



1.2

SOIL MECHANICS

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1.2.1 CONSOLIDATION TEST



AD 002

TECNOTEST

DATA ACQUISITION

Generally speaking, tests performed in the laboratory to determine the mechanical properties of soil are lengthy and require numerous measurements to be made at various intervals. Automatic data acquisition is therefore recommended to lighten the technicians' workload, to avoid errors and, above all, to enable tests to be continued into the night and during weekends/holidays. TECNOTEST has a specific hardware and software system for such needs, allowing the single channel data acquisition unit applied to each machine, to be arranged in a network. The unit is the well known GEOTRONIC.

GEOTRONIC (AD 002)

MICROPROCESSOR-BASED READOUT CONTROL UNIT

- Graphic display (backlit): 60 x 32 mm
- "HOLD" value key
- "TARE" key
- Peak value memorisation
- Unit of measurement: kN, daN, N, mm, micron, cm³, kPa
- $\pm 30,000$ divisions
- Power supply (via external adaptor): 110-240V, 50-60Hz, single phase - 10 Watts
- Transducer input: 2 mV/V; 3 mV/V; 7 mV/V
- Current loop interface
- Up to 32 GEOTRONIC units may be connected to create a network.
- Optional software (AD 050/001) is available for transmitting data to the PC and managing the test files in Windows applications.
- Clock - Calendar.

CALIBRATION FUNCTION ALLOWS:

- Testing of output devices for malfunctions
- Testing of non-volatile memory for malfunctions
- Testing of analog-digital converter for malfunctions
- Testing of displays and keypads for malfunctions
- Keypad input of calibration parameters
- Procedure for semi-automatic calibration on 11 points equally divided over the full scale.



T 665/N WITH PC

ONE-DIMENSIONAL CONSOLIDATION TESTS ON SOIL

ASTM D 2435 ASTM D 4546 BS 1377 UNI CEN ISO/TS 17892-5

The one-dimensional consolidation test gives useful information about the consolidation of a sample which is restrained laterally. The test can be performed with the aim of determining either the relationship between imposed force and resultant strain or between strain and time of application of a constant force.

The sample, of cylindrical shape, is contained within an indeformable ring and placed between two porous discs; a series of calibrated weights, applied to a lever system, transmit a load to the load plunger which slides freely within the ring, thus consolidating the sample.

A measurement instrument indicates the axial strain of the sample.

FIXED FULCRUM OEDOMETER T 663/020

Load capacity 160 kg on the lever arm, that is approx. 1.8 t on the sample.

The lever arm adjustment is achieved by means of a screw pin located on the load bridge.

Specifications:

Frame and lever arm made of special heat-treated cast aluminium
 Load transmission elements made of steel
 Lever arm/reaction pin with roller bearings
 Articulation of load bridge/plunger with spherical matching
 Lever arm counterweight with screw adjustment
 Weight hanger with two support plates
 Lever arm with triple beam ratios, 9/1, 10/1, 11/1
 Lever arm release system with screw and adjusting ring nut
 Dial gauge/transducer support
 Bubble level fitted to check horizontal levelling of lever arm

Consolidation cell, strain measuring instrument and calibrated weights are excluded and should be ordered separately.

DIMENSIONS: 850 x 210 x 500 (h) mm.

WEIGHT: 22.5 kg.

CONSOLIDATION CONTAINER T 667/C

To be positioned on the oedometer; it allows the consolidation of the sample contained in shear boxes T 666 - T 666/2 - T 666/4 (page 64).

CONSOLIDATION CONTAINER T 663/B36

To be positioned on the oedometer; it allows the consolidation of the sample contained in shear box T 666/1.

SET FOR PERMEABILITY TESTS T 663/080

Tecnotest's consolidation cells may be used as permeameters: to complete the measuring apparatus for falling head permeability, set T 663/080 is available, and comprises:

V 772/2	25 x 0.1 CC GRADUATED BURETTE
V 775/P	BURETTE STAND
V 791/T	PVC TUBING: Ø 6-9 mm. 2 m long

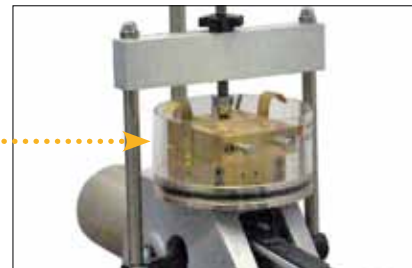


T 663/020 (x3)
 T 661 (x3)
 AD 100/011 (x3)
 AD 002 (x3)
 (TABLE AND WEIGHTS NOT INCLUDED)



