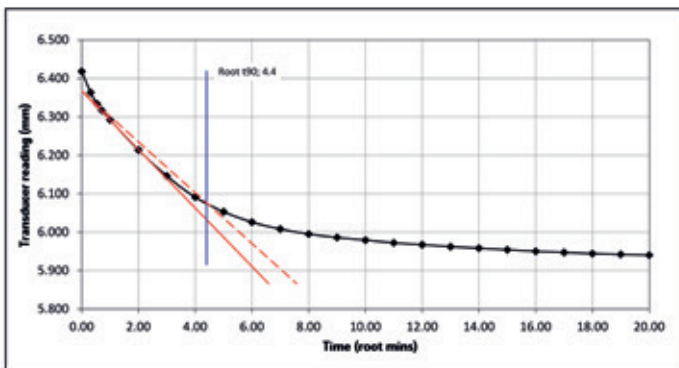
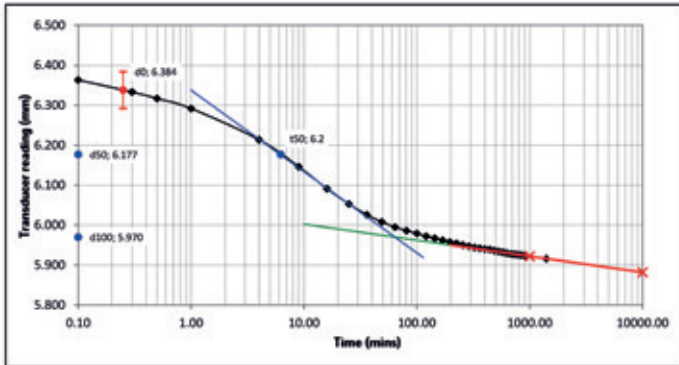


Channels (load cell, vertical displacement transducer and horizontal displacement transducer) and template assignment for performing direct shear test with real-time data processing using our Geo-Analysis templates

DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS USING INCREMENTAL LOADING
Tested in accordance with ASTM Designation: D 2435
TEST DATA

Project location	EXAMPLE	Specimen number	3A
Project reference	12345	Specimen depth (m)	1.5
Borehole number	BH2		

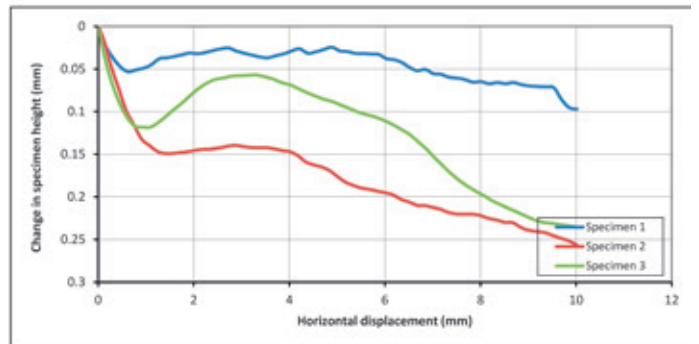
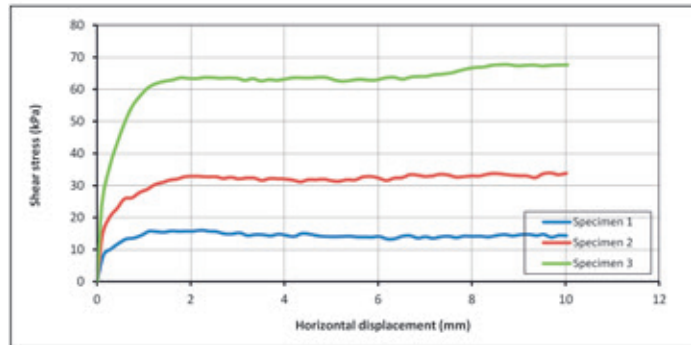
Increment number 5 - Loading	Vertical stress (kPa)	1280	Mass (kg)	25.70
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Example of a consolidation test analysis with the 30-WF6008/T8 Geo-Analysis template (ASTM standard), t50 and t90 calculations

DETERMINATION OF SHEAR STRENGTH BY DIRECT SHEAR (in the small shearbox apparatus)
Set of single stage tests - tested in accordance with BS 1377:1990:Part 7: Clause 4 (procedure 4.5.4)
TEST REPORT - SHEARING

Project location	EXAMPLE	Sample depth	0.50
Project reference	12345	Sample type	Compacted cohesionless
Borehole number	BH1	Specimen orientation	N/A
Sample number	2A		



Tested Date	/JKW	Checked Date		Approved Date	
	30/01/2013				

Example of a direct shear test processed with the 30-WF6008/T2 Geo-Analysis template (BS EN ISO standard): the top plot shows shear stress versus horizontal displacement; the bottom plot shows change in specimen height versus horizontal displacement

Calibration equipment for geotechnical laboratory

Any laboratory needs to verify periodically the calibrations of their electronic measuring systems, in order to produce reliable and accurate results. Equipment for calibrating force, displacement, volume change and pressure measuring devices are described below.

FORCE MEASUREMENT

For calibration of force measuring devices we offer the following load cells fitted with digital readout unit, supplied complete with ACCREDIA calibration certificate according to EN ISO 376.

Load Cell

30-WF0372/SIT

5 kN load cell complete with ACCREDIA calibration certificate and stainless steel loading seat.



Stainless steel loading seat for load cell model 30-WF0372/SIT

30-WF0373/SIT

50 kN load cell complete with ACCREDIA calibration certificate and stainless steel loading seat.



Reference load cell 30-WF0372/SIT or 30-WF0373/SIT

NOTE: In order to issue the calibration certificate, the load cell must be ordered complete with digital readout unit 30-WF6601

Digital readout unit

30-WF6601

Digital readout unit for load cells

NOTE: one digital readout unit can be used for both load cells



PRESSURE MEASUREMENT

Pressure calibrations are performed with a digital pressure gauge, supplied complete with ACCREDIA calibration certificate.



30-WF6305/SIT

50 bar digital pressure gauge complete with ACCREDIA calibration certificate.

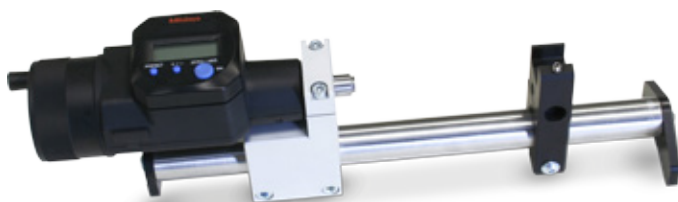
VOLUME CHANGE

Calibration of the volume change apparatus can be simply performed by weighing the water coming out of the device, using any digital balance with 0.01 g resolution.

DISPLACEMENT MEASUREMENT

Calibration of displacement measuring devices can be performed with either the analog or digital micrometer 25 and 50 mm travel respectively, 0.001 mm resolution. The 25 mm travel is available optionally, with traceable calibration certificate and the 50 mm travel with ACCREDIA certificate adding the suffix /C to the code.

Code	Travel [mm]	Res. [mm]	Version	Note
30-WF0652	25	0.001	Analog	
30-WF0652/C	25	0.001	Analog	Traceable calib. certificate
30-WF0653	50	0.001	Digital	
30-WF0653/C	50	0.001	Digital	ACCREDIA calib. certificate



30-WF0653 with digital micrometer



LOCAL STRAIN MEASUREMENT

The calibration is performed with a special device that can also be used for standard linear displacement transducers with up to 50 mm travel.

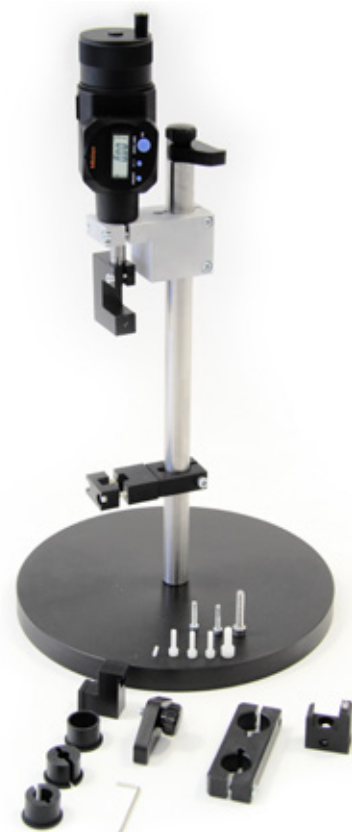
- Frame capable of positioning the micrometer horizontally and vertically
- Adaptors for both vertical and radial strain transducers
- Resolution 0.001 mm
- Dimensions 260 x 60 x 100 mm (w x d x h)
- Weight: 1.5 kg approx..

30-WF0653/K

Calibration device for local strain transducers and standard linear displacement transducers up to 50 mm travel

30-WF0653/KC

As above but complete with ACCREDIA certificate



DYNAMIC TESTING SYSTEMS

31 The dynamic properties of soils such as stress-strain characteristics have been recognized as integral aspects of construction designs such as maritime, seismic engineering, placement of foundations of machines or structures subjected to different dynamic interactions.

The correct description of the soil behavior within the range of small deformations is also an extremely important element in the prediction of the movement of structures and how they interact with subsoil, and thus has a great impact on the quality of the actual mapping of the internal forces in the structural system of the whole building, including the foundations.

Stiffness modules for very small deformations are now recognized as fundamental properties of the soil. For this reason, in geotechnical engineering we commonly use information obtained from laboratory and field dynamic and seismic tests to solve conventional problems of interaction between the building and the subsoil.

Different systems are available to cover the wide range of deformations due to these different causes.



Dynamic Triaxial system 31-WF70E06



Dynatriax EmS adopts the new Electromechanical Servoactuation technology. It offers excellent reliability, accurate testing and lower maintenance requirements.



DYNATRIAX EmS

STANDARD

- ▶ BS 1377:7 ▶ ASTM D2850 ▶ ASTM D4767
- ▶ BS 1377:8 ▶ BS 1377:6 ASTM D7181 ▶ ASTM D5311
- ▶ ASTM D3999 ▶ AASTHO T0307



For detailed information, including complete test configurations, please visit our website or contact our team of specialists

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

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

MAIN FEATURES

- » Electromechanical Servoactuation, no need for compressed air or hydraulic power supply for the vertical force
- » Capability to perform Static (effective stress and stress path), Dynamic and Unsaturated soil triaxial tests
- » Maximum dynamic load: 15 kN
- » Maximum static load: 10 kN
- » Triple-axes closed loop control of axial load/displacement, cell and back pressure
- » Automatic compensation of cell/back pressure during dynamic stage
- » Operating frequency more than 10 Hz (depending on test conditions)
- » Complete automation of all test stages using a high sensitivity closed loop PID feedback
- » Options available for bender elements testing and for local strain transducers
- » Standard and user defined wave shapes which can mimic the real in situ measurements (earthquakes)

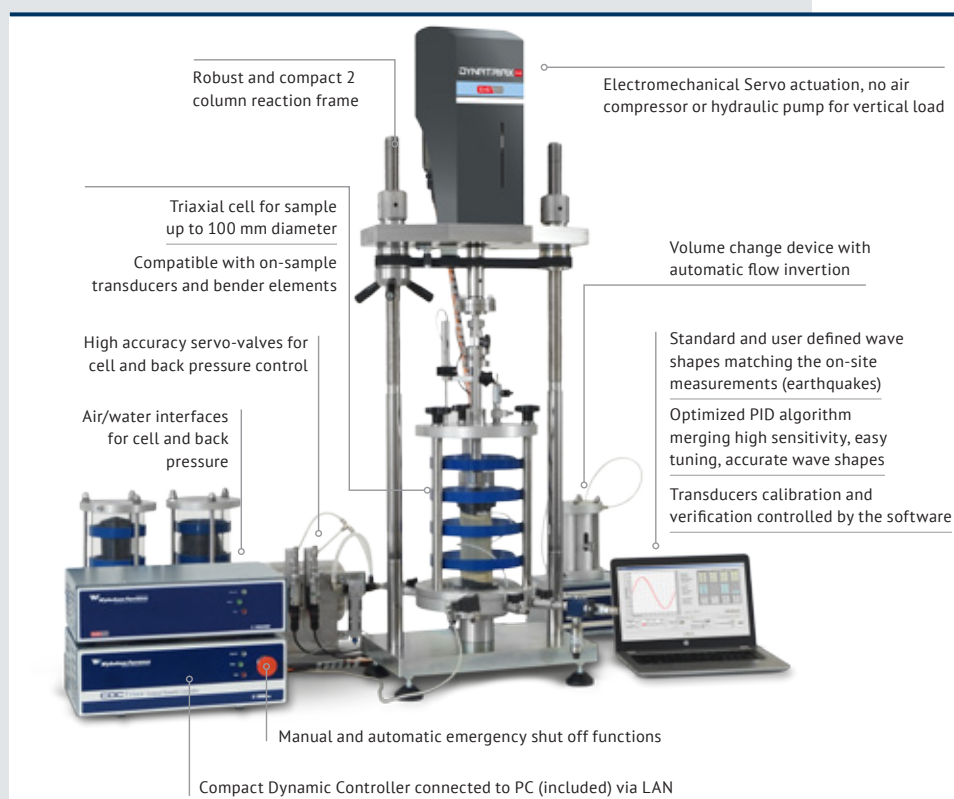
PID CONTROL

An extremely efficient algorithm with larger gain ranges gives enhanced sensitivity, making it easier to tune the system and achieving more accurate wave shapes.

Recently added features include manual and automatic amplitude control which compensate for small changes that may occur in the system during cycling, ensuring that the required peaks are consistently reached. The improved tuning panel, with its more user-friendly interface, provides all the tools necessary to optimize the system control during static and cyclic test stages.



*Stress-controlled cyclic shear stage. Real time measurements, compression/extension and amplitude are displayed
User-friendly interface control panel*



- » Test set-up by unique programmable multi-stage procedure. When a test is running, it is possible to access all parameters to expand and modify the stages as per the response of the specimen
- » Manual and automatic emergency shut off function
- » Multitasking, user-friendly Windows-based software pre-installed on the PC
- » Extra-accurate transducers calibration adopting linear or polynomial regression or multi-coefficient linearization
- » 208-230 V, 50-60 Hz, 1 ph or 110 V, 60 Hz, 1 ph

The base system includes:

ELECTRO-MECHANICAL VERTICAL LOAD APPLICATION

- high performance motorized actuator, 15 kN capacity, backlash-free and noiseless
- sophisticated PID closed-loop control, ensuring load is reached fast, smoothly and accurately and then maintained with high level of accuracy. The submersible load cell delivers high accuracy from the lowest values

REACTION FRAME

DATA ACQUISITION, PROCESS AND CONTROL

The CDC (Compact Dynamic Controller) manages up to 3 closed loop axes (axial load/displacement, cell and back pressure) with an effective loop rate of 10 kHz and performs the test completely automatically including the on/off valves for the drainage line and for the air supply to the triaxial cell.

SENSORS

Load cell, LVDT transducer, pressure transducers, volume change have to be ordered separately

TRIAXIAL CELL AND ACCESSORIES

PRESSURE SYSTEM

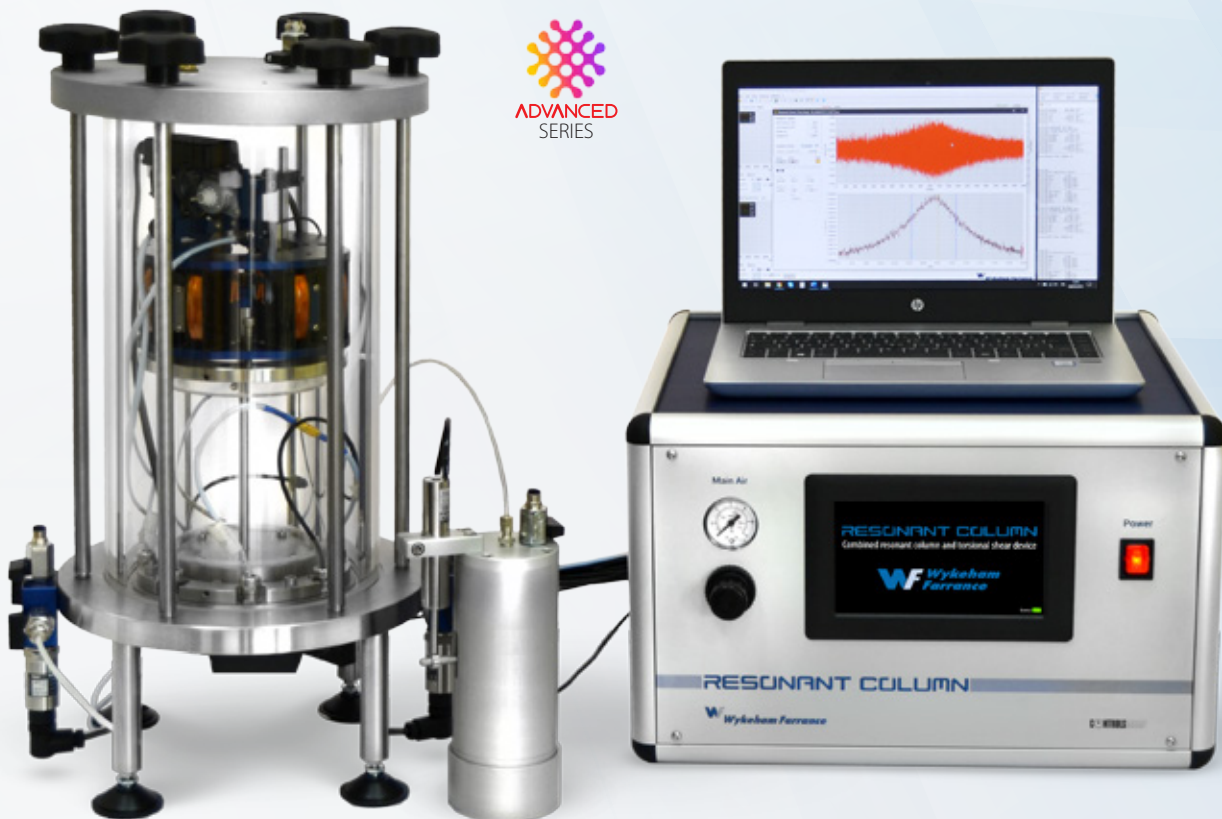
Air/water interface for cell and back pressure are required.

NOTE: System requires air compressor, air filter and de-airing water system.

Resonant Column and Cyclic Torsional Shear Device

31-WF8600

Resonant Column combines the features of both resonant column and cyclic torsional shear for evaluating shear modulus and damping ratio versus shear strain



Resonant Column

STANDARD ▶ ASTM D4015



For complete information and details, including complete test configurations, please visit our website and ask for the co-operation of our specialists

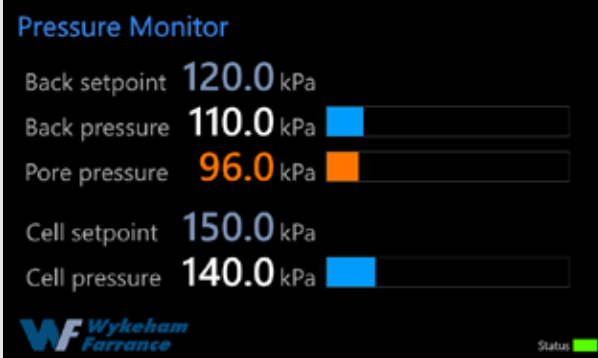
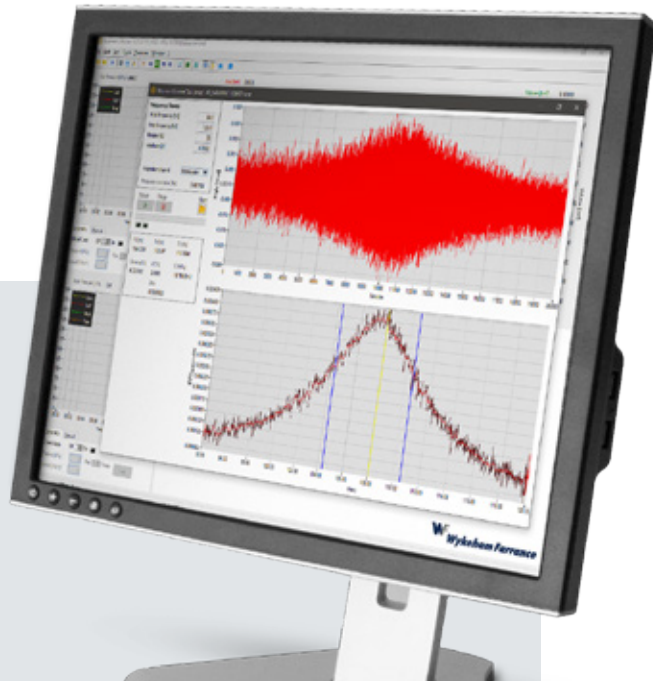
This is one of the many **ADVANCED** products of **CONTROLS** Group range.

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

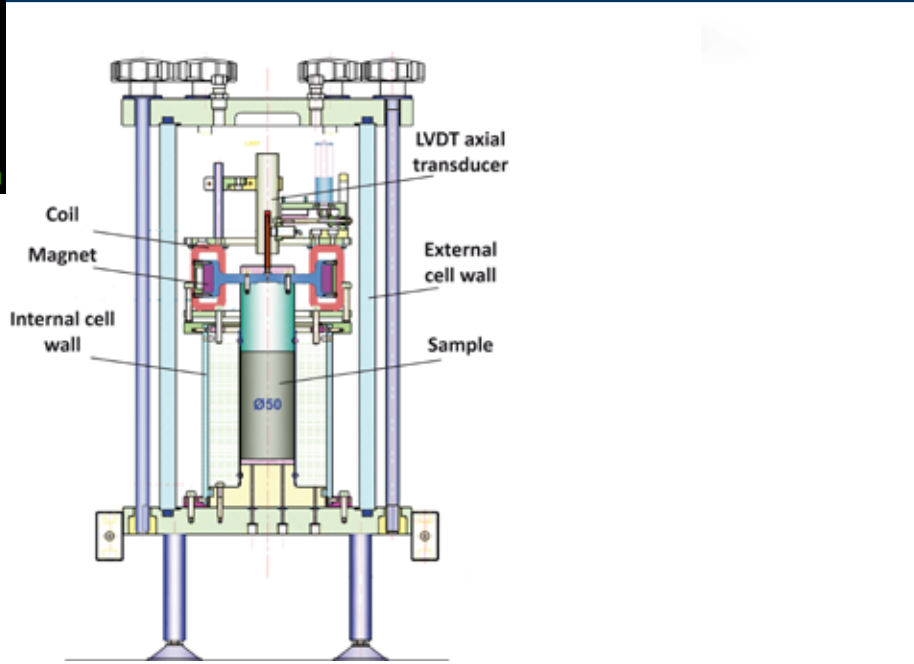
MAIN FEATURES

- » Combined Resonant Column / Torsional Shear device in a single unit
- » Stainless steel cell with acrylic transparent cylinder won't rust or corrode increasing your equipment longevity.
- » Intuitive high resolution 7" color touchscreen display makes cell, back and pore pressure easy to monitor.
- » Automatic detection of fundamental frequency
- » RC: damping ratio from half power bandwidth, free vibration data and white noise
- » TSS: damping ratio from hysteresis loops
- » Maximum torque: 1.5 Nm
- » Maximum angular deformation: 10°
- » Maximum cell and back pressure: 1 MPa
- » Suitable for 50 mm dia. specimen (or 38 mm on request)
- » Integrated signal generator and oscilloscope
- » Upper and bottom drainage guarantees proper sample saturation
- » Internal floating frame for large angular and axial deformation
- » 10 channels signal conditioning unit

The excitation Voltage is fixed and the frequency increased by steps (RC discrete) or continuously (RC chirp) in automatic increments or steps.
The system records the shear strain and calculates the Fundamental Resonant Frequency corresponding to the maximum



Cell, back and pore pressure monitoring via high resolution 7" color touchscreen display



The system consists of the following components:

TRIAXIAL CELL

Stainless steel cell with acrylic transparent cylinder with 170 mm int. dia. x 200 mm ext. dia., including channels for bottom and top drainages; internal floating frame for assembling the electrical motor that applies the torsional load. Test accessories for 50 mm (or 38 mm available on request) diameter specimens.
N°2 calibration bars kit + n°1 calibration weight.

MAIN CONTROL BOX, LAPTOP PC AND SOFTWARE

Compact unit connected to laptop PC contains all control, power supply and electrical and pneumatic devices. This system contains also the air actuators (I/P converters) and the amplification equipment.
High resolution 7" color touchscreen display for cell, and pore pressure monitoring

SENSORS

The sensor kit contains: Axial LVDT transducer, volume change apparatus, three pressure transducers, two Eddy current displacement sensors with high precision motorized proximity sensors positioning, low noise MEMS accelerometer.

NOTE: System requires air compressor, air filter and de-airing water system.

- » USB data acquisition and signal generation board
- » Two electro-pneumatic converters for cell and back pressure
- » Laptop PC with dedicated software included
- » Software manages the following stages: saturation, consolidation, Resonant frequency, Torsional Shear
- » Excitation frequency: Dynamic (RC) 1-300 Hz; Cyclic (TS) from 0 to 50 Hz maximum
- » Multivoltage – Multifrequency power supply 230 V - 50Hz or 110 V- 60Hz, 1 ph



Cyclic simple shear 31-WF7500

The cyclic simple shear apparatus is generally used for research in the dynamic field of soil behavior and can quite easily simulate many different field loading conditions.



Cyclic Simple Shear

STANDARD ▶ ASTM D6528



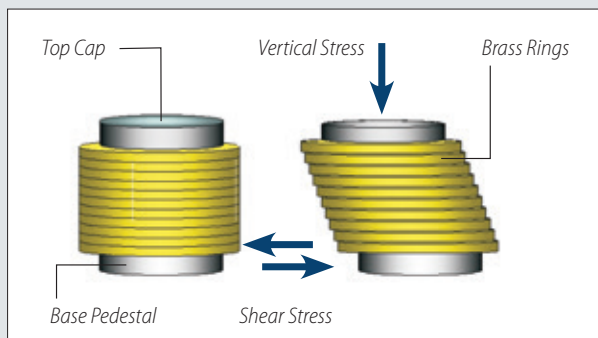
For complete information and details, including complete test configurations, please visit our web site and ask for the corporation of our specialists

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

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

MAIN FEATURES

- » Possibility to simulate many different field loading conditions:
 - Stability under seismic events
 - Degradation of shear stress
 - Evaluation of the liquefaction parameters
- » Possibility of constant height shear test
- » Possibility of constant stress test
- » Possibility of constant rate of strain test
- » Shear strain is induced by horizontal movement at the bottom of the sample relative to the top.
- » Operating frequency up to 10 Hz (depending on test condition)
- » 5 kN horizontal and vertical actuators
- » 5 kN load cells fitted in-line with actuators, 1 N accuracy
- » Built-in transducers +/- 15 mm travel for each actuator
- » External transducer +/- 5 mm travel for controlling and maintaining sample height



Schematic Stress condition of the sample in the cyclic simple shear



Sample Preparation using wooden dolly included the machine.

The system consists of the following components:

SIMPLE SHEAR MACHINE

It consists of a simple shear load frame, an air receiver with axial (vertical) and lateral (horizontal) loading control valves and two 5 kN actuators, built into a specially designed floor-mounted cabinet. Each actuator has an internal displacement transducer, which relays the actuator piston position back to the computer. The sample is positioned on a pedestal with a top cap that is rigidly fixed and houses a 70 mm diameter vertical ram in a linear bearing to allow axial movement but prevent lateral movement and covered by a rubber membrane placed and secured with O-rings.

To maintain a constant diameter (K0 conditions) the sample is laterally confined by a series of brass rings.

The bottom half is mounted on roller bearings in the same way as in a standard shear box apparatus.

IMACS - INTEGRATED MULTI-AXIS CONTROL SYSTEM

The IMACS is a compact self-contained unit that provides all critical control, timing and data acquisition functions for the test and the transducers. These channels are digitized by accurate, high speed 20-bit (A/D) converters for data analysis and presentation. The control module has four channels for feedback control, two are dedicated to the actuator for axial load/displacement, the other two are dedicated to the application of the lateral load/ displacement.

SENSORS

Two Load cells, built-in displacement transducers for each actuator and external transducer for controlling and maintaining sample height. Each one is supplied with proper in-line signal conditioning pods for normalizing all the transducer output.

- » Suitable for 70 mm dia. specimen or 50 mm using dedicated adapters
- » Constant diameter of the sample during the test. Any change in volume can only be as a result of vertical movement of the top platen.
- » Multivoltage – Multifrequency power supply 230 V - 50Hz or 110 V- 60Hz, 1 ph

ROCK TESTING

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 general 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.

ROCK TESTING

32

Rock Mechanics

Rock shear box apparatus	98	Strain gauges	109
Joint roughness test device (Tilt test)	99	Compression test device for rock specimens	109
Profilometers (Barton comb)	99	Compression/Splitting test device	110
Rock classification hammer	99	Oil and water permeability equipment	110
Rock picks	99	Hydromatic stand-alone controller for permeability	110
Mohs hardness scale set	99	Slake durability apparatus	111
Rock strength index apparatus (Point load)	100		
Laboratory coring machines	101		
Core trimmer and cut-off machines	102		
Specimen grinding machine	103		
Saw for rock, concrete, asphalt and masonry	103		
Multisaw and autosaw, universal saws	103		
Uniaxial and triaxial tests	104		
Advantest Rock	105		
Automax Multitest	106		
Semi-automatic Wizard Auto system	107		
Datalog 8	107		
Hoek cells	108		

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

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)

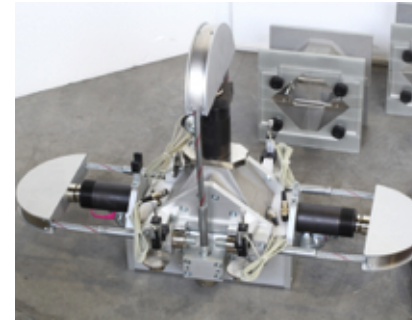
Ordering information

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



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

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

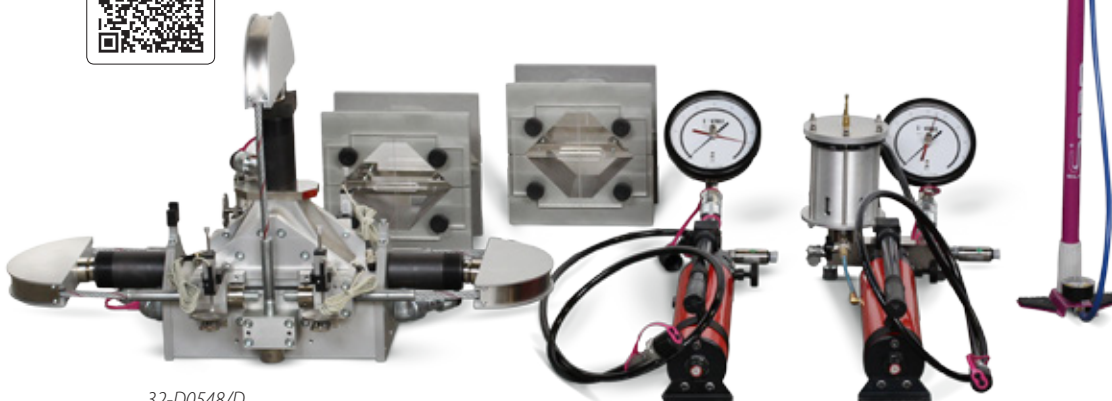
Mould former

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

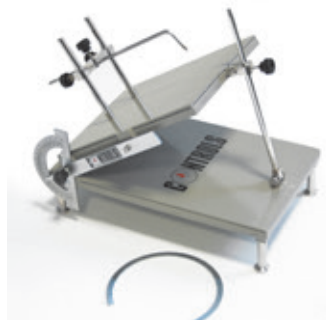
JOINT ROUGHNESS COEFFICIENT TEST DEVICE (TILT TEST)

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.

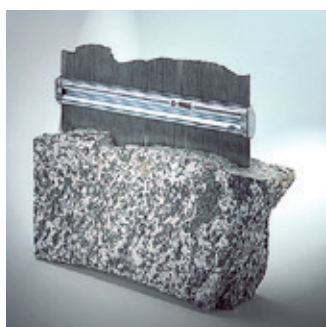
Two models available:

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



32-D0550 complete test set

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 membrane 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

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



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

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

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

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

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. 230V, 50-60 Hz, 1 ph.

32-C0330/Z
As above but 110V, 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

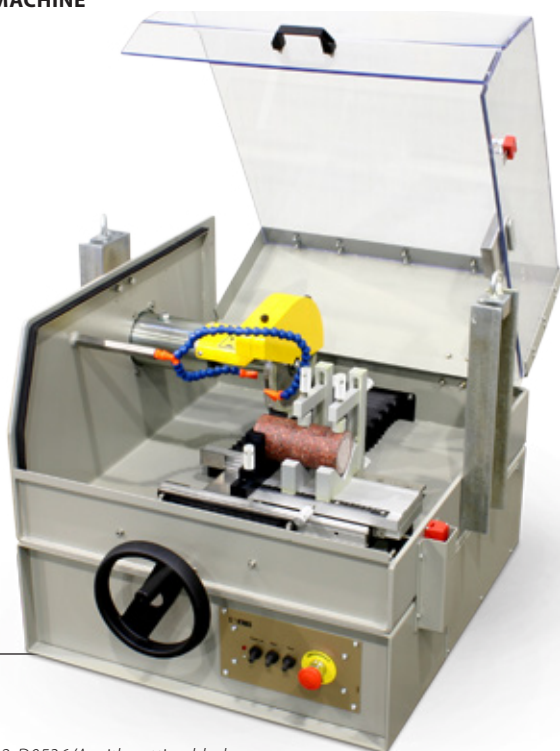


32-D0343, 32-D0344, 32-D0345

Specimen preparation

CORE TRIMMER AND CUT-OFF MACHINE

32



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 Accessories.

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

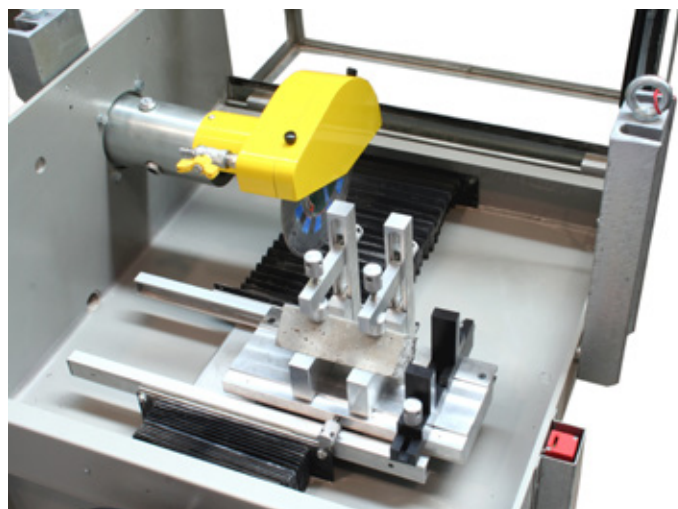
Laboratory core trimmer and cut-off machine complete with water inlet. 230 V, 50 Hz, 1 ph.

32-D0536/AY

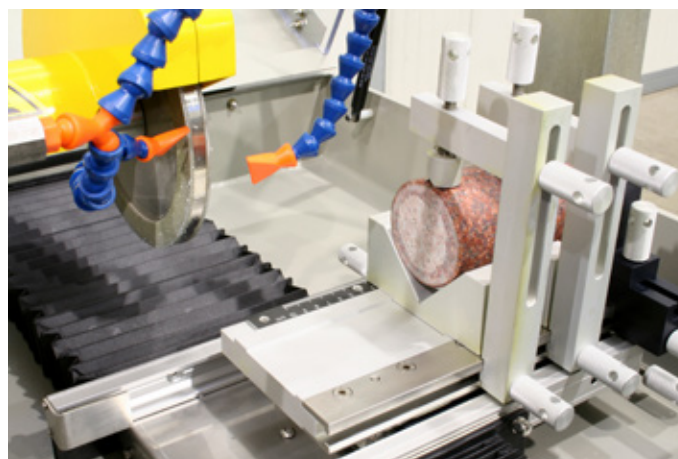
As above but 220 V, 60 Hz, 1 ph.