T 663/020 (x2)
 T 661 (x2)
 DV 922/C (x1)
 AD 100/011 (x1)
 AD 002 (x1)
 T 663/050 (x1)
 T 663/060 (x1)
 (WEIGHTS NOT INCLUDED)

T 667/C



T 663/080

1.2.1 CONSOLIDATION TEST



T 661/1



TECNOTEST

COMPLETING PARTS

CONSOLIDATION CELLS

The cell base and load plunger are made of brass or stainless steel, the sample holder ring and fixing pins too; a Plexiglas cylinder is fitted to contain saturation water.

The cell is fitted with a drainage duct and watertight fitting between ring and base so as to allow permeability tests. Each cell is supplied with two porous discs.

AVAILABLE MODELS:

CELL CODE	SECTION cm ²	SAMPLE DIA. mm	SAMPLE HEIGHT mm	WEIGHT SET CODE
T 661	20	50.47	20	T 661/10
T 661/1	40	71.40	20	T 661/11
T 661/2	50	79.80	20	T 661/12
T 661/3	100	112.80	25	T 661/13

CALIBRATED WEIGHT SETS

These calibrated weight sets have been calculated to generate the following forces on the sample: 0.125, 0.25, 0.5, 1, 2, 4, 8, 16 and 32 kgf/sq. cm². The set of weights for cell T 661/3 allows the same sequence of loading but up to a maximum of 16 kgf/sq.cm. The previous table indicates the weight sets corresponding to the respective cells.

THE SETS CONTAIN THE FOLLOWING QUANTITIES OF WEIGHTS:

WEIGHTS (kg)	T 661/10	T 661/11	T 661/12	T 661/13
0.125	0	0	2	0
0.250	2	0	1	2
0.500	1	2	3	1
1.000	1	1	1	2
2.000	1	1	1	1
4.000	1	1	0	0
5.000	0	0	1	1
8.000	1	1	0	0
10.000	0	0	15	15
16.000	3	7	0	0
TOTAL Kg	64	128	160	160

N.B. WEIGHTS MAY BE ORDERED INDIVIDUALLY:

T 660/Z	0.125 kg CALIBRATED WEIGHT
T 660/A	0.250 kg CALIBRATED WEIGHT
T 660/B	0.500 kg CALIBRATED WEIGHT
T 660/C	1 kg CALIBRATED WEIGHT
T 660/D	2 kg CALIBRATED WEIGHT
T 660/E	4 kg CALIBRATED WEIGHT
T 660/L	5 kg CALIBRATED WEIGHT
T 660/F	8 kg CALIBRATED WEIGHT
T 660/M	10 kg CALIBRATED WEIGHT
T 660/G	16 kg CALIBRATED WEIGHT

PRECISION ± 0.1 %

INSTRUMENTS FOR STRAIN MEASUREMENT

DV 922/M	ANALOG DIAL GAUGE 5 mm TRAVEL, 0.001 divisions (Rambold)
DV 922/C	ANALOG DIAL GAUGE 10 mm TRAVEL, 0.01 divisions (Rambold)
DV 924	ANALOG DIAL GAUGE 12 mm TRAVEL, 0.002 divisions
DV 922/D	DIGITAL DIAL GAUGE 12 mm (1/2") 0.001 resolution, 5 figure display



N.B. AS LOWER COST ALTERNATIVE, WE SUGGEST:

T 628/E1	ANALOG DIAL GAUGE 10 mm TRAVEL, 0.01 divisions
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The mechanical analog dial gauge may be replaced by an electronic transducer having same travel which, in combination with a special control unit, enables measurements to be taken in digital form or for data to be acquired automatically.