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

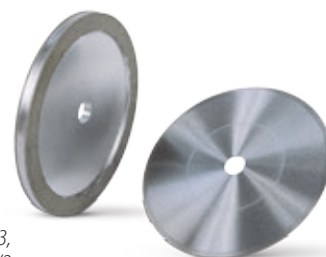
As above but 110 V, 60 Hz, 1 ph.

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 building 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.

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



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

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 5×10^{-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 ADVANT-EST 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



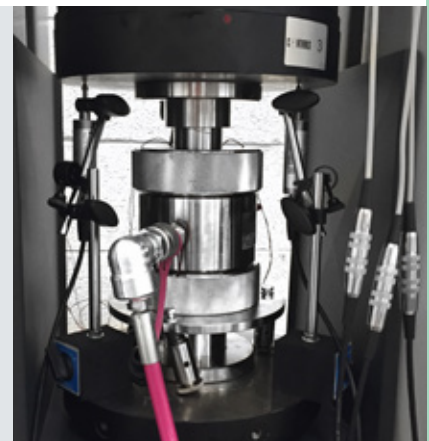
ADVANTEST ROCK

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

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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

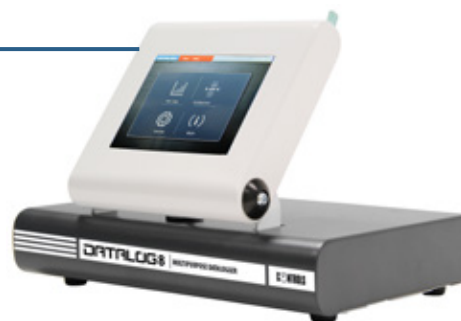
Low friction manual pressure maintainer for lateral pressure in the Hoek triaxial cells, including pump and precision pressure gauge.

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



DATALOG 8 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

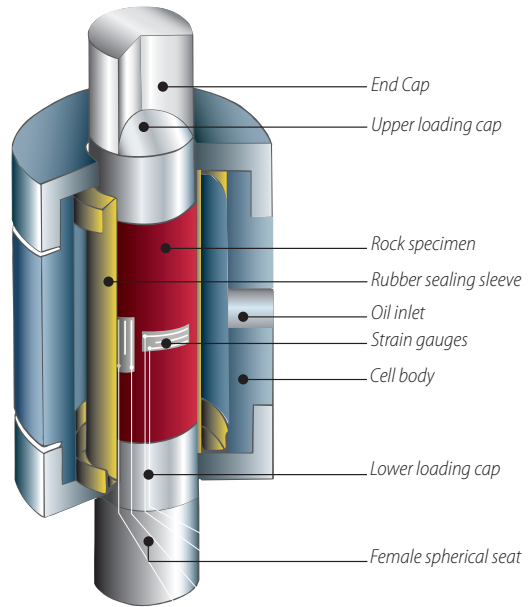
- ▶ ASTM D5407 ▶ ASTM D7012
- ▶ ISRM Suggested method

32

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, two strain gauges, a rubber sealing sleeve and a rubber sealing sleeve.

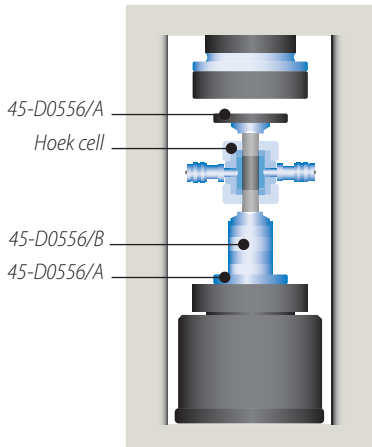
Measurements of axial and radial strain are carried out with the use of electric strain gauges, both in vertical and horizontal direction, directly glued on the lateral surface of the specimen. The wiring connections are passed within the rubber sleeve through the cell body and loading cap. Each strain 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)

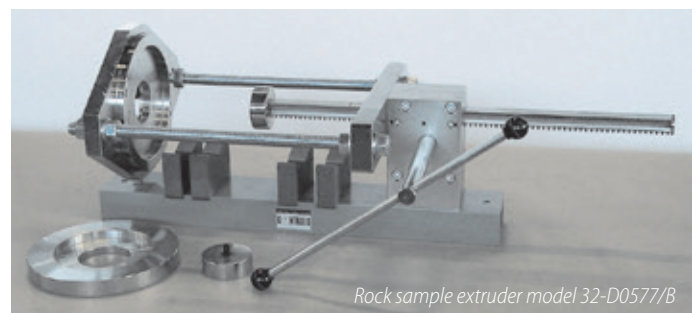
ROCK SAMPLE EXTRUDER

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

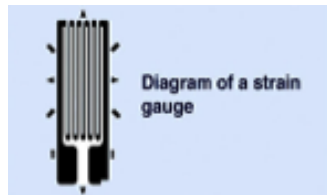
Specimen extruder for Hoek cells series 45-D055x

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



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

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

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

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, tweezers, adhesive with catalyst agent, 100 m of bipolar cable, solder, soldering iron, scalpels, scissors, duct tape, sellotape, sandpaper and carrying case.



82-P0398

82-P0398

Compensation device for up to 4 Wheatstone bridges with ¼ or ½ bridge setup

82-P0399/1

Connecting terminals, 50 pairs sheet



82-P0399/C



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

Splitting Tensile test

STANDARD

- ▶ ASTM D3967
- ▶ ISRM Suggested method

32

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



32-D9032/H

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

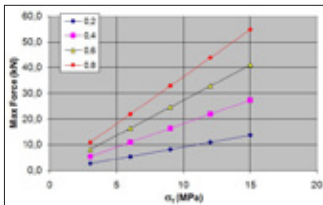
ISRM Splitting device for HQ size



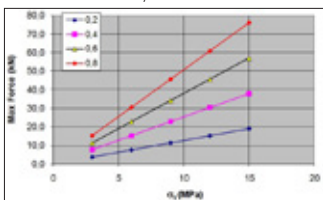
32-D9032/NX-/HQ

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.



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

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 Mechanics testing but also suitable

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

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.

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

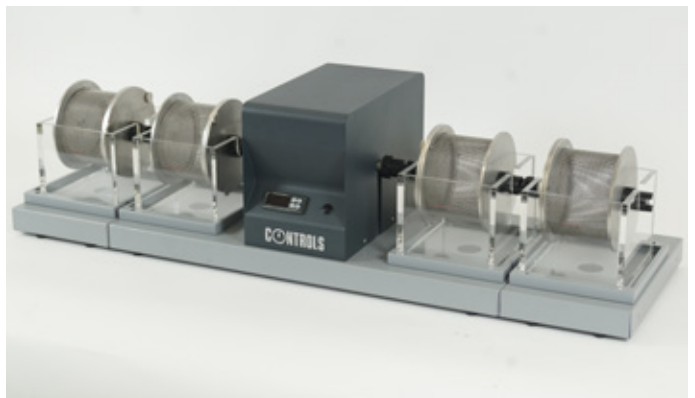
32-D0546/AZ

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

COMPACTED ROAD BASE and SUBBASE SOILS

33 Moisture/Density relationship

34 CBR California Bearing Ratio

35 Field density, Bearing capacity

38 Soil permeability

When highway or railway earthworks,

bases, sub-bases and dams are prepared for construction, it is necessary to compact the material mechanically, in order to achieve the necessary high degree of density. In doing so, this procedure increases the shear strength, reduces the permeability and water absorption, and reduces the tendency to settle under repeated loading. Compaction is therefore defined as the process of increasing the density of a material by mechanical means.

To simulate the procedure adopted in the earthworks to obtain a defined level of compaction in the field, several laboratory tests have been developed over the years; differing only by the varying level of energy applied to the soil sample.

The equipment detailed here in Section 33 concerns mainly Proctor moulds and compactors. Section 34 covers the CBR equipment and various models of loading presses, while the equipment presented in Section 35 covers all devices for determining the in-situ density and various models of plate bearing test apparatus.

Finally, Section 38 details the various apparatus for determining the permeability of soil.

Compacted road base and subbase soils

33

Moisture/Density relationship

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CBR California Bearing Ratio

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Field density, Bearing capacity

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Soil Permeability

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Proctor moulds and rammers

Used for determining the relationship between the moisture content and density of compacted soil. The moulds include collar, mould body and base plate.

The rammer construction includes a guide sleeve with vent holes. Different versions are available that conform to the various commonly used standards. They are all made of plated steel and are identical in shape, only differing slightly in diameter and capacity. For the extrusion of soil specimens from the mould, the Universal specimen extruder may be used. See Accessories.

An alternative (and preferable) method of compacting is to use an automatic compactor. For more information, see AUTO-PROCTOR, the automatic Proctor-CBR compactor, page 116

Proctor moulds and rammers conforming to EN

STANDARD ▶ EN 13286-2

Moulds

Code	Internal diameter (mm)	Body height (mm)	Approx. weight (kg)
33-T0070/EN	100 ± 1	120 ± 1	5.0
33-T0070/ENS*	100 ± 1	120 ± 1	5.0
33-T0071/EN	150 ± 1	120 ± 1	8.9
33-T0071/ENS*	150 ± 1	120 ± 1	8.9
33-T0074/E	250 ± 1	200 ± 1	32

*Split version

Steel plates

Code	Diameter (mm)	Thickness (mm)	Approx. weight (kg)
33-T0070/E1	99.5	10	0.6
33-T0071/E1	149.5	10	1.3
33-T0074/E1	249.5	20	7.6

Rammers

Code	Rammer diameter (mm)	Free fall height (mm)	Rammer weight (kg)	Approx. weight (kg)
33-T0075/E	50 ± 0.5	305 ± 3	2.49	3.0
33-T0076/E	50 ± 0.5	457 ± 3	4.54	5.3
33-T0077/E*	125 ± 0.5	600 ± 3	15.0	23

Proctor moulds and rammers conforming to ASTM, AASHTO and CNR

STANDARD

▶ ASTM D558, D698, D1557 ▶ AASHTO T99, T134, T180 ▶ CNR N°69

Moulds

Code	Volume (cm ³)	Internal diameter (mm)	Body height (mm)	Approx. weight (kg)
33-T0070/A	944	101.6	116.4	7.0
33-T0071/A	2124	152.4	116.4	9.0
33-T0072/A*	944	101.6	116.4	7.5
33-T0073/A*	2124	152.4	116.4	9.5

*Split versions

Rammers

Code	Rammer diameter (mm)	Free fall height (mm)	Rammer weight (kg)	Approx. weight (kg)
33-T0075	50.8	305.0	2.49	3.0
33-T0076	50.8	457.2	4.54	5.3

Accessories (for all moulds)

16-T0080

Universal extruder

Used to remove 4"(101.6 mm), 6"(152.4 mm), 100 mm and 150 mm diameter specimens from Proctor, CBR and Marshall moulds. Constructed of steel, with adapters that correspond to the diameter of the moulds and can easily be fitted. Capacity: 50 kN, Ram travel: 197 mm (ram) + 68 mm (screw), Weight: 25 kg (approx.)

Proctor moulds and rammers conforming to BS

STANDARD ▶ BS 1377:4, 1924:2

Moulds

Code	Volume (cm ³)	Internal diameter (mm)	Body height (mm)	Approx. weight (kg)
33-T0070/BS	1000	105.0	115.5	7.0

Rammer

Code	Rammer diameter (mm)	Free fall height (mm)	Rammer weight (kg)	Weight (kg)
33-T0075/B	50	300	2.5	3.0
33-T0076/B	50	450	4.5	5.3



16-T0080

Proctor moulds and rammers conforming to NF

STANDARD ▶ NF P94-078, P94-93, P98-231-1

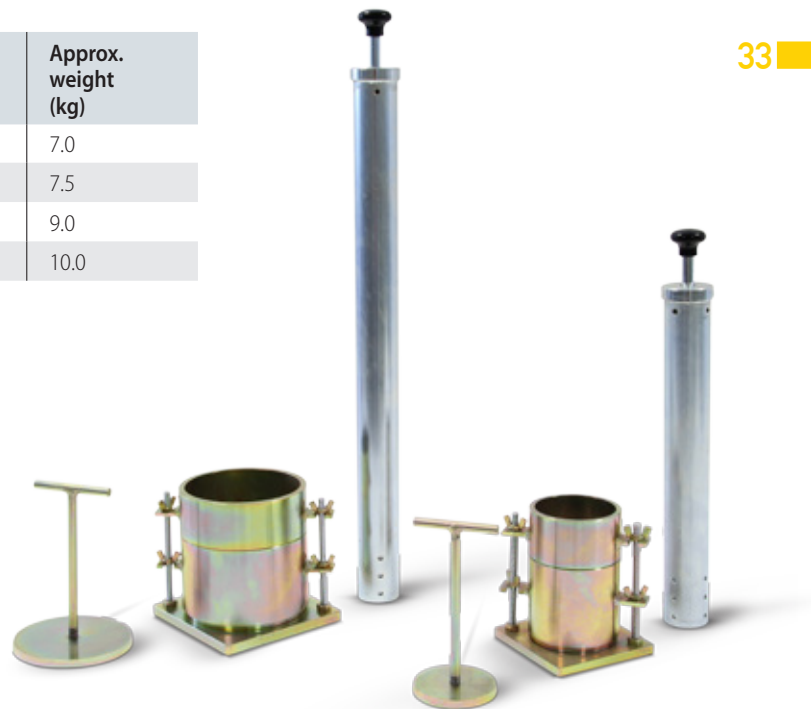
Moulds

Code	Volume (cm ³)	Internal diameter (mm)	Body height (mm)	Approx. weight (kg)
33-T0070/NF	944	101.6	116.4	7.0
33-T0072/NF*	944	101.6	116.4	7.5
33-T0089/NF	2758	152.0	152.0	9.0
33-T0089/NFS*	2758	152.0	152.0	10.0

*Split versions

Rammer

Code	Rammer diameter (mm)	Free fall height (mm)	Rammer weight (kg)	Weight (kg)
33-T0075	50.8	305	2.49	3.0
33-T0076	50.8	457	4.535	5.3



EN compaction equipment

Proctor moulds and rammers conforming to NLT and UNE

STANDARD ▶ NLT-108/91 ▶ UNE 103-500

Moulds

Code	Volume (cm ³)	Internal diameter (mm)	Body height (mm)	Approx. Weight (kg)
33-T0070/C	1000	102.0	122.4	7.0
33-T0070/C3*	1000	102.0	122.4	7.0
33-T0071/C	2320	152.4	127.0	10.0
33-T0071/C3*	2320	152.4	127.0	10.0

*Split versions

Rammer

Code	Rammer diameter (mm)	Free fall height (mm)	Rammer weight (kg)	Weight (kg)
33-T0075	50.8	305	2.49	3.0
33-T0076	50.8	457	4.535	5.3



ASTM Compaction equipment

Multi-Standards Universal Automatic Proctor/CBR Compactor

STANDARD

- ▶ EN 13286-2 ▶ EN 13286-47
- ▶ ASTM D698 ▶ ASTM D1557
- ▶ ASTM D1883 ▶ ASTM D558
- ▶ AASHTO T99 ▶ AASHTO T180
- ▶ AASHTO T193 ▶ BS 1377:4
- ▶ NF P94-093 ▶ NF P94-066
- ▶ UNE 103-500 ▶ AS 1289.5.1.1
- ▶ AS 1289.5.2.1

33

Detail of blow distribution, evidencing the central blow specimens



Mould Ø 150/6"



Mould Ø 100/4"



MAIN FEATURES and ADVANTAGES

- » Universal and fully automatic machine matching all Standards EN, ASTM, AASHTO, AS, BS, NF, and others, including central stroke
- » Immediate software setting of the reference Standard
- » Tailored compaction cycles programmable by the user
- » Continuous monitoring of the dropping height during compaction and automatic real time adjustment assuring high precision throughout the whole compacting path
- » Dropping height precision better than Standards' prescription from the beginning to the end of the compacting path
- » Automatic dropping high set by controller avoiding manual adjustment
- » Robust long-lasting transmission suitable for intensive use
- » 30 strokes / min
- » Safety guards and emergency stop button included
- » Total accessibility to the test area by double door system also including transparent panels
- » Compatible with mould dia. 100 to 152.4 mm (4" and 6")
- » Universal impact rammer including circular dia. 50 mm and 2"
- » Upgrading kit for Australian Standards available (see accessories)
- » Quick and easy rammer swap and weight adjustment
- » Noise reduction cabinet

CONTROLS Proctor/CBR universal compactor performs fully automatic, accurate, programmable and uniform compaction cycles providing repeatable test results and preventing human errors. Conforming to EN, ASTM, AASHTO, AS, BS, NF (and others), designed for moulds 100 mm - 4" and 150 mm - 6", the 33-T3700 Series features:

Superior accuracy

The machine continuously measures and adjusts the dropping height at each stroke during compaction assuring uniquely high precision throughout the whole compacting path. The rammer holding mechanism is based on a robust transmission assuring long-durability also in case of intensive use.

Optimal user interface

The machine adopts a user-friendly HMI based on high-resolution colour graphical display 128x80 pixels and membrane keyboard. Test procedures are pre-stored according all the reference Standards and it is also possible to program user-defined tailored procedures.

Total functionality

The machine is supplied with universal impact rammer including circular dia. 50 mm and 2". Furthermore, rammer swap and weight adjustment in accordance with international Standards (see Table) is quick and easy.

An upgrading kit for Australian Standards is also available on request (see accessories).

Dropping height is set from the digital display replacing any impractical manual adjustment. The mould fixing system, adopting a quick release clamping mechanism, is extremely flexible resulting compatible with both, CONTROLS and other made CBR/Proctor moulds (please ask our sales department for verification).