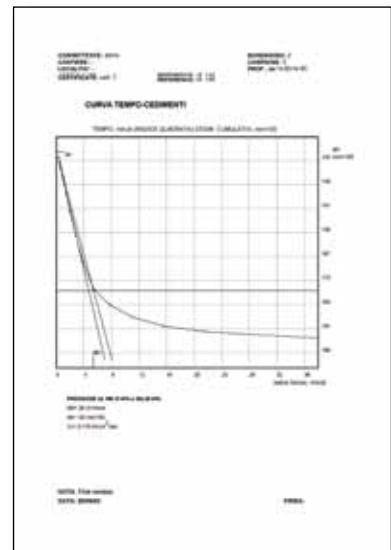
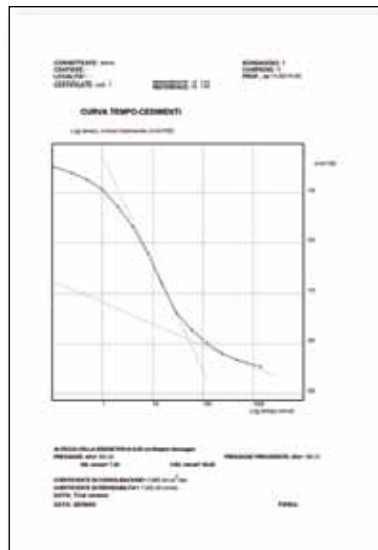
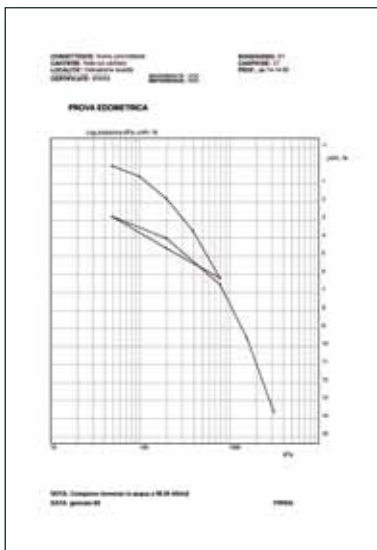
AD 100/011	LINEAR BRIDGE TRANSDUCER, 10 mm TRAVEL, 0.001 resolution
AD 113/011	LINEAR BRIDGE TRANSDUCER, 10 mm TRAVEL, 0.002 resolution
AD 115/026	POTENTIOMETRIC TRANSDUCER, 25 mm TRAVEL, accuracy 0.01 mm
AD 002	GEOTRONIC Microprocessor-based digital control unit. 30,000 (±) divisions. 5 digit graphic display. Current loop interface. Internal storage of up to 100 data items. Tare function. Power supply 220-110-240 V, 50-60 Hz, single phase, 10 W.
AD 225/007	"OEDOMETRIC TEST" SOFTWARE
AD 225/008	AD 225/007 EXPANSION FOR "CV AND K DETERMINATION"
AD 225/004	"OEDOMETRIC SWELL TEST" SOFTWARE



AD 115/026
AD 113/011
AD 100/011



AD 002
AD 100/011



1.2.1 CONSOLIDATION TEST



T 661/6

T 661/7

T 661/8



T 662
+ 3 OEDOMETERS
WITH ACCESSORIES



T 663/050
T 663/060

TECNOTEST

SPARE PARTS AND ACCESSORIES

POROUS DISCS

MADE OF SILICON CARBIDE, SUPPLIED IN SETS OF 2 PIECES:

T 661/A	FOR SAMPLES diameter 50.47 mm
T 661/B	FOR SAMPLES diameter 71.40 mm
T 661/C	FOR SAMPLES diameter 79.80 mm
T 661/D	FOR SAMPLES diameter 112.80 mm

SAMPLE CUTTERS FOR UNDISTURBED SAMPLES

MADE OF STAINLESS STEEL:

T 661/6	FOR SAMPLES diameter 50.47 mm
T 661/7	FOR SAMPLES diameter 71.40 mm
T 661/8	FOR SAMPLES diameter 79.80 mm
T 661/9	FOR SAMPLES diameter 112.80 mm

CALIBRATING DISCS:

T 661/M	FOR SAMPLES diameter 50.47 mm
T 661/R	FOR SAMPLES diameter 71.40 mm
T 661/S	FOR SAMPLES diameter 79.80 mm
T 661/T	FOR SAMPLES diameter 112.80 mm

BENCHES FOR OEDOMETERS

SINGLE PLACE BENCH

T 663/050

Made of strong profiled and plated steel, complete with shelf and weight hanger.

Extension benches T 663/060 can be added if required.

Can be disassembled.

DIMENSIONS: 1000 x 1000 x 200 (h) mm

WEIGHT: 35 kg

SINGLE PLACE EXTENSION BENCH

T 663/060

Made of strong profiled and plated steel when added to T 663/050 provides 2 or more places.