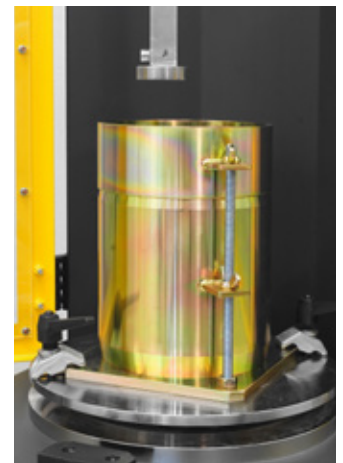
Standards	Rammer face dia.	Rammer weight	Rammer dropping height
ASTM D698	50,8 mm	2,49 kg	304,8 mm
ASTM D558	50,8 mm	2,49 kg	304,8 mm
ASTM D1557	50,8 mm	4,54 kg	457,2 mm
ASTM D1883	50,8 mm	2,49 kg 4,54 kg	304,8 mm 457,2 mm
AASHTO T99	50,8 mm	2,49 kg	305 mm
AASHTO T180	50,8 mm	4,54 kg	457 mm
AASHTO T193	50,8 mm	2,49 kg 4,54 kg	305 mm 457 mm
EN 13286-2 EN 13286-47 NF P94-093	50 mm	2,50 kg 4,50 kg	305 mm 457 mm
BS 1377-4	50 mm	2,50 kg 4,50 kg	300 mm 450 mm
AS 1289.5.1.1	50 mm	2,7 kg	300 mm
AS 1289.5.2.1	50 mm	4,90 kg	450 mm

Ergonomic and safe

The machine features a double door system including transparent panels ensuring comfortable access to the test area and providing free view of the chamber during compaction. Safety switches stop the machine when doors are open, and an emergency stop button is mounted on the control panel. Altogether, safe operation conforming to the CE directives is assured. A noise reduction cabinet is available on request. It is manufactured from steel sheet and lined internally with soundproofing material. If necessary, the control panel can be easily removed and mounted externally. Furthermore, this soundproofing cabinet is designed to keep the operator access fully comfortable by double top-and-front opening system.



Detail of the quick release clamping mechanism for the mould



Double door system with transparent panels for easy access to the wide test area

Models	33-T3712, 33-T3713, 33-T3714
Mould/specimen dia.	100 to 152.4 mm (4" and 6")
Rammer faces (interchangeable conforming to Standards, see table)	Circular dia. 50 mm and 2"
Rammer weight (interchangeable conforming to Standards, see table)	2.49, 2.50, 2,70* kg 4.50, 4.54, 4,70* kg
Rammer dropping height (digitally set conforming to Standards, see table)	300, 305, 450, 457 mm
Blow rate	30 strokes / min
Safety features	Compliant with CE directives
Power rating	650 W approx.
Overall dimensions (wxdxh)	494 x 595 x 2378 mm
Weight approx.	150 kg

Ordering information

33-T3712
Universal Fully Automatic programmable Proctor/CBR compactor for specimens from 100 mm - 4" to 150 mm - 6" mm diameter, conforming to EN, ASTM, AASHTO, BS, NF, AS and major international Standards. Universal rammer kit included.
230 V, 50 Hz, 1 ph

33-T3713
Same as above but 220 V, 60 Hz, 1 ph

33-T3714
Same as above but 110 V, 60 Hz, 1 ph

Accessories

33-T3712/AU
Upgrading kit for Australian Standard AS 1289.5.1.1 and AS 1289.5.2.1

33-T3712/CB
Noise reduction cabinet for CBR-Proctor universal compactor

ASTM-AASHTO Automatic Proctor/CBR Compactor

Beside the multi-Standards Proctor/CBR Universal Automatic Compactor, it is also available a simpler but always automatic model specifically conforming to ASTM-AASHTO which do not require a central impact. More details and full ordering information about this model can be found in the CONTROLS Group website.

*using upgrade kit 33-T3712/AU

Vibration compaction hammer

STANDARD

- ▶ EN12697-9 ▶ EN 12697-10
- ▶ EN12697-32 ▶ EN 13286-4
- ▶ BS 1377:4 ▶ BS 1924:2

Used for the compaction of Proctor and CBR soil specimens. using the appropriate tamping foot it can also be used for compacting asphalt in the "Percentage refusal density test". See Vibrating hammer for PRD specimens.

The hammer is supplied without support frame and tampers which have to be ordered separately. See accessories.

- Overall dimensions (wxdxh): 130x530x380 mm
- Weight approx.: 6.8 kg

Ordering information

33-T8702/A

Vibrating hammer. 220-240 V, 50-60 Hz, 1 ph

33-T8702/AZ

Same as above but 110 V, 60 Hz, 1 ph

Accessories

33-T8702/FR

Supporting frame for vibrating hammer.

- Weight: 26 kg approx.

33-T8702/W

Extra weight, 20 kg total, for steel frame model 33-T8702/FR

33-T0087/6

Small tamping foot, 102 mm dia., head only

33-T0087/7

Large tamping foot, 146 mm dia., head only

33-T0087/8A

Shank, 300 mm long



33-T8702/A with 33-T8702/FR, 33-T0087/6, 33-T0087/7 and mould

indicates the maximum pressure obtained in the test.

Supplied in a wooden carrying case.

- Load scale: 0 to 55 kg , 1 kg subdivisions with max load indicator
- Diameter of interchangeable needles: 28.55, 24.79, 20.22, 16.54, 12.83, 9.07, 6.40, 5.23 and 4.52 mm
- Weight approx.: 3.5 kg

33-T0166

LOAD RING PENETROMETER



Used for measuring the bearing strength and compaction degree of soils. The apparatus consists of a "T" shaped handle connected to a load ring 1 kN (100 kgf) cap., with max load pointer, and an extension rod with five 100 mm graduations. The 30° end cone has an area of 645 mm² (1 sq. in). Supplied complete with calibration chart.

- Weight approx.: 4 kg

33-T0165

COMPACTION PENETROMETER

STANDARD

- ▶ ASTM D1558

Used for establishing the moisture content-penetration resistance relationship of fine-grained soils.

It consists of a special spring dynamometer with pressure indicating scale on the stem of the handle. A sliding ring on the stem



33-T0165

Compressive strength of Unbound and Hydraulically bound mixtures

STANDARD

- ▶ EN 12390-4 ▶ EN 13286-41



This multipurpose compression tester can be used for applying static compaction to CBR samples or for 10% Fines/ACV on aggregates.

For more information see page 294

Ordering information

50-C92P02

PILOT Pro Automatic COMPACT-Line compression tester, 600 kN capacity, load measurement by pressure transducer. 230 V, 50-60 Hz, 1 ph.

50-C92P04

As above but 110 V, 60 Hz, 1 ph.

Determination of compactability

Moisture Condition Value (MCV) and Chalk Crushing Value (CCV)

STANDARD

▶ EN 13286-46 ▶ BS 1377:4

Manufactured under license from TRL-UK

33-T0064 MOISTURE CONDITION APPARATUS

Used in the assessment of earthworks for construction by comparing compaction characteristics at various moisture contents in order to determine the "Moisture Condition Value" and "Chalk Crushing Value." This robust apparatus is designed for use in the construction laboratory and incorporates a rammer, scale, counter, and mould.

Weight: 55 kg (approx.)

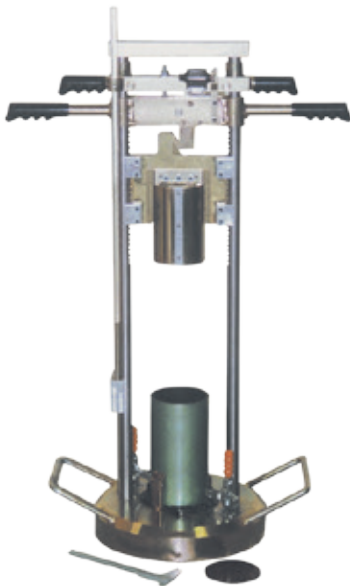
Accessories

33-T0064/1

Moisture condition mould

33-T0064/2

Fibre discs, pack of 6.



Relative density of cohesionless soil

STANDARD

▶ EN 13286-5 ▶ ASTM D4253

▶ ASTM D4254

This method, in the EN standard, covers the determination of the maximum dry density and water content of cohesionless materials when compacted using a vibrating table. Materials for which this method is applicable may contain up to 12% fines (<0.063 mm) by mass. The maximum particle size of the material to be tested is 80 mm. This method applies to mixtures to be used in road construction.

The ASTM also specifies that the method is used for the determination of the relative density of cohesionless soil for which impact compaction will not produce a well-defined moisture/density relationship curve and where the maximum density of the impact method will generally be less than by the vibratory method.

Two versions of test set are available: 33-T0063/A conforming to EN and 33-T0063 conforming to ASTM. They are practically identical except for the 0.1 ft³ mould which is also included with 33-T0063.



Specifications

Both 33-T0063/A (EN) and 33-T0063 (ASTM) test sets include:

- **33-T0063/3:** 14200 cm³ (0.5 ft³) mould set
- **33-T0063/4:** Relative density gauge set
- **33-T0063/1:** Vibrating table (33-T0063/1 Y for 220 V, 60 Hz or 33-T0063/1 Z for 110 V, 60 Hz) with the following specifications:
 - Vibration frequency: 3600 rpm.
 - Amplitude range: 0.05 to 0.64 mm
 - Vibrator type: electromagnetic
 - Separate amplitude control panel
 - Table dimensions: 762 x 762 mm
 - Table capacity: 250 kg

The 33-T0063 ASTM version also includes:

33-T0063/2

0.1 cu. Ft. relative density mould set (cylinder with lead, cylinder in cast aluminum, disc with handle and upper cylinder).

-Overall weights approx.:

33-T0063/A: 289 kg

33-T0063: 310 kg

Note: each part can be ordered individually

Ordering information

33-T0063/A

EN Relative density test set. 230 V, 50 Hz, 1 ph.

33-T0063

ASTM Relative density test set. 230 V, 50 Hz, 1 ph.

33-T0063/Y

As above but 220 V, 60 Hz, 1 ph.

33-T0063/Z

As above but 110 V, 60 Hz, 1 ph.

Accessories

33-T0063/7

12.5 and 25 mm diameter pouring devices.



CBR (California Bearing Ratio), IBI (Immediate Bearing Index)

This method is used for the laboratory evaluation of subgrade and subbase coarse materials in road construction. The apparatus comprises moulds with accessories, compaction rammers (the automatic models are the same as those used for the compaction of Proctor moulds - see page 116), load testing machines with accessories, etc. Different models are available that conform to the various relevant specifications. Please note that often, some of the items (e.g. Swell plate, Tripod etc.) are common to more than one standard test set.

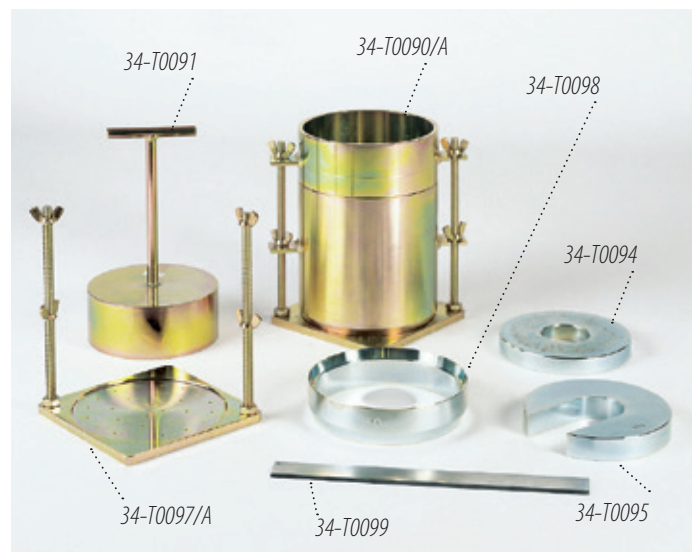
34

ASTM, AASHTO, UNE, UNI CBR EQUIPMENT

STANDARD ▶ ASTM D1883 ▶ AASHTO T193 ▶ UNE 103-502 ▶ CNR UNI 10009

Ordering information and specifications

Code	Description	Specifications	Approx. weight, kg
34-T0090/A	CBR mould	With collar and perforated base plate - Plated steel. 6" (152.4 mm) diameter, - 7" (177.8 mm) body height	7.8
34-T0090/A1	Split CBR mould	Same as T0090/A, split longitudinally on one side	8.5
34-T0090/3	Filter screen	Stainless steel woven mesh, No.100 (150 µm), 144 mm diameter	0.05
33-T0076	Compaction rammer	2" (50.8 mm) diameter rammer face, 457.2 mm fall, 4.54 kg weight	5.3
33-T0096	Sliding weight rammer (as alternative to 33-T0076)	2" (50.8 mm) diameter rammer face, 457.2 mm fall, 4.54 kg weight	8
34-T0091	Spacer disc with "T" handle	5 ¹⁵ / ₁₆ " (150.8 mm) diameter x 2.416" (61.4 mm) high. Plated steel	7.5
34-T0091/1	UNE Spacer disc	Plated steel	7.5
34-T0094	Annular surcharge	Plated steel, 2.27 kg	2.27
34-T0095	Slotted surcharge	Plated steel, 2.27 kg	2.27
34-T0098	Cutting edge	Plated steel	0.5
34-T0099	Straight edge	3 x 30 x 300 mm	0.3
34-T0097/A	Solid CBR base	Plated steel	1.0
86-D1800	Filter paper	No.1 x 150 mm diameter. Pack of 100	0.3
34-T0092	Swell plate	With adjustable stem	1.0
34-T0093	Gauge tripod	Non-corrodible alloy	0.3
82-D1255	Dial gauge	10 mm travel, 0.01 mm divisions	0.1
16-T0080	Universal extruder	For 100 to 152.4 mm diameter samples	25
34-T0100/B	Soaking tank	Plastic, 680 x 490 x 540 mm (internal dimensions)	9.1



ASTM, AASHTO, UNE, CNR test set (partial)

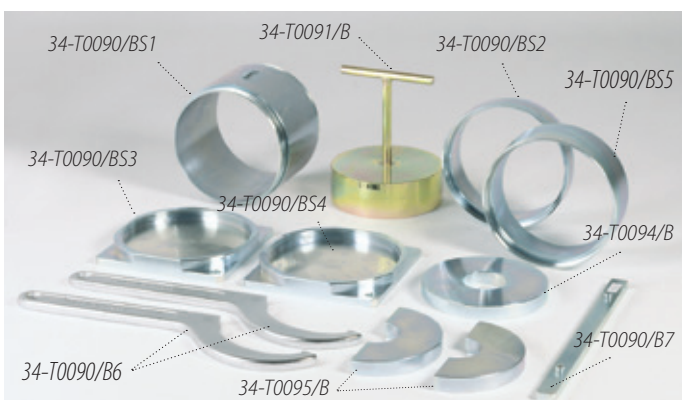


BS CBR EQUIPMENT

STANDARD ▶ BS 1377:4 ▶ BS 1924:2

Ordering information and specifications

Code	Description	Specifications	Ap- prox. weight, kg
34-T0090/BS1	CBR mould body	Plated steel with both ends threaded to fit the base or collar. 152 mm internal diameter x 127 mm high	3.0
34-T0090/BS2	Extension collar	152 mm internal diameter x 50 mm high	1.0
34-T0090/BS3	Perforated base plate	Plated steel	1.8
34-T0090/BS4	Solid base/top plate	Plated steel	1.8
34-T0090/BS5	Cutting collar	Plated steel	1.0
34-T0090/B6	"C" spanner	To tighten / loosen the collar from the mould body. Two required	1.0
34-T0090/B7	Tool for base plate	To tighten / loosen the solid or perforated base plate from the mould	1.0
34-T0091/B	Compaction plug with handle	150 mm diameter x 50 mm high	7.2
33-T0076/B	Compaction rammer	50 mm diameter rammer face, 450 mm fall, 4.5 kg weight	5.3
34-T0094/B	Annular weight	Plated steel, 2 kg	2.0
34-T0095/B	Split weight	Plated steel, 2 kg	2.0
34-T0095/C	Tamping bar	12.7 mm dia. x 380 mm long	0.4
34-T0099	Straight edge	3 x 30 x 300 mm	0.3
82-D1694	Steel rule	500 mm long	0.1
86-D1800	Filter paper	No.1 x 150 mm diameter. Pack of 100	0.3
34-T0092	Swell plate	With adjustable stem	1.0
34-T0093	Gauge tripod	Non-corrodible alloy	0.3
82-D1255	Dial gauge	10 mm travel, 0.01 mm divisions	0.1
82-D1257 as alt. to D1255	Dial gauge	30 mm travel, 0.01 mm divisions	0.1
16-T0080	Universal extruder	For 100 to 152.4 mm diameter samples	25
34-T0100/B	Soaking tank	Plastic, 680 x 490 x 540 mm (internal dimensions)	9.1



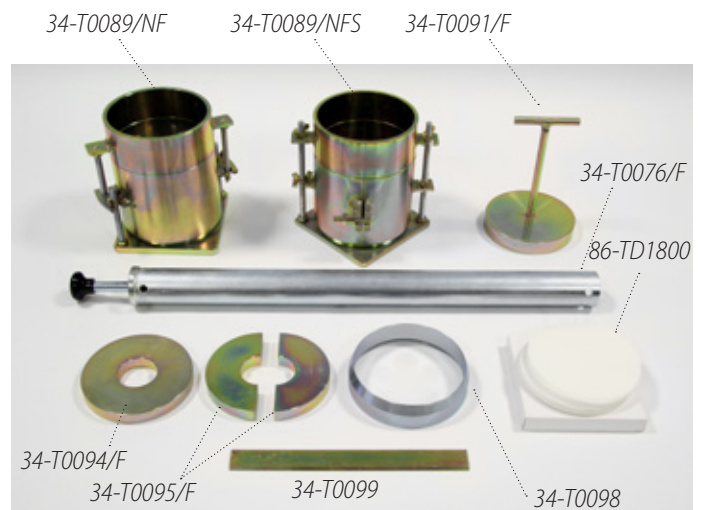
BS test set (partial)

NF CBR EQUIPMENT

STANDARD ▶ NF P94-078 ▶ NF P94-093 ▶ NF P98-231-1

Ordering information and specifications

Code	Description	Specifications	Ap- prox. weight, kg
34-T0089/NF	NF CBR mould	Complete with collar and perforated base plate. Plated steel. 152 mm diameter x 152 mm body height	9.0
34-T0089/NFS	Split NF CBR mould	Same as T0089/NF, split longitudinally on one side	9.0
34-T0076/F	Modified compaction hammer	51 mm diameter rammer face, 457.2 mm fall, 4.54 kg weight	5.3
86-D1800	Filter paper	No.1 x 150 mm diameter. Pack of 100	0.3
34-T0091/F	Spacer disc	Plated steel, 25.4 mm high	3.8
34-T0091/1	Spacer disc	Plated steel, 36 mm high	5.3
34-T0094/F	Annular surcharge weight	Plated steel, 2.3 kg	2.3
34-T0095/F	Split surcharge weight	Plated steel, 2.3 kg	2.3
34-T0098	Cutting edge	Plated steel	0.5
34-T0099	Straight edge	3 x 30 x 300 mm	0.3
34-T0092/F	Swell plate	Plastic with 3 mm diameter holes	0.3
82-D1255	Dial gauge	10 mm travel, 0.01 mm divisions	0.1
82-D1257 as alt. to D1255	Dial gauge	30 mm travel, 0.01 mm divisions	0.1
34-T0093	Gauge tripod	Non-corrodible alloy	0.3
34-T0100/B	Soaking tank	Plastic, 680 x 490 x 540 mm (internal dimensions)	9.1
16-T0080	Universal extruder	For 100 to 152.4 mm diameter samples	25



NF test set (partial)

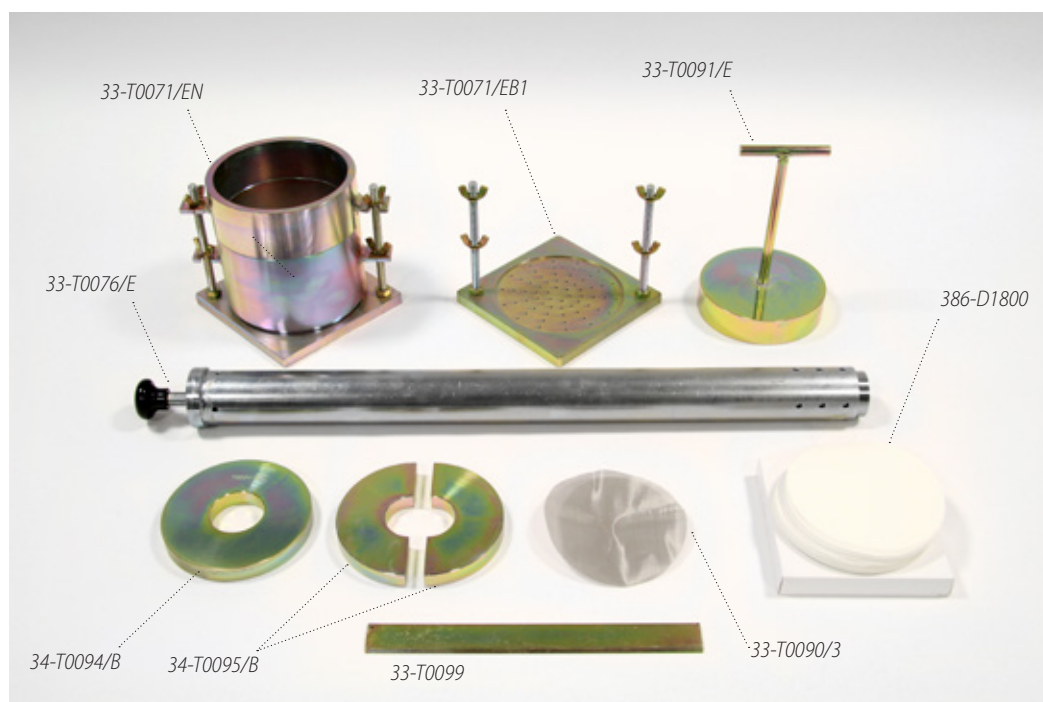
EN CBR EQUIPMENT

STANDARD ▶ EN 13286-47

34

Ordering information and specifications

Code	Description	Specifications	Approx.weight, kg
33-T0071/EN	Proctor/CBR mould	With collar and solid base plate. Plated steel. 150 mm diameter, 120 mm height	8.9
33-T0071/ENS	Proctor/CBR mould split version	With collar and solid base plate. Plated steel. 150 mm diameter, 120 mm height	8.9
33-T071/EB1	Perforated base plate	Plated steel	1.0
34-T0090/3	Filter screen	Stainless steel woven mesh, No.100 (150 µm), 144 mm diameter	0.05
33-T0076/E	Compaction rammer	50 mm diameter rammer face, 457 mm fall, 4.50 kg weight	5.3
34-T0091/E	Spacer disc with "T" handle	149.5 mm diameter, 36 mm high. Plated steel	5.0
34-T0094/B	Annular surcharge	Plated steel, 2 kg	2.0
34-T0095/B	Split surcharge	Plated steel, 2 kg	2.0
34-T0099	Straight edge	3 x 30 x 300 mm	0.3
86-D1800	Filter paper	No.1 x 150 mm diameter. Pack of 100	0.3
34-T0092/E	Swell plate	Aluminum perforated with adjustable stem	1.0
34-T0093	Gauge tripod	Non-corrodible alloy	0.3
82-D1255	Dial gauge	10 mm travel, 0.01 mm divisions	0.1
82-D1257 <i>as alt. to D1255</i>	Dial gauge	30 mm travel, 0.01 mm divisions	0.1
16-T0080	Universal extruder	For 100 to 152.4 mm diameter samples	25
34-T0100/B	Soaking tank	Plastic, 680 x 490 x 540 mm (internal dimensions)	9.1
33-T0077/E	Proctor Hammer	High energy, 15 kg falling weight	15



EXPANSION (SWELL) TEST APPARATUS

**34-T0093
DIAL GAUGE TRIPOD**

Used to support the dial gauge for monitoring the swelling of CBR samples. Made from a special non-corrodible alloy. Weight: 0.3 kg (approx.)

82-D1255
Dial gauge, 10 x 0.01 mm
as alternative:

82-D1257
Dial gauge, 30 x 0.01 mm

*34-T0092 (T0092/E) with
Tripod 34-T0093 and Dial
gauge 82-D1257*



34-T0092
ASTM Perforated plate with adjustable stem (Swell plate) . Plated steel.
-Weight: 1 kg approx.

34-T0092/F
NF Perforated plate with adjustable stem (Swell plate). Plastic.
-Weight: 0.3 kg approx.

34-T0092/E
EN Perforated plate with adjustable stem (Swell plate) . Aluminum.
-Weight: 0.3 kg approx.



34-T0092/F

**34-T0100/B
LARGE SOAKING TANK**
The CBR moulds are immersed in this plastic water tank during the swelling test. Supplied complete with supporting base, which allows free water circulation.
Capacity: 6 CBR moulds
Dimensions:
External: 800 x 600 x 550 mm;
Internal: 680 x 490 x 540mm;
Weight: 9.1 kg (approx.)



*Extruder 16-T0080. Detailed information
on page*



34-T0100/B with CBR moulds

FIELD CBR APPARATUS

STANDARD
▶ ASTM D4429 ▶ BS 1377:9
▶ BS 1924:2 ▶ UNI 10009

34-T0115/A
Field CBR test set

Used for the in-situ determination of the bearing capacity of soils used in road construction. The complete set is housed in a strong carrying case and includes:

34-T0112*
50 kN capacity mechanical jack.
Weight 8.5 kg.

34-T0112/1*
Ball seating for 34-T0112. Weight 1 kg.
82-T1000/40M*
40 kN capacity load ring. Weight 4 kg.

34-T0103/1*
Adjustable CBR penetration piston.
Weight 2.2 kg.

34-T0104/7*
Adjustable dial gauge holder.

34-T0115/3
Set of 3 extension rods and adapters.
Weight 33 kg.

34-T0115/41
Datum bar assembly including two tripod stands and a 1220 mm long aluminum bar. Weight 7 kg.

82-D1257*
Penetration dial gauge, 30 mm travel,
0.01 mm divisions.

34-T0115/5
9 kg slotted surcharge weight.

34-T0115/6
4.5 kg slotted surcharge weight.



34-T0114 with items*

34-T0115/7
4.5 kg annular surcharge weight.

**Items for use with the 34-T0114 to
create a hand operated CBR laboratory
loading press.*

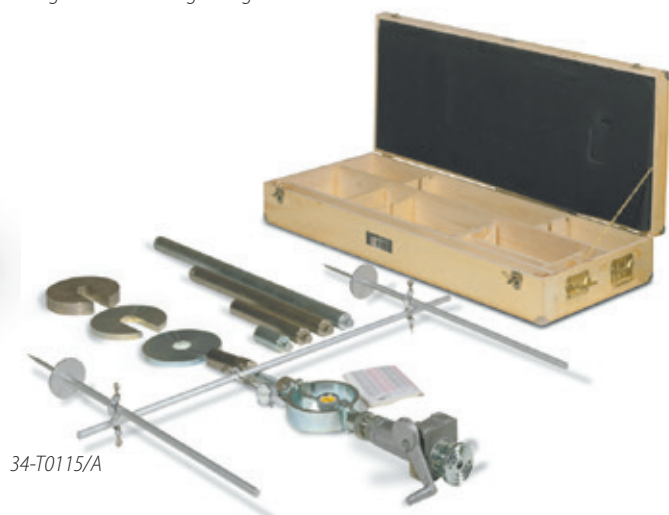
Total weight: 70 kg (approx.)

Note: all above items can also be purchased individually.

Accessories

34-T0115/9
Vehicle bracket. For fixing loading jack to a vehicle.

34-T0114
Conversion frame to convert the 34-T0115/A test set into a hand operated CBR loading press for laboratory use.
Total weight (including parts identified with the *in the 34-T0115/A set): 55 kg (approx.)



34-T0115/A

CBR (California Bearing Ratio) Penetration test

STANDARD ▶ ASTM D1883 ▶ EN 13286-47 ▶ BS 1377:4 ▶ NF P94-078 ▶ AASHTO T193 ▶ UNI 10009

The CBR penetration test can be performed with a number of loading presses, some of them specifically designed for CBR tests, and others with multiple applications (Universal models-page 126 and 318), at different levels of sophistication. Further details of the product range available is provided below to assist your selection.

34

34-T0102/A

CBR Mechanical loading press, manually/hand operated, 50 kN capacity, complete with 50 kN load ring, penetration piston and dial gauge.



34-T0106/A

CBR Motorized loading press, 50 kN capacity, complete with 50 kN load ring, penetration piston and dial gauge. 230 V, 50 Hz, 1 ph.

- Two column frame with upper crossbeam adjustable in height.
- Test speed: 1.27 mm/min
- Maximum ram travel: 120 mm
- Load ring 50 kN with 0.001 mm div. gauge*
- Dial gauge 30 x 0.01 mm
- Adjustable penetration piston
- Overall dimensions: 392 x 495 x 1194 mm
- Weight approx.: 75 kg

34-T0106

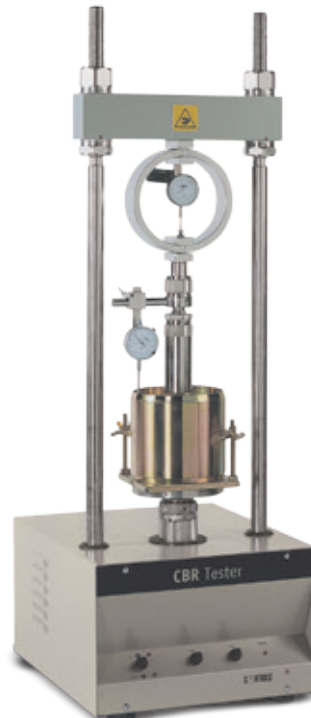
CBR Motorized loading press. Frame only. 230 V, 50 Hz, 1 ph.

To be completed with accessories selected by the user. See page 125

For 110 V, 60 Hz models, add "Z" to the code.

For 220 V, 60 Hz models, add "Y" to the code.

e.g. 34-T0106/AY, 34-T0106/Z



- Two column frame with upper crossbeam adjustable in height.
- Maximum ram travel: 120 mm
- Load ring 50 kN with 0.001 mm div. gauge*
- Dial gauge 30 x 0.01 mm
- Adjustable penetration piston
- Overall dimensions: 300 x 410 x 1140 mm
- Weight approx.: 75 kg

***Important note: All standards prescribe load measurement device (load rings) with minimum resolution obtainable with gauge 0.001 mm divisions. Gauges with 0.01 mm divisions are not accepted.**

CBR ACCESSORIES TO PERFORM THE TEST IN DIGITAL MODE

The 34-T0106 frame can be equipped in digital mode, as shown, with the following accessories:

34-V0107/CBR

Test set to perform the CBR test in digital mode, including:

82-P0375

Load cell, 50 kN capacity

82-P0375/C

Adapter to fit load cell (two pieces)

82-P0322

Displacement transducer, 25 mm travel

34-T0104/81

Adjustable transducer holder

34-T0103/1

Adjustable CBR penetration piston

Also required:

82-P60R02

DIGIMAX TS, Touchscreen, 4-channel readout and processing unit for load and displacement sensors. Suitable for CBR, Marshall, Indirect tensile and general purpose tests. 110-240 V, 50-60 Hz, 1 ph.

82-SW/CMU

PC software for CBR, Marshall, Indirect tensile and general purpose tests.

Note: for more details and information on the DIGIMAX TS and Software, see page 129



34-V0107/CBR complete kit for CBR test, digital configuration

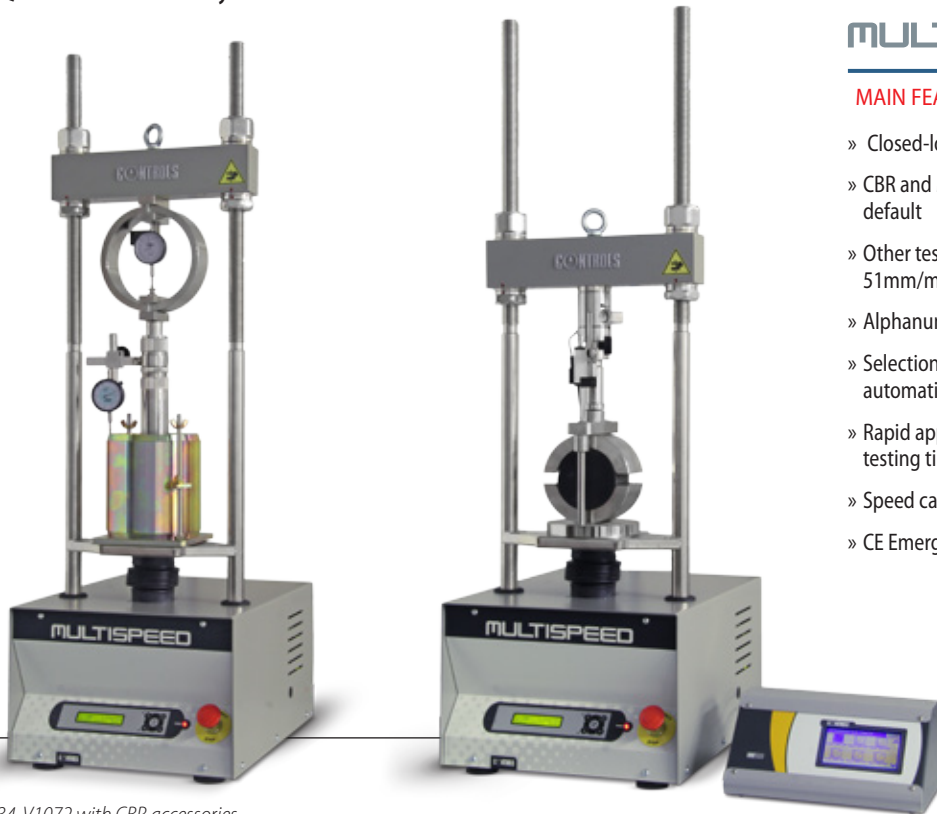


34-T0106 with 34-V0107/CBR and 82-P60R02

MULTISPEED Digital and Automatic universal testers

Suitable for CBR, Marshall*, Indirect tensile*, Unconfined compression*, Quick triaxial* and many other tests.

34



34-V1072 with CBR accessories (analogic)

34-V1072 with Marshall accessories (digital) and Digimax TS 82-P60R02.

MULTISPEED DIGITAL

MAIN FEATURES

- » Closed-loop speed control
- » CBR and MARSHALL test speed can be selected by default
- » Other testing speeds (custom) between 0.2 and 51 mm/min, can be easily set
- » Alphanumeric 2 x16 character display
- » Selection of maximum platen displacement with automatic stop
- » Rapid approach and return function, to reduce the testing time
- » Speed calibration function by firmware
- » CE Emergency stop button

34-V1072 SERIES MULTISPEED DIGITAL VERSION COMPRESSION TESTER

The MULTISPEED compression tester is the ideal solution for Road testing laboratory. The 50 kN capacity and the fully variable test speed of 0.2 to 51 mm/min make it possible to perform not only the CBR and Marshall tests, but many other applications like the Indirect Tensile test, Quick Triaxial tests, Unconfined and Uniaxial soil testing and, in general, all tests to be performed under displacement control. The machine can be equipped with analogical or digital load/displacement measurement systems as well as with the specific accessories, to suit either the field or central laboratory requirement. The various test accessories and relevant Standards, are shown and listed on page 128 and 320

**For the other applications (Marshall, Indirect tensile, etc.), see page 128*

Ordering information

34-V1072

MULTISPEED, digital compression tester, 50 kN capacity, testing speed steplessly adjustable from 0.2 to 51 mm min. 230V, 50-60 Hz, 1 ph

34-V1074

Same as above but 110 V, 60 Hz, 1 ph

CBR accessories

Analogical mode

34-T0103/3

Adjustable penetration piston complete with dial holder and dial gauge 30 x 0.01 mm div.

82-T1000/50M

Load ring 50 kN capacity, fitted with dial gauge 0.001 mm div.

Digital mode

34-V0107/CBR

Test set to perform the CBR test in digital mode, including:

82-P0375

Load cell, 50 kN capacity

82-P0375/C

Adapter to fit load cell (two pieces)

82-P0322

Displacement transducer, 25 mm travel

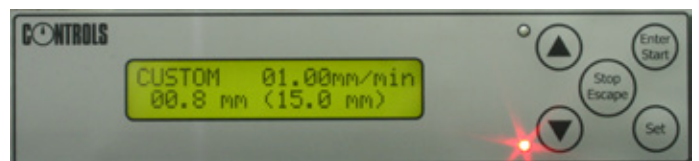
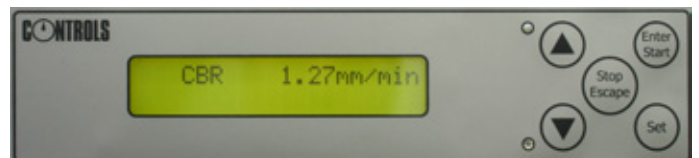
34-T0104/81

Adjustable transducer holder

34-T0103/1

Adjustable CBR penetration piston

All above items can be ordered individually.