Also complete with shelf and weight hanger.

DIMENSIONS: 1000 x 1000 x 200 (h) mm

weight: 25 kg

THREE PLACE BENCH

T 662

Steel made, suitable for 3 oedometers.

Cannot be disassembled.

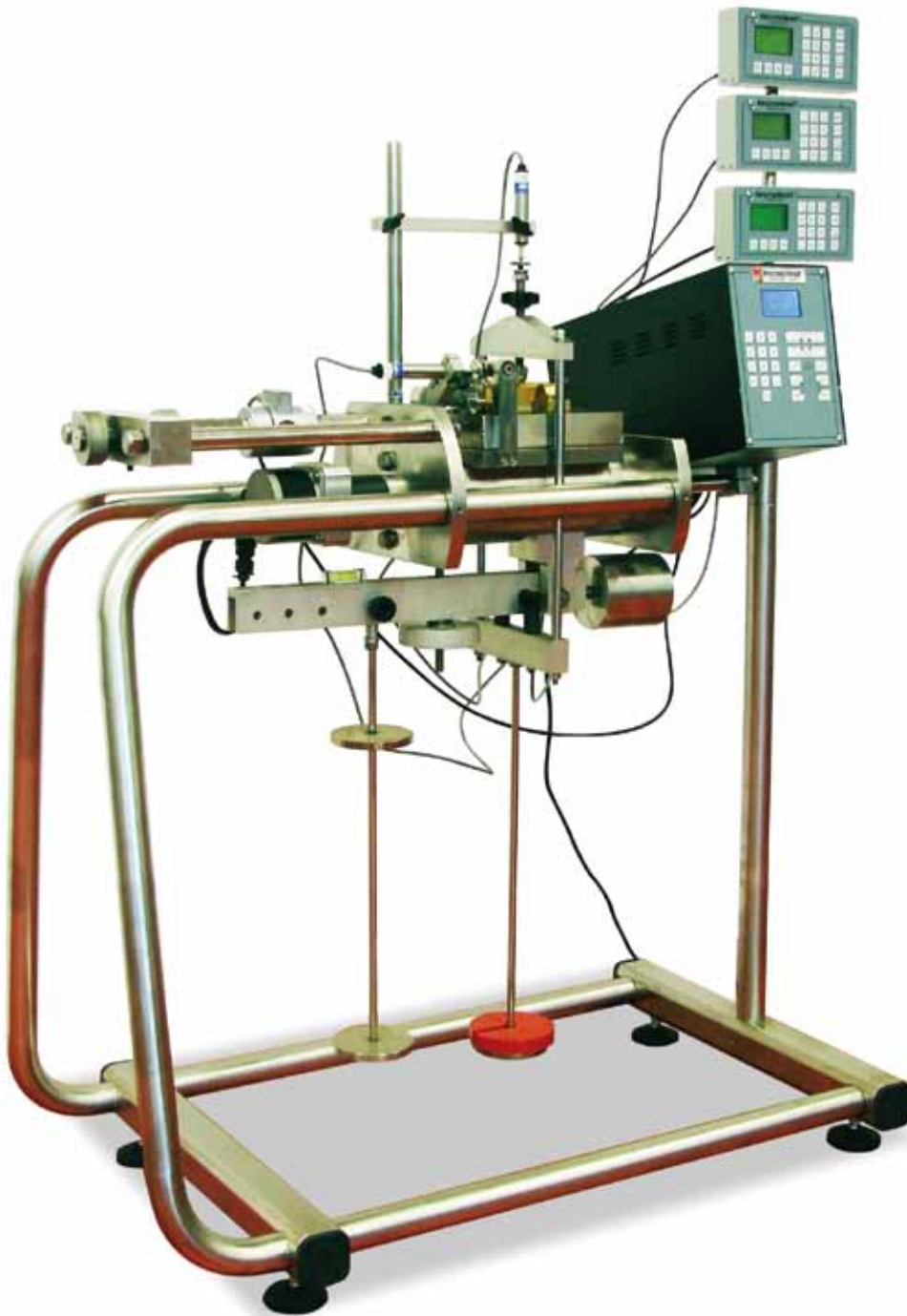
DIMENSIONS: 1000 x 780 x 960 (h) mm

WEIGHT: 20 kg

DIRECT/RESIDUAL SHEAR TESTS OF SOILS

ASTM D 3038 BS 1377:7 UNI CEN ISO/TS 17892-10

This test is used to determine the shear strength of a soil sample subjected to orthogonal stress with respect to the failure plane. The sample is enclosed within a robust metal box horizontally split into two halves and provided with a vertical plunger. The shearing stress is created by imposing a movement of the lower half of the shear box, whilst applying a static load to the load plunger. In the more refined machines, called “controlled displacement equipment”, the variables that may be measured during the test are as follows: vertical strain, horizontal strain, shearing stress whilst the vertical force and displacement speed are kept absolutely constant.