Examples of screenshots

82-SW/CMU

PC software for CBR, Marshall, Indirect tensile and general purpose tests.

Note: The Multispeed 34-V1072 Series also requires data acquisition system. See Digimax TS 82-P60R02 on page 129



MULTISPEED AUTOMATIC

MAIN FEATURES

- » Stand-alone automatic digital load frame 50 kN capacity
- » Closed-loop speed control
- » Four channel on board data acquisition
- » Large touchscreen graphic display: 240 x 128 pixel
- » CBR and MARSHALL test speed can be selected by default
- » Infinitely variable speed from 0.05 to 51 mm/min can be easily set by keyboard
- » Data download: using LAN port (ASCII, TXT or Controls format)
- » USB port for USB memory stick data storage

34

34-V1172 equipped with CBR digital testing accessories

34-V1172 equipped with Marshall digital testing accessories

34-V1172 SERIES MULTISPEED AUTOMATIC VERSION UNIVERSAL TESTER

The 34-V1172 Series MULTISPEED is a versatile stand-alone machine; an ideal solution for road testing laboratories and generally for any test that requires displacement/speed control. The 50kN capacity and fully variable speed of 0.05 to 51 mm/min make it possible to perform not only CBR and Marshall tests, but also many other applications such as indirect tensile, quick undrained triaxial and unconfined/uniaxial soil tests.

No external transducer is required for displacement measurement. The firmware allows performance of transducer calibrations and setting of up to 10 test profiles, saving data onboard. A real-time test graph and transducer data are displayed on the touchscreen. The machine has built-in data acquisition with four channels dedicated to two strain gauge load cells and two potentiometric linear transducers; one of each can be used during the test.

Ordering information

34-V1172

MULTISPEED automatic compression tester, 50 kN capacity, 4 channel built-in data acquisition and variable speed from 0.05 to 51 mm/min. 230V, 50-60Hz, 1 ph

34-V1174

same as above but 110V, 60Hz, 1 ph

Technical specifications

Both machine series 35-V1072 and 35-V1172 features:

- Horizontal clearance (distance between columns): 270 mm
- Maximum vertical clearance (without accessories): 730 mm
- Platen travel: 100mm
- Overall dimensions (l x w x h): 392x495x1213 mm
- Net weight approx.: 65 kg

CBR accessories

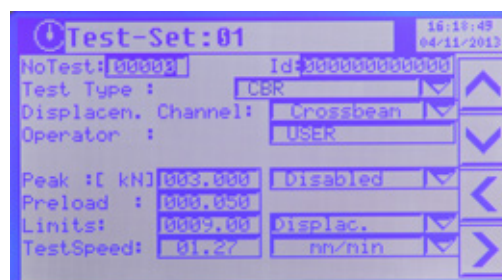
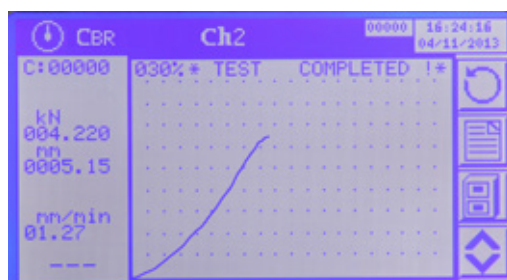
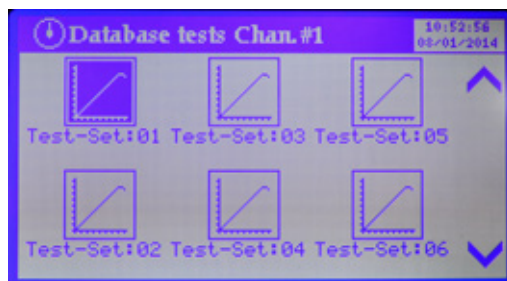
Digital mode

34-V0107/CBR

See page 126

82-SW/CMU

PC software for CBR, Marshall, Indirect tensile and general purpose tests.



Examples of screenshots

Multispeed accessories for 34-V1072 and 34-V1172 series

To perform MARSHALL test in digital mode conforming to:

STANDARD

- ▶ EN 12697-34* ▶ ASTM D1559
- ▶ ASTM D5581 ▶ ASTM 6927-06
- ▶ AASHTO T245 ▶ BS 598-107
- ▶ NF P98-0251-2 ▶ DIN 1996
- ▶ CNR 30



34-V0107/MAR

Test set to perform the Marshall test in the digital mode, including:

82-P0375

Load cell 50 kN capacity

82-P0375/C

Adapter to fit load cell (two pieces)

82-P0322

Displacement transducer, 25 mm travel

34-T0104/81

Adjustable transducer holder

34-T0104/13

Compression device extension

34-T0104/10

Compression device

76-B0033/4

Stability mould

All above items can be ordered individually.

82-SW/CMU

PC software for CBR, Marshall, Indirect tensile and universal tests. (Optional).

Note: The Multispeed 34-V1072 Series also requires data acquisition system. See Digimax TS 82-P60R02 on next page.

**The EN Standard specifies that Marshall Testers must be used in digital mode with a recording unit.*

To perform CBR and MARSHALL tests in digital mode

(To avoid duplications when both tests have to be performed)

34-V0107/CM

Test set for performing CBR and Marshall tests in digital mode, including:

82-P0375

Load cell, 50 kN capacity

82-P0375/C

Adapter to fit load cell (two pieces)

82-P0322

Displacement transducer, 25 mm travel

34-T0104/81

Adjustable transducer holder

34-T0103/1

Adjustable CBR penetration piston

34-T0104/13

Compression device extension

34-T0104/10

Compression device

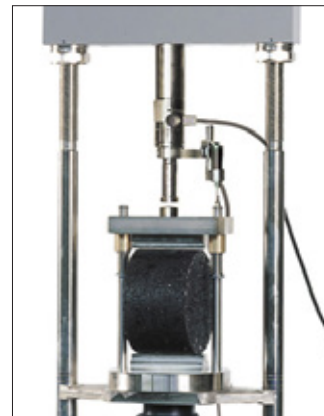
76-B0033/4

Stability mould 4"

To perform INDIRECT TENSILE tests on bituminous mixtures conforming to:

STANDARD

- ▶ EN 12697-12 ▶ EN 12697-23
- ▶ ASTM D4123 ▶ CNR 34



82-P0375

Load cell, 50kN capacity

82-P0375/C

Adapter to fit load cell (two pieces)

82-P0322

Displacement transducer, 25mm travel

34-T0104/81

Adjustable transducer holder

34-T0104/13

Compression device extension

34-T0104/10

Compression device

76-B0078/F

Frame for tensile splitting device. To be completed with suitable pair of loading strips.

76-B0078/F1

Pair of loading strips for 100 mm diameter samples

76-B0078/F2

Pair of loading strips for 150 mm diameter samples

82-SW/CMU

PC software for CBR, Marshall, Indirect tensile and universal tests. (Optional).

Note: The Multispeed 34-V1072 Series also requires data acquisition system. See Digimax TS 82-P60R02 on next page.

To perform UNCONFINED COMPRESSION tests on soil conforming to:

STANDARD

- ▶ EN 12697-12 ▶ EN 12697-23
- ▶ ASTM D4123 ▶ CNR 34



82-P0370

Load cell, 2.5kN capacity

82-P0375/C

Adapter to fit load cell (two pieces)

82-P0322

Displacement transducer, 25mm travel

34-T0104/81

Adjustable transducer holder

70-T0108/5

Load cell extension

34-T0104/4

Platens for unconfined compression

82-SW/CMU

PC software for CBR, Marshall, Indirect tensile and general purpose tests (Optional)

Note: The Multispeed 34-V1072 Series also requires data acquisition system. See Digimax TS 82-P60R02 on next page.



If further tests have to be performed, eg. Unconfined, Quick triaxial, Compression and flexural tests on rock and cement etc, please refer to the web page universal tester accessories.

DIGIMAX TOUCH screen readout and data acquisition unit for CBR, Marshall, Indirect tensile and universal tests

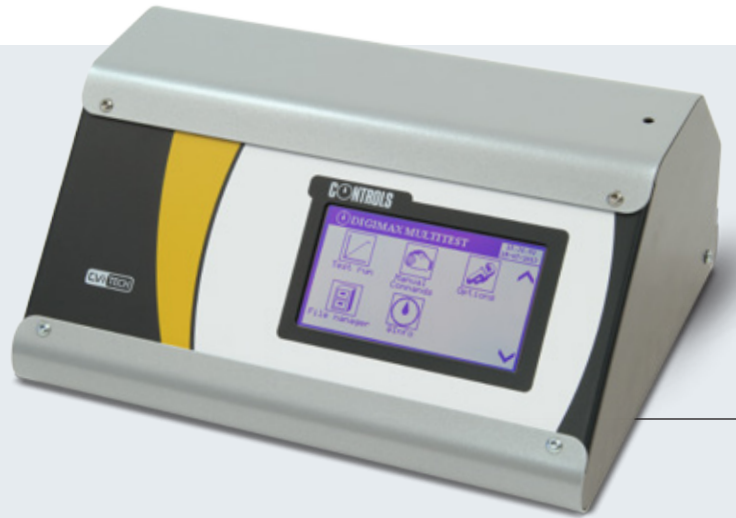
MAIN FEATURES

- » Large size touch screen display 240 x 128 pixel showing numbers and diagrams
- » PC connection via LAN port allowing broader band, better stability and longer distance compared to the RS232 serial communication. Basic software included
- » Unlimited data storage on USB pen drives
- » Total number of channels: 4 in total. 2 channels are dedicated to load sensors and 2 channels are dedicated to displacement transducers. A maximum of 2 channels (1 load and 1 displacement) selected by the user can be simultaneously used
- » Effective sampling rate up to 50 / sec

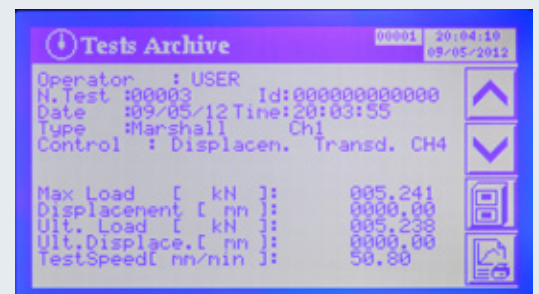
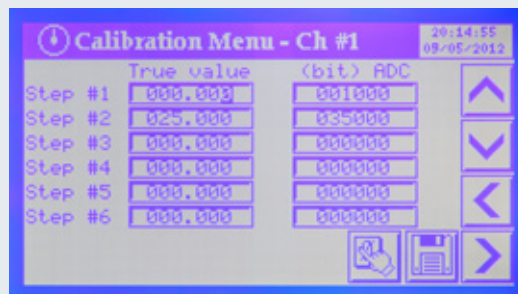
Ordering information

82-P60R02

DIGIMAX TOUCH- Four channel readout and processing unit for load and displacement sensors, up to two channels can be used simultaneously. Suitable for Marshall, CBR, indirect tensile and general purpose tests. 110-240V, 50-60Hz, 1 ph.



34



82-SW/CMU

PC software for CBR, Marshall, Indirect tensile and Universal tests

STANDARD

- » EN 12697-34 ▶ ASTM D1883
- » ASTM D1559 ▶ ASTM D5581
- » AASHTO T245 ▶ EN 12697-12
- » BS 1377:4 ▶ NF P94-078
- » AASHTO T193
- » EN 13286-47 ▶ UNI 10009
- » ASTM D6927

This program is written to run in MS Windows® for data acquisition and processing of CBR, Marshall, Indirect tensile and generally of load/displacement tests. The software is designed to be used specifically with new Digimax touch 76-P60R02.

MAIN FEATURES

- » Suitable for running CBR, Marshall, Indirect Tensile and universal load/displacement tests
- » Data is presented numerically and graphically in real time
- » Saving and management of tests through single files
- » Single and multiple test result management and printout
- » Data export to MS Excel®
- » Connection to Controls machines with high speed Ethernet connection



82-SW/CMU test data screenshot

Impact soil tester

CLEGG HAMMER
34-T0168/B

Used to obtain an indication of the degree of compaction of soil in road construction. Results can be directly correlated to the CBR test. The unique microprocessor system automatically checks all readings throughout the test and displays the fourth reading as the Impact Value. An essential trench control tool for all cable and pipe laying service contractors.

Specifications

Dimensions: 140 x 140 x 700 mm (approx.)
 Weight: 6.5 kg (approx.)



34-T0168/B

ADVANTAGES

- » Results can be directly correlated to the CBR test
- » An essential trench control tool for all cable and pipe laying service contractors

Strength of stabilized soil

STRENGTH OF STABILIZED SOIL TEST SETS

STANDARD

- ▶ EN 13286-53 ▶ NF P 94-100
- ▶ NF P98-230-2

These tests are performed to determine the unconfined compressive strength of fine and medium grained soils.

Two versions with different sizes are available that conform to:

- EN 13286-53
- NF P 94-100

EN 13286-53 TEST SETS

34-T0123/A

EN stabilized soil set for fine and medium grained soils – specimen size Ø 50 x 50 mm (diameter x height) – EN 13286-53

34-T0123/B

EN stabilized soil set for fine and medium grained soils – specimen size Ø 50 x 100 mm (diameter x height) – EN 13286-53

34-T0124/A

EN stabilized soil set for fine and medium grained soils – specimen size Ø 100 x 100 mm (diameter x height) – EN 13286-53

34-T0124/B

EN stabilized soil set for fine and medium grained soils – specimen size Ø 100 x 200 mm (diameter x height) – EN 13286-53

All above sets include a mould, set of 2 end plugs, set of 2 plug displacing collars with 3 different heights, one demoulding plunger and specimen collector.

All components can be purchased separately.

Approx. weight: 10 kg (34-T0123/A), 12 kg (34-T0123/B), 20 kg

(34-T0124/A) and 53 kg (34-T0124/B)
NF P 94-100 TEST SET

34-T0123/S

NF stabilized soil set for fine and medium grained soils – specimen size Ø 50 x 50 mm (diameter x height) – according to NF P94-100

This set includes a mould, 5 stainless steel casing, 2 compaction plugs, set of plug displacing collars, one demoulding plunger and a specimen collector.

Spares

34-T0123/S1

Set of 5 stainless steel casing for specimen size Ø 50 x 50 mm (diameter x height)



34-T0123/A



34-T0124/B

Field density. Sand replacement method

The verification of the degree of compaction can be determined on site by a simple procedure essentially consists of removing and weighing a part of compacted soil and replacing in the hole with sand by a simple apparatus recording the volume of sand and then calculating the density of the removed soil.

We offer two version according to ASTM/AASHTO/NF and BS

ASTM/AASHTO/NF SAND DENSITY CONE APPARATUS

STANDARD

- ▶ ASTM D1556 ▶ AASHTO T191
- ▶ NF P94-061-3 ▶ UNE 7371, CNR 22

Three versions are available, each suitable for soils of different grain sizes. The sets all include a double cone, a metal base plate and two plastic sand jars, except the 35-T0133 model which is supplied with one acrylic sand container.

The 35-T0129 6.5" (165.1 mm) diameter model can be completed with a calibrating container. See Accessories.

Ordering information

35-T0128
4" dia. (101.6 mm) sand density cone apparatus. Weight approx.. 3 kg

35-T0129
6.5" dia. (165.1 mm) sand density cone apparatus. Weight approx.. 3 kg

35-T0133
12" dia. (304.8 mm) sand density cone apparatus. Weight approx.. 20 kg

Accessories

35-T0130/8
Calibrating container for 35-T0129, 165 mm internal diameter, 187 mm deep.

BS SAND REPLACEMENT APPARATUS

STANDARD

- ▶ BS 1377:9 ▶ BS 1924:2

The operating principle is identical to the ASTM/AASHTO method. Three sizes of apparatus are available, each comprising a pouring cylinder, calibration can and density tray made of plated sheet-steel.

Ordering information

35-T0125
100 mm sand replacement complete set. Weight approx.:7.7 kg

35-T0125/A
150 mm sand replacement complete set. Weight approx.: 13 kg

35-T0126
200 mm sand replacement complete set. Weight approx.:27.5 kg

Accessories

35-T0127
Standard sand 0.2 to 0.6 mm grain size conf. to BS/ASTM/AASHTO. Sack of 50 kg.

Part description*	35-T0128 4" dia.	35-T0129 6.5" dia.
Double cone	35-T0128/1	35-T0129/1
Plastic sand jar (2 pieces)	35-T0130/2	35-T0130/2
Metal base plate	35-T0128/2	35-T0129/2

*All parts can be purchased individually



Sand replacement cones 35-T0128, 35-T0129 and 35-T0133

Part description*	35-T0125 100 mm dia.	35-T0125/A 150 mm dia.	35-T0126 200 mm dia.
Sand pouring cylinder	35-T0125/1	35-T0125/A1	35-T0126/1
Calibration can	35-T0125/2	35-T0125/A2	35-T0126/2
Density tray	35-T0125/3	35-T0125/A3	35-T0126/3



Sand replacement cylinders 35-T0125, 35-T0125/A, 35-T0126

FIELD DENSITY TOOLS

Used to dig, level and remove soil during various field density tests

35-T0140
Metal dibber. Weight 300 g

35-T0141
Scraper. Weight 600 g

35-T0142
Steel pointed rod. Weight 100 g.

35-T0143
Density spoon. Weight 150 g.

35-T0144
Rubber mallet 50 mm dia. Weight 1 kg

35-T0145
Hammer, 300 g.

35-T0145/G
Club hammer, 2 kg.

35-T0146
Density pick. Weight 1 kg.

35-T0147
Chisel 300 mm long. Weight 1 kg.

86-D1348
Lever lid tin, 5 liters cap, Weight 100 g.



Field density

BALLOON METHOD

The principle of operation is similar to the sand replacement method but the hole is filled with a rubber balloon into which water is pumped. The amount of water can be easily determined by reading the graduations marked on the cylinder or piston stress. Two versions are available: the ASTM/AASHTO/CNR model, with 1.6 liter capacity (35-T0131), and the NF version, with 3 or 6 liter capacity (35-T0134 and 35-T0134/A).

35

35-T0131 ASTM/AASHTO BALLOON DENSITY APPARATUS

STANDARD

- ▶ ASTM D2167 ▶ AASHTO T205
- ▶ CNR N° 22

This test set consists of a graduated cylinder with 1596 ml capacity housed inside an aluminum guard, a reversible rubber aspirator pump, a 9" square density plate and 12 rubber balloons.