T 665/N
AP 032/005
AD 100/011
AD 100/026
AD 002 (3 pcs)
T 666

1.2.1 DIRECT SHEAR TEST

TECNOTEST



T 665/N
BA 003
DV 922/C
T 666
DV 922

ELECTRONIC APPARATUS FOR DIRECT SHEAR TESTING

T 665/N

Accurate, noiseless and reliable: this apparatus is of robust construction, made to last, as the most widely-used instrument in a soil testing laboratory should be.

It is equipped with an advanced, electromechanical operating device comprising a stepper motor, a precision made reduction unit and final worm screw with reduced play.

These devices are designed to obtain linear, micrometrical movements at constant speed and, independently from force developed, fast reverse drive. Noise levels are virtually imperceptible and no maintenance is required.

Continual drive speed in either direction can be varied via the electronic control unit from 0.00001 to 12 mm/minute.

RS232 Interface for PC. Graphic display (backlit).

The number of cycles, forward/reverse speeds and displacement for the measurement of residual shear may also be programmed. Instructions for use are provided in sequence on the display unit and data are input directly via the alphanumeric keypad.

Also provided are separate buttons for rapid approach and standard test speeds, as well as buttons to stop and reset the unit. Safety alarm lights are also provided (to signal piston overtravel and dynamometer overload).

Accommodates shear boxes measuring up to 100 x 100 mm. Bench, horizontal displacement of shear box mechanism, counter-balanced leverage system and vertical weight hanger have all been made in either non-rust forming or chromium-plated metals so as to eliminate all the painted surfaces most subject to wear.

SPECIFICATIONS:

- Max. force forward/reverse: 6 kN
- Speed range: 0.00001 – 12 mm/minute
- Different speeds may be selected for forward and reverse drive
- Speed/load limitations: none
- Displacement movements: 0.03 μm
- Rapid approach speed (unloaded): 12 mm/min.
- Forward/reverse cycles: programmable up to 20 mm
- Number of cycles: no limit to number which may be programmed
- Microswitches prevent piston overtravel and dynamometer overload
- Leverage system allows applied weights to be amplified by 10, 9, 7.92 and 6.125
- A small handwheel serves to sustain/release the vertical load
- Supports are provided for transducers, dial gauges and dynamometers.

DIMENSIONS (without packing): 1016 x 572 x 1548 (h) mm

WEIGHT (without packing): 100 kg

DIMENSIONS (packed): 1100 x 700 x 1250 (h) mm

WEIGHT (packed): 140 kg.

MODELS:

T 665/N **220-240 V, 50 Hz, SINGLE PHASE, 325 W**

T 665/N1 **110 V, 60 Hz, SINGLE PHASE, 325 W**

N.B. The standard equipment supplied with the shear testing apparatus does not include the following essential components:

- load and shear measurement instruments,
- shear box or calibrated weights.

These instruments are to be ordered separately and may be chosen from the items listed on the following pages.

ANALOG MEASURING INSTRUMENTS

LOAD

Classic proving rings with mechanical measurement of deflection and made of special treated steel, supplied complete with microswitches to prevent overloading/ tension, millesimal dial gauge and official calibration certificate. Linearity is within $\pm 1\%$ in the upper 80% of full scale and repeatability is better than 0.5%.

BA 003	PROVING RING WITH 3 kN FULL SCALE for 60 x 60 mm, 70 x 70 mm, 63.5 and 67.7 mm diameter samples
BA 006	PROVING RING WITH 6 kN FULL SCALE for 100 x 100 mm samples

Each proving ring (with relevant dial gauge) is calibrated by an Accredited Laboratory which issues a CALIBRATION CERTIFICATE.

The same proving rings, supplied with Tecnotest certificate are also available.

BB 003	PROVING RING WITH 3 kN FULL SCALE
BB 006	PROVING RING WITH 6 kN FULL SCALE

Strain: vertical 10 mm - horizontal 30 mm

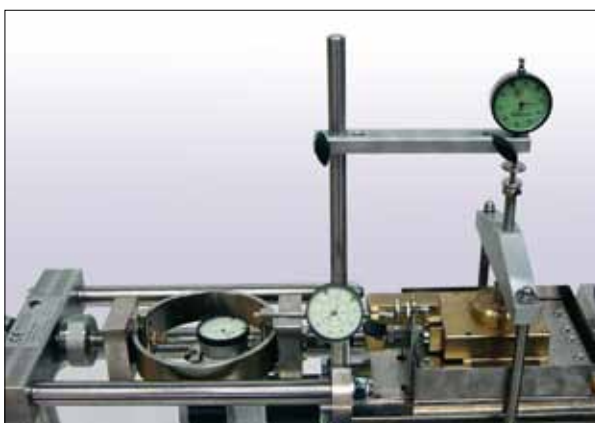
DV 922/C	ANALOG DIAL GAUGE 10 mm TRAVEL ACCURACY 0.01 (original Rambold)
DV 922	ANALOG DIAL GAUGE 30 mm TRAVEL ACCURACY 0.01 (original Rambold)

Low cost alternative:

T 628/E1	ANALOG DIAL GAUGE 10 mm TRAVEL ACCURACY 0.01
T 628/E	ANALOG DIAL GAUGE 30 mm TRAVEL ACCURACY 0.01

As an alternative we also offer digital dial gauges (without data acquisition facility):

DV 923/10	DIGITAL DIAL GAUGE: 10 mm TRAVEL ACCURACY 0.01 mm
DV 923/30	DIGITAL DIAL GAUGE: 30 mm TRAVEL ACCURACY 0.01 mm



DIGITAL MEASURING INSTRUMENTS

LOAD

Instead of the load ring, an extensometric type load cell may be fitted which, combined with a special Geotronic readout unit, enables measurements to be taken in digital form or for data to be acquired automatically.

AP 032/005	LOAD CELL - 5 kN CAPACITY
AP 032/003	LOAD CELL - 3.5 kN CAPACITY

LINEARITY - HYSTERESIS $\leq \pm 0.03\%$ F.S.

Strain: vertical 10 mm - horizontal 30 mm

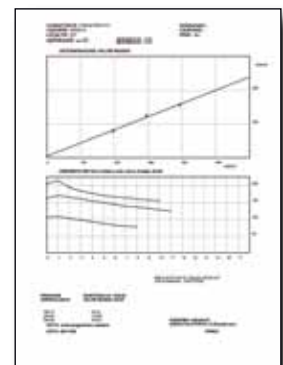
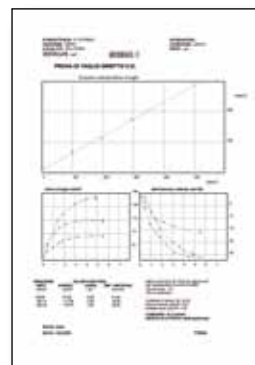
AD 100/011	LINEAR EXTENSOMETRIC BRIDGE TRANSDUCER 10 mm TRAVEL, accuracy 0.001 mm
AD 113/011	LINEAR EXTENSOMETRIC BRIDGE TRANSDUCER 10 mm TRAVEL, accuracy 0.002 mm
AD 100/026	LINEAR EXTENSOMETRIC BRIDGE TRANSDUCER 25 mm TRAVEL, accuracy 0.001 mm
AD 113/026	LINEAR EXTENSOMETRIC BRIDGE TRANSDUCER 25 mm TRAVEL, accuracy 0.002 mm
AD 115/026	POTENTIOMETRIC TRANSDUCER 25 mm TRAVEL, accuracy 0.01 mm

All the above-mentioned instruments are used in combination with the single channel Geotronic unit. They are supplied with Tecnotest individual calibration certificate.