- Capacity: 1596 ml.
- Weight: 6 kg (approx.)

Accessories and spares

35-T0131/4

Rubber balloons, pack of 12.



35-T0131

NF BALLOON APPARATUS

STANDARD

- ▶ NF P94-061-2

This apparatus is used for determining the in-situ density of well-bonded soil according to NF specifications. A metal cylinder is filled with water which is then pumped into a rubber membrane mounted on the base of the cylinder, which fills a hole previously made in the soil. The water pressure is controlled by a pressure gauge and the volume of the balloon is measured on the graduated piston stem. Two versions are available: 3000 and 6000 ml capacity. The apparatus are supplied complete with base plate, 3 locking clamps and 6 reinforced balloons.

- Weight:
 - 35-T0134, 9.5 kg (approx.)
 - 35-T0134/A, 11.5 kg (approx.)



35-T0134

Ordering information

35-T0134

Balloon density apparatus, 3000 ml capacity.

35-T0134/A

Balloon density apparatus, 6000 ml capacity.

Accessories and spares

35-T0134/2

Spare reinforced 3000 ml membranes for 35-T0134. Pack of 6.

35-T0134/A2

Spare reinforced 6000 ml membranes for 35-T0134/A. Pack of 6.



35-T0134/A

SURFACE SOIL SAMPLERS

In this method a sampling tube is driven into the ground to take a standard core sample, which is then removed, trimmed, and weighed in order to establish the in-situ density of the soil. Two different versions are available, one conforming to ASTM/CNR and one to BS.

ASTM/CNR SURFACE SOIL SAMPLER

STANDARD

▶ ASTM D2937 ▶ CNR N° 22

This apparatus is made from corrosion-resistant steel and consists of a 5 kg sliding-weight drop-hammer which falls freely onto the driving head situated above the sampling tube.

- Weight: 10 kg (approx.).
- Sampling tube: 73 mm internal diameter, 66 mm long.

Ordering information

35-T0135

ASTM/CNR Surface soil sampler.

Accessories and spares

35-T0135/1

Spare thin wall sampling tube, 73 mm internal diameter, 66 mm long.



BS SURFACE SOIL SAMPLERS (CORE CUTTERS)

STANDARD

▶ BS 1377:9

This version of the soil sampler includes a core cutter, driving dolly and driving rammer. Two sizes are available: 100 and 150 mm internal diameter, both made of steel.

Ordering information

35-T0137

100 mm diameter core cutter set.

35-T0138

150 mm diameter core cutter set.



FIELD DENSITY OF UNDISTURBED SOIL

35-T0164

Piston volumeter, 30 cm³ capacity.

This is an easy to use pocket device; very useful for determining the in-situ density of undisturbed soil. A stainless steel tube is driven into the soil and the volume is read off the stem which is marked from 0 to 30 cm³.

- Weight: 0.5 kg (approx.).



Soil samplers parts

Description	35-T0137 100 mm diameter	35-T0138 150 mm diameter
Core cutter (weight)	35-T0137/1 (1 kg)	35-T0138/1 (4.5 kg)
Driving dolly (weight)	35-T0137/2 (1 kg)	35-T0138/2 (4 kg)
Driving rammer (weight)	35-T0137/3 (13.5 kg)	35-T0138/3 (16 kg)
Total weight (approx.)	15.5 kg	24.5 kg

Note: all parts can also be purchased individually

Bearing capacity

STANDARD

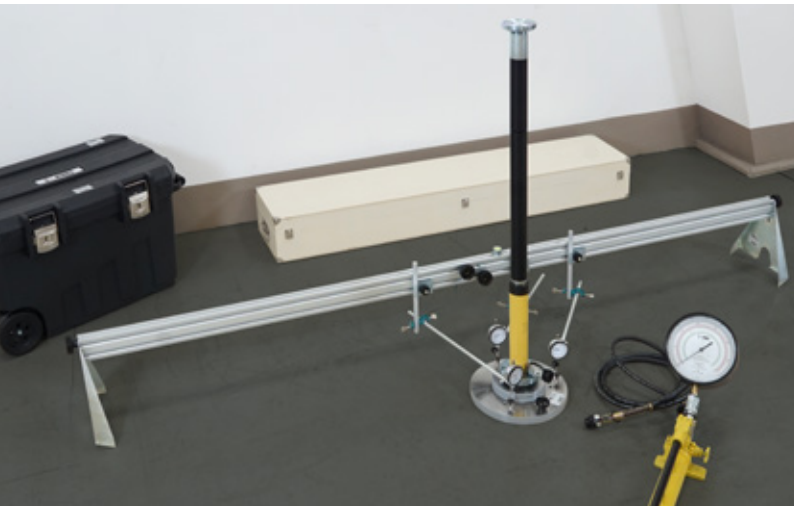
- ▶ ASTM D1194 ▶ ASTM D1195
- ▶ ASTM D1196 ▶ BS 1377:9
- ▶ UNE 739 ▶ UNE 7391
- ▶ CNR N° 92 ▶ CNR N° 146

PLATE BEARING TEST APPARATUS 100, 200 AND 500 KN CAPACITY

These test methods are used for estimating the bearing capacity of a soil under field loading conditions for a specific loading plate and depth of embedment. They also cover load tests on soil and flexible pavement components, for use in evaluation and design of airport and highway pavements. The complete kits conforming to BS, ASTM and CNR are identified by a single code (see ordering information).

Alternatively, all components are also proposed individually to design a tailor-made configuration giving the customer maximum flexibility. Plate bearing test apparatus conforming to DIN 18134, Swiss method SNV 70312 and NF P94-117-1 are shown and described on page 138 and 139.

35



Model 35-T1101, analog version with manometer, 3 dial gauges and carrying cases

MAIN FEATURES

- » 3 capacities: 100, 200 and 500 kN
- » 3 levels of data acquisition matching all technical & budget requirements
- » Analog version with triple scale manometer: force (kN), oil pressure (Bar) and specific load (MN/m²)
- » Digital version with digital read out unit featuring wide graphic display, rechargeable battery and built-in pressure transducer
- » Electronic version with pressure and displacement transducers connected to DATALOG 8 logger, battery operated rugged version ideal for field use
- » Excellent ergonomics: quick assembly/dismount, easy and safe transportation on site with practical carrying cases
- » Heavy duty hydraulic parts and robust loading plates assure total reliability in rough site testing conditions
- » Dual flow manual hand pump with flexible hydraulic hose 3 meters long
- » Loading jack with 2 spherical seats (the upper one is magnetic for simplifying the test execution)
- » Measuring bridge made in aluminum alloy, lightweight, transportable and easy to assembly
- » Complete hydraulic assembly housed in a hard plastic wheeled carrying case
- » Multiple kits to ASTM, BS and CNR
- » Maximum flexibility with infinite tailor-made configurations for non-standard requirements



Plate bearing test apparatus series 35-T1103/xx configurable with 3 different levels of data acquisition system: analog, digital or electronic



Analog version with 30x0.01 mm dial gauges and triple scale manometer



Digital version with 25.4x0.001 mm digital gauges and digital load readout unit (battery operated) with built-in pressure transducer



Electronic version with pressure and displacement transducers 50 mm travel, connected to Datalog 8, battery operated unit with rigid carrying case suitable for use in the field. See page 416.

MAJOR COMPONENTS FOR 100 AND 200 kN CAPACITY

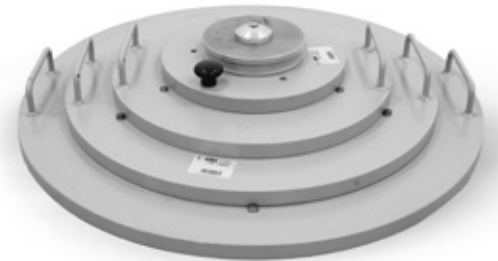
Hydraulic assembly

Composed by: 100 and 200 kN cylinder capacity. Dual flow hand pump with 3 m connecting hose. Two spherical seats: the lower transfer the reaction load to the plate; the upper, mounted at the top end of the loading column, is magnetic to simplify the test execution. Extension rods for closing the gap between upper spherical seat and reaction frame.

Loading plates

The loading plates are made in high strength steel. All plates include practical handles for easy transportation and can be placed in a pyramid arrangement to ensure rigidity. The range includes:

- 160 mm (6") dia. x 25 mm (1")
- 300 mm (12") dia. x 25 mm (1")
- 456 mm (18") dia. x 25 mm (1")
- 608 mm (24") dia. x 25 mm (1")
- 760 mm (30") dia. x 25 mm (1")



Complete series of loading plate 35-T1100/Px

Load and settlement measurement

Analogic configurations

100 kN capacity precision bourdon gauges 200 mm dia., triple scale:

- force 0-100 kN, div. 0.5 kN
- oil pressure 0-690 Bar, div. 2.5 Bar
- spec. load* 0-1.41 MN/m², div. 0.01 MN/m²

200 kN capacity precision bourdon gauges 200 mm dia., triple scale:

- force 0-200 kN, div. 1 kN
- oil pressure 0-600 Bar, div. 2.5 Bar
- spec. load* 0-2.83 MN/m², div. 0.02 MN/m²

*Note: specific load values refer to a bearing plate with 300 mm dia.

Settlement measurement by 30 x 0.01 mm dial gauges



Triple scale 100 kN manometer



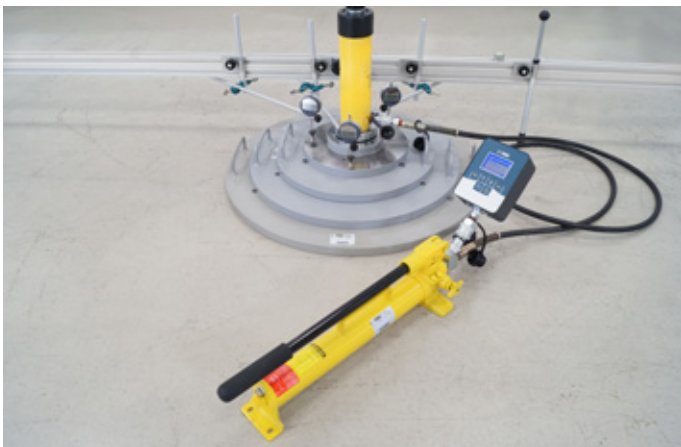
Triple scale 200 kN manometer

Electronic configuration

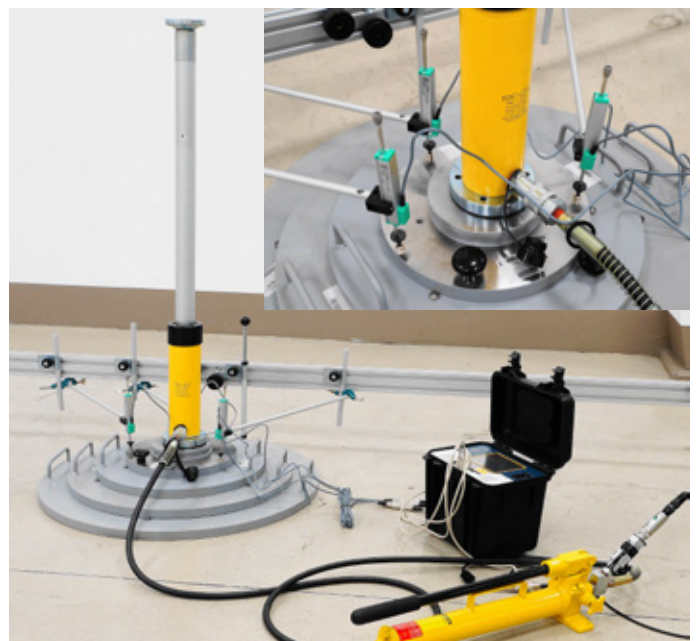
Comprising pressure and displacement transducers, 50 mm travel, connected to the Datalog 8, battery operated. See page 416

Digital configuration

Digital load readout unit (battery operated) with built-in pressure transducer. Settlement measurement by 25.4 mm x 0.001 mm digital gauges.



Detail of digital configuration with digital gauges positioned on the bearing plates



Detail of electronic configuration with displacement transducers positioned on the bearing plates

Bearing capacity

MAJOR COMPONENTS FOR 100 AND 200 KN CAPACITY

Reference bar (measuring bridge)

Made from lightweight aluminum alloy, this reference bar is transportable, quick to assemble on-site, and features two external supports and built-in spirit level. The main measuring bar is 2.5 meter long and can be expanded with extensions up to 5.5 meters total length. Basic or extender measuring bridge and adjustable supports for displacement gauges can be housed in a practical wooden carrying case.

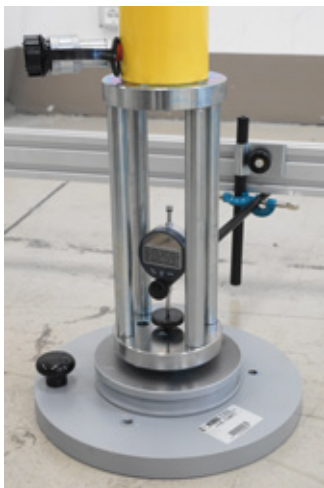


Complete measuring bar 5.5 meters long and adjustable supports for displacement devices housed inside the wooden carrying case

Measuring tunnel

It is used for the testing configuration with single displacement device (required by CNR 146 method A). It is compatible with analog, digital dial gauge and electronic displacement transducer.

Only for hydraulic assembly capacity 100 and 200 kN. See 35-T1100/MT



Measuring tunnel 35-T1100/MT suitable for single displacement device configuration

Packing

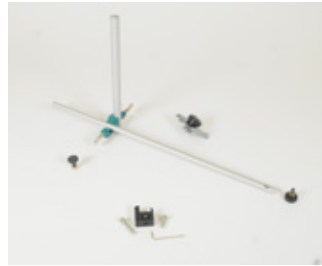
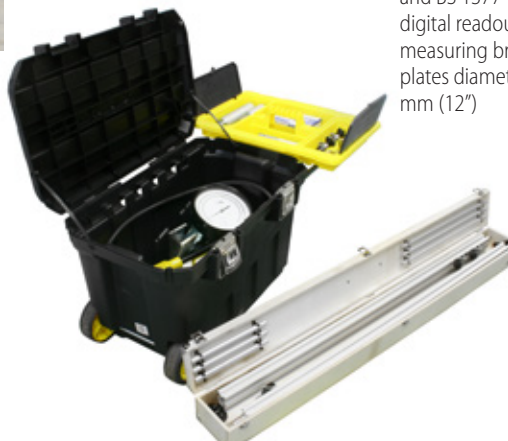
Complete testing kits 100 and 200 kN capacity include a wheeled plastic carrying case housing the following parts:

- hydraulic assembly (pump, cylinder, extension rods)
- plates diameter 160 mm (6") and 300 mm (12")
- load and displacement devices.

Additional plates diameter 456 mm (18"); 608 mm (24") and 760 mm (30") can be packed in a dedicated wooden box available as accessory. (See next pages, 35-T1100/BOX).

Measuring bridge 2.5 m and extensions may be optionally housed in a wooden carrying case available as accessory. (See 35-T1100/BC).

Complete testing kits housed inside 2 carrying cases for easy transportation on site



35-T1100/ARM adjustable support for displacement device

Ordering information

All apparatus are supplied complete with trolley type plastic case and cardboard box for the measuring bridge. The set of platens part of the ASTM models 35-T1103/DGT and 35-T1103/EL can be packaged in a wooden box. See accessory 35-T1100/BOX

Analog versions

35-T1100

Plate bearing test apparatus 100 kN cap. to CNR No. 146 method A, analog version with 3 scale manometer, single dial gauge and measuring tunnel, measuring bridge 2.5 m long, loading plates diameter 160 mm (6") and 300 mm (12")

35-T1101

Plate bearing test apparatus 100 kN capacity to CNR No. 146 method B and BS 1377-9, analog version with 3 scale manometer, 3 dial gauges, measuring bridge 2.5 m long, loading plates diameter 160 mm (6") and 300 mm (12").

Digital versions

35-T1100/DGT

Plate bearing test apparatus 100 kN capacity to CNR No. 146 method A, digital version with digital readout unit, single digital gauge and measuring tunnel, measuring bridge 2.5 m long, loading plates diameter 160 mm (6") and 300 mm (12")

35-T1101/DGT

Plate bearing test apparatus 100 kN capacity to CNR No. 146 method B and BS 1377-9, digital version with digital readout unit, 3 digital gauges, measuring bridge 2.5 m long, loading plates diameter 160 mm (6") and 300 mm (12")

35-T1102/DGT

Plate bearing test apparatus 200 kN capacity to CNR No. 146 method B and BS 1377-9, digital version with digital readout unit, 3 digital gauges measuring bridge 2.5 m long, loading plates diameter 160 mm (6") and 300 mm (12")

35-T1103/DGT

Plate bearing test apparatus 200 kN capacity to CNR, BS 1377-9, ASTM D1195, D1196 digital version with digital readout unit, 3 digital gauges, measuring bridge 5.5 m long, loading plates diameter 160 mm (6"), 300 mm (12"), 456 mm (18"), 608 mm (24") and 760 mm (30")

Electronic versions

35-T1100/EL

Plate bearing test apparatus 100 kN capacity to CNR No. 146 method A, electronic version with pressure and single displacement transducers (plus measuring tunnel) connected to DATALOG 8, measuring bridge 2.5 m long, loading plates diameter 160 mm (6") and 300 mm (12")

35-T1101/EL

Plate bearing test apparatus 100 kN capacity to CNR No. 146 method B and BS 1377-9, electronic version with pressure and 3 displacement transducers connected to DATALOG 8, measuring bridge 2.5 m long, loading plates diameter 160 mm (6") and 300 mm (12")

35-T1102/EL

Plate bearing test apparatus 200 kN capacity to CNR No. 146 method B and BS 1377-9, electronic version with pressure and 3 displacement transducers connected to DATALOG 8, measuring bridge 2.5 m long, loading plates diameter 160 mm (6") and 300 mm (12")

35-T1103/EL

Plate bearing test apparatus 200 kN capacity to CNR, BS 1377-9, ASTM D1195, D1196, electronic version with pressure and 3 displacement transducers connected to DATALOG 8, measuring bridge 2.5 m long, loading plates diameter 160mm (6"), 300 mm (12"), 456 mm (18"), 608 mm (24") and 760 mm (30")

MAJOR COMPONENTS FOR 500 KN CAPACITY

Hydraulic assembly

Comprising: 500 kN cylinder capacity; Dual flow hand pump with 3 m connecting hose; Two spherical seats (the lower transfer the reaction load to the plate; the upper, mounted at the top end of the loading column, is magnetic to simplify the test execution); Sturdy extension rods for closing the gap between upper spherical seat and reaction frame.

35-T1100/H5

500 kN capacity loading system conforming to ASTM D1194 and ASTM D1195. It has to be completed with the loading plates and suitable accessories conforming to the selected configuration:

-Analogue

-Digital

-Electronic

Load and settlement measurement

Analog configurations

35-T1100/A5

500 kN capacity precision bourdon gauges 200 mm diameter, triple scale: - force: 0-500 kN, div. 2.5 kN - oil pressure: 0-700 Bar, div. 2.5 Bar - specific load*: 0-7.07 MN/m², div. 0.05 MN/m²,

**Note: specific load values refer to a bearing plate with 300 mm dia.*

35-T1100/ARM**

Adjustable support for displacement device

82-D1257**

Dial gauge 30 mm x 0.01 mm

Digital version

35-T1100/D

Digital load readout unit (battery operated) with built-in pressure transducer

35-T1100/ARM**

Adjustable support for displacement device

82-D1262/B**

Digital gauge 25.4 x 0.001 mm

***Note: quantity in accordance with the numbers of displacement gauges used in the testing configuration, 3 pcs (recommended)*

Electronic version

82-P9008/F

DATALOG 8, 8 channels multipurpose data logger, battery operated and with rigid carrying case ideal for field use.

82-P9008/ELT1**

Single connection cable

35-P0700

Pressure transducer



82-P0349/ELT

Connection cable for pressure transducer

35-T1100/ARM**

Adjustable support for displacement device

35-P0324**

Displacement transducer 50 mm stroke

***Note: quantity in accordance with the numbers of displacement gauges used in the testing configuration, 3 pcs (recommended)*

Loading plates

35-T1100/P6

160 mm diameter (6") x 25 mm (1"). Weight 6 kg

35-T1100/P12

300 mm diameter (12") x 25 mm (1"). Weight 14 kg

35-T1100/P18

456 mm diameter (18") x 25 mm (1"). Weight 28 kg

35-T1100/P24

608 mm diameter (24") x 25 mm (1"). Weight 55 kg

35-T1100/P30

760 mm diameter (30") x 25 mm (1"). Weight 80 kg

Reference bar (measuring bridge)

35-T1100/B25

Datum bar 2.5 m long

35-T1100/BEX

Extension kit to extend the datum bar from 2.5 m to 5.5 m

Note: all above items can be ordered individually providing maximum flexibility with infinite tailor-made configurations for non-standard requirements

Packing

Complete testing kit 500 kN capacity can be housed in practical carrying cases for easy handling of the apparatus on site:

35-T1100/BC

Wooden carrying case for reference bar, 2.5 m and 5.5 m versions

35-T1100/H5C

Wheeled carrying case for 35-T1100/H5, 500 kN hydraulic assembly

35-T1100/BOX

Wooden box for loading plates diameter 456 mm (18") 608 mm (24") and 760 mm (30")



Triple scale 500 kN manometer

Bearing capacity DIN method version

STANDARD

- ▶ DIN 18134 ▶ PN-S-02205
- ▶ BN-64-8931-02 ▶ BS 1377:9

35

DIN PLATE BEARING TEST APPARATUS

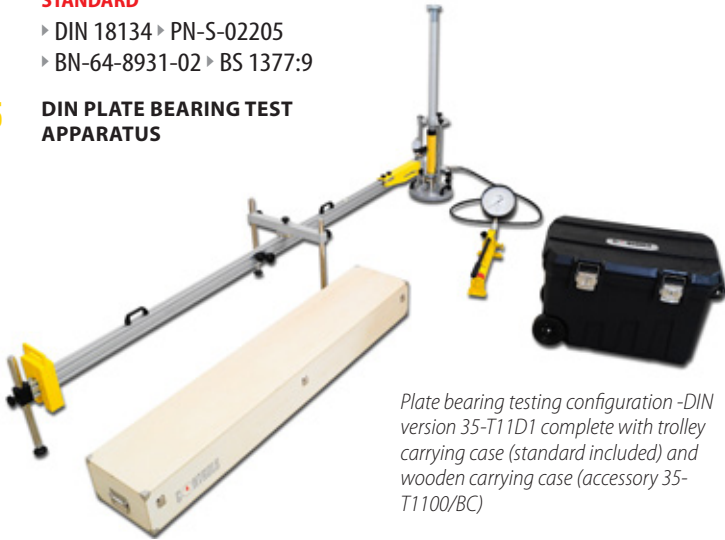


Plate bearing testing configuration -DIN version 35-T11D1 complete with trolley carrying case (standard included) and wooden carrying case (accessory 35-T1100/BC)

The above Standards cover the same determination of the ASTM, BS etc. described on page 134.

The test apparatus comprises by the same components except for the measuring bridge system and tunnel, designed as prescribed by DIN standards.

The test apparatus is available in the Analog or Electronic version, 100 or 200 kN capacity.

Ordering information

Analog configuration

35-T11D1

Plate bearing test apparatus 100 kN capacity conforming to DIN 18134, BS 1377-9. Analog configuration with diameter 200 mm triple scale manometer and dial gauge 30 mm x 0.01 mm

35-T11D2

Plate bearing test apparatus 200 kN capacity. conforming to DIN 18134, BS 1377-9. Analog configuration with diameter 200 mm triple scale manometer and dial gauge 30 mm x 0.01 mm

MAIN FEATURES

- » 4 different configurations with 100 and 200 kN capacity, analog and electronic versions
- » Analog versions fitted with 200 mm diameter triple scale manometer: force (kN), oil pressure (Bar) and specific load (MN/m²)
- » Electronic version fitted with high resolution load cell
- » Dual flow hand pump for quick contact to the reaction frame and for accurate test execution
- » Spherically seated loading jack. The seat surface is magnetic for simplifying the test execution
- » Telescopic measuring bridge made in aluminum alloy, lightweight, transportable and quick to assembly
- » Complete hydraulic assembly housed in a hard plastic wheeled carrying case

Electronic configuration

35-T11D1/EL

Plate bearing test apparatus 100 kN capacity conforming to DIN 18134, BS 1377-9. Electronic configuration with high resolution load cell and displacement transducer 50 mm stroke connected to DATALOG 8 battery operated version with rigid carrying case suitable for field use.

35-T11D2/EL

Plate bearing test apparatus 200 kN capacity conforming to DIN 18134, BS 1377-9. Electronic configuration with high resolution load cell and displacement transducer 50 mm stroke connected to DATALOG 8 battery operated version with rigid carrying case suitable for field use.

Accessories

35-T1100/BC

Wooden carrying case for datum bar

82-D1262/B

High resolution digital indicator 25.4 x 0.001 mm

35-T1100/P600

Loading plate 600 mm dia. x 20 mm reinforced with stiffeners and centering pin suitable for plate bearing test apparatus conforming to DIN Standard, series 35-T11Dx/x

35-T1100/P762

Loading plate 762 mm diameter x 20 mm reinforced with stiffeners and centering pin suitable for plate bearing test apparatus conforming to DIN Standard series 35-T11Dx/x



Detail of the hydraulic assembly of 35-T11D1: load plate diameter 300 mm; hydraulic cylinder with spherical seat and extension rods; telescopic arm; measuring tunnel; anti tilting 3-column jig and dial gauge



Detail of the measuring bridge housed inside the wooden carrying case accessory 35-T1100/BC



Detail of the hydraulic assembly of 35-T11D1: triple scale manometer and digital gauge 82-D1262/B

SWISS method version

STANDARD

▶ SNV 70312

**PLATE BEARING TEST
APPARATUS-SWISS METHOD**

35-T0121

Used to estimate the bearing capacity of a soil under field loading conditions on flexible pavement components.

The relatively lightweight (68 kg in total) and small dimensions of the apparatus make it very easy to use and to move from one place to another. The measuring bridge made from aluminum alloy, is very light and has telescopic extensions so it can be positioned in a few minutes with minimum effort. The remote load control and

gauge are mounted on the pump and it is not necessary to go near the platen for recording the load.

- The deformations are measured with three dial indicator
- Loading ram cap.: 100 kN
 - Gauge range: 0 to 0.8 MN/m²
 - Dial indicators: No. 3, 30 mm travel 0.01 mm divisions
 - Carrying case dimensions:
 - 1) 1080x360x200 mm
 - 2) 920x360x200 mm
 - Total weight approx.: 68 kg

Ordering information

35-T0121

Platen bearing test apparatus, 100 kN capacity, 300 mm platen diameter



FRENCH method

STANDARD

▶ NF P94-117-1

**ALUMINUM BEARING PLATE 600
MM DIAMETER**

This bearing plate is normally used, together with a hydraulic jack, hand pump with manometer and the 80-B0180 Benkelman beam apparatus, for determining the bearing capacity and deflection of road pavements as fully described on page 380.

It can also be conveniently used in plate load testing as an alternative to the standard 300 to 760 mm diameter steel plates. The aluminum bearing plate should be completed with the accessories specified below.

Ordering information

80-B0180/B1

Aluminum bearing plate, 600 mm diameter, with reinforcing ribs. Weight 30 kg(approx.).

Accessories

80-B0180/B2

Hydraulic jack, 200 kN capacity. Weight 10 kg (approx.).

80-B0180/B3

Three interchangeable extensions with spherical seated foot. Weight 12 kg (approx.).

80-B0180/B4

Hand pump with 200 mm diameter high precision manometer. Calibrated in bar (0 to 3.5) and in daN (0 to 10000). Complete with connecting hose. Weight 11 kg (approx.).

80-B0180/B5

Carrying case for the above items except for the 80-B0180/B1. Weight 10 kg.

80-B0180*

Benkelman beam apparatus. Weight 10 kg

80-B0181*

Wooden carrying case for 80-B0180
*For more information see page 380



Dynamic deformation modulus of soil

STANDARD

- ▶ ASTM E2835-11* ▶ TP-BF** -StB part 8.3/2012 ▶ ZTV E-StB 09
- ▶ ZTV T-StB 95 ▶ ZTV A- StB 97 ▶ RVS 8 (Austrian regulations) ▶ RIL 836

*Standard test method for measuring deflections using a portable impulse plate load test device

**German technical test standard for soil and rock in road construction

LIGHTWEIGHT DEFLECTOMETER

35-T0120/A

The dynamic plate load test performed with the lightweight deflectometer is used to determine the soil bearing capacity and compaction quality of soils and non-cohesive subbases, as well as for soil improvement applications. Built-in soil layers can easily be tested without load abutment, facilitating quick assessments of test lots even under limited space conditions. The test method is suited to coarse-grain and mixed grain soils with a maximum grain size of 63mm and can be used to determine the dynamic modulus of deformation of soil in the range $E_{vd} = 15$ to 70 MN/m^2 .



35-T0120/A during operation

Applications

- Road and railway construction, earth moving
- Quality assurance in canal construction
- Compaction monitoring in pipe trenches and cable ducts
- Testing of pavement bedding
- Testing of foundation backfill
- Quality inspection in boreholes
- Testing of modulus of deformation in line with soil exploration

INTRA-COMPANY MONITORING SAVES COSTS!

Being easy to handle and providing immediate measuring results, the lightweight deflectometer is especially suited for monitoring intra-company operations. It facilitates quick decisions for continuing construction at the site. The

documentation can be printed directly at the site via the thermal printer or as a protocol printout after transferring and processing the data on a PC.

ADVANTAGES OF THE DYNAMIC PLATE LOAD TESTING.

- Fast and cost-saving
 - Time-saving (maximum 2 minutes per measuring point)
- No vehicle required
 - Immediate on-site evaluation of test results
- Easy to handle
 - Low tester weight, few components, human-engineered
 - Easy for one person to operate and carry
 - Testing can be achieved in difficult-to-reach locations

- Reliable and precise
 - Calibrated by an approved calibration institute
 - Complies with the latest state of the art technology
 - Field tested and used successfully throughout the world
 - Calibrated according to ASTM E2835-11 by authorization of the Federal Highway Research Institute

Specifications

Loading mechanism

Total weight: 15 kg
 Drop weight: 10 kg
 Maximum impact force: 7.07 kN
 Duration of impact: 17 ms
 Material: zinc coated/hard-chrome plated steel

Load plate

Diameter: 300 x 20 mm
 Total weight: 15 kg
 Material: zinc coated steel

Electronic settlement measuring instrument

Interfaces: USB, Thermal-Printer, GPS
 Power supply: 4 x R6 batteries
 Dimensions: 210 x 100 x 45 mm
 Settlement measuring range: 0.1 to 2.0 mm ± 0.02 mm
 Measuring range: $E_{vd} < 225 \text{ MN/m}^2$
 Temperature range: 0 to 40°C
 Storage capacity of measured data: 500 series

Accessories

35-T0120/A1

Transport cart for easier on-site transport of the lightweight deflectometer between the measuring points.

35-T0120/A2

Magnetic base plate for proper positioning of loading unit.

35-T0120/A5

Transport box for secure transport of the lightweight deflectometer to the site and between measuring points.

Note: thermal printer and PC software for data processing and storage are included with the apparatus.



35-T0120/A2



35-T0120/A5



35-T0120/A



35-T0120/A1

Soil permeability: constant and falling head apparatus

STANDARD

- ▶ ASTM D2434-06 ▶ BS 1377:5
- ▶ BS EN ISO 17892-11
- ▶ AASHTO T215

CONSTANT HEAD APPARATUS

This method describes a procedure for the determination of the permeability of water through granular (cohesionless) soils in a steady-state condition. The procedure is to establish representative values of the coefficient of permeability, *k*, of granular soils that may occur in natural depos-

its as placed in embankments, or when used as base courses under pavements. The determination of *k* was developed under the assumptions of the validity of Darcy's Law, which states that the coefficient of permeability is the ratio of the flow rate to the hydraulic gradient. In order to limit consolidation influences during testing, this procedure is limited to disturbed granular soils with permeability in range of 1 to 1x10⁻⁵. For a complete list of test accessories see table.

STANDARD

- ▶ BS EN ISO 17892-11
- ▶ ASTM D5856

FALLING HEAD APPARATUS

The falling head permeability test is used to determine the permeability of fine grained soils with intermediate and low permeability such as silts and clays with permeability in range of 1x10⁻⁵ to 1x10⁻⁹. This testing method can be applied to an undisturbed sample. The falling head principle can be applied to an undisturbed

sample in a sampling tube and to a sample in an oedometer consolidation cell.

This test method covers laboratory measurement of the hydraulic conductivity of laboratory-compacted materials with a rigid-wall, compaction-mould permeameter and may be used with compacted specimens that have a hydraulic conductivity less than or equal to 1 × 10⁻⁵ m/s.

For a complete list of test accessories see table.

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Ordering information (Including all test accessories)

	Constant Head		Falling Head	
Permeability Cell	38-T0184/C1*	Constant Head permeability cell, 75 mm internal dia., 3 take-off points.	38-T0185/C1*	Falling head permeability cell, 100 mm internal dia. Complete with 75 micron gauze and 2 m of tubing conforming to BS EN ISO 17892-11
	38-T0184/C2	Constant Head permeability cell, 114 mm internal dia., 6+6 (blanked) take-off points.	38-T0185/C2**	Compaction mould permeameter, 4" (101,6 mm) dia. conforming to ASTM D5856
38-T0185/C3			Compaction mould permeameter, 6" (152,4 mm) dia. conforming to ASTM D5856	
Tank	38-T0184/T*	Constant level tank. Complete with inlet, outlet, overflow, connecting tubing for the cell.	38-T0185/T*	Soaking reservoir, complete with overflow tube
Manometer Stand	38-T0183/MS*	Manometer stand with 4 tubes positioning. Tubes, ruler and anchoring system has to be ordered separately. Dimensions: 1152 x 250 x 34 mm	38-T0183/MS**	Manometer stand with 4 tubes positioning. Tubes, ruler and anchoring system has to be ordered separately. Dimensions: 1152 x 250 x 34 mm
Ruler	38-T0183/R*	Ruler for T0183/MS	38-T0183/R	Ruler for T0183/MS
Manometer Tubes	38-T0183/6*	Manometer tube 6 mm dia. Connecting valve has to be ordered separately (T0183/6C)	38-T0183/6**	Manometer tube 6 mm dia. Connecting valve has to be ordered separately (T0183/6C)
	38-T0183/8	Manometer tube 8 mm dia. Connecting valve has to be ordered separately (T0183/8C)	38-T0183/8**	Manometer tube 8 mm dia. Connecting valve has to be ordered separately (T0183/8C)
	38-T0183/14	Manometer tube 14 mm dia. Connecting valve has to be ordered separately (T0183/14C)	38-T0183/14**	Manometer tube 14 mm dia. Connecting valve has to be ordered separately (T0183/14C)
	38-T0183/22	Manometer tube 22 mm dia. Connecting valve has to be ordered separately (T0183/22C)	38-T0183/22	Manometer tube 22 mm dia. Connecting valve has to be ordered separately (T0183/22C)
Anchoring System	38-T0183/A	Anchoring system to fix manometer tubes with connecting valves on T0183/MS	38-T0183/A**	Anchoring system to fix manometer tubes with connecting valves on T0183/MS
Control Panel	38-T0183/P	Control Panel used for saturating sample	38-T0183/P	Control Panel used for saturating sample

Note-1: * Standard configuration for Constant Head apparatus a in 38-T0184/KIT

Note-2: * Standard configuration for Falling Head apparatus included in 38-T0185/KIT 1.

** Standard configuration for Falling Head apparatus for compacted soil included in 38-T0185/KIT 2

Ordering information

38-T0184/KIT

Constant Head apparatus complete with T0184/C1, T0184/T, T0183/MS, T0183/R and T0183/6 x3

Ordering information

38-T0185/KIT1

Falling Head apparatus complete with T0185/C1, T0185/T, T0183/MS, T0183/A, T0183/6, T0183/8 and T0183/14

38-T0185/KIT2

Falling Head apparatus for compacted soil complete with T0185/C2, T0185/T, T0183/MS, T0183/A, T0183/6, T0183/8 and T0183/14