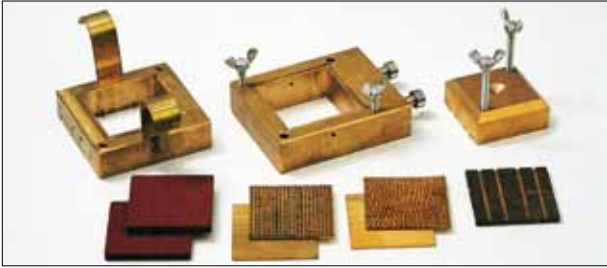
BUYER'S GUIDE PAGE 86

GEOTRONIC DIGITAL CONTROL UNIT

MICROPROCESSOR-BASED	AD 002
AD 225/005	"CASAGRANDE DIRECT SHEAR" PROGRAM
AD 225/006	AD 225/005 EXPANSION FOR MEASURING "RESIDUAL SHEAR STRENGTH"



1.2.2 DIRECT SHEAR TEST



T 666



T 666/2



SAMPLE CUTTERS

Made of corrosion-resistant metal, they fit into a special housing on the relative shear box so as to allow the extrusion of the sample directly onto the shear box.

T 666/A	CUTTER FOR SAMPLES 60 x 60 x 20 mm
T 666/5	CUTTER FOR SAMPLES 63.5 diameter x 20 mm
T 666/B	CUTTER FOR SAMPLES 100 x 100 x 20 mm
T 666/D	CUTTER FOR SAMPLES 67.7 diameter x 20 mm

POROUS DISCS AND PLATES

Made of silicon carbide, supplied in sets of 2 pieces.

T 666/6	SET FOR SAMPLES 60 x 60 mm
T 666/8	SET FOR SAMPLES DIA. 63.5
T 666/7	SET FOR SAMPLES 100 x 100 mm

Made of sintered bronze, supplied in sets of 2 pieces.

T 666/10	SET FOR SAMPLES DIA. 67.7 mm
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TECNOTEST

SHEAR BOXES

Machine-finished, consisting of:

- lower element with fixed base and lifting lugs
- upper element with loading pad and handles for displacement from the cutter mold to the box
- two perforated retaining plates
- two non-perforated retaining plates
- connection pins
- two porous discs

Four standard models are available in brass:

T 666	FOR 60 x 60 x 20 mm SPECIMENS
T 666/1	FOR 100 x 100 x 20 mm SPECIMENS
T 666/2	FOR 63.5 dia. x 20 mm SPECIMENS
T 666/4	FOR 67.7 dia. x 20 mm SPECIMENS

N.B.: THE 100 x 100 mm SHEAR BOX REQUIRES A LARGE HOUSING WHICH IS SUPPLIED AT NO EXTRA COST IF PURCHASED TOGETHER WITH THE DIRECT SHEAR APPARATUS; TO FIT SHEAR BOXES MEASURING 60 x 60 mm AND 63.5 mm DIA. INTO THIS HOUSING, A SPECIAL ADAPTOR T 666/12 MUST BE ORDERED.

T 666/P	PISTON GUIDE ACCESSORY FOR SHEAR BOX T 666/4 TO UNICEN ISO/TS 17892-10
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CALIBRATED WEIGHTS

Each model of shear box is supplied with a special calibrated weight calculated to generate an initial pressure on the sample of: 0.125 kgf/cm².

To obtain pressure multiples of 0.125 kgf/cm² (that is 0.250, 0.500, 1, 2, 4 and 8 kgf/cm²), two sets of calibrated weights are available, in particular:

T 660/6	SET OF CALIBRATED WEIGHTS for specimens measuring 60 x 60 mm, 70 x 70 mm and 2.5" dia. (63.5 mm)
----------------	--

Consisting of:

N° 1 T 660/B	0.5 kg calibrated weight
N° 1 T 660/C	1 kg calibrated weight
N° 1 T 660/D	2 kg calibrated weight
N° 1 T 660/E	4 kg calibrated weight
N° 1 T 660/F	8 kg calibrated weight
N° 1 T 660/G	16 kg calibrated weight

The succession of pressure multiples of 0.125 kgf/cm² is obtained by positioning the weight hanger at position (x9) for 60 x 60 mm specimens, (x7.92) for 2.5" diameter specimens and (x6.125) for 70 x 70 mm specimens.

T 660/7	SET OF CALIBRATED WEIGHTS for 100 x 100 mm specimens
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Consisting of:

N° 1 T 660/A	0.25 kg calibrated weight
N° 1 T 660/B	0.50 kg calibrated weight
N.°1 T 660/C	1 kg calibrated weight
N° 1 T 660/D	2 kg calibrated weight
N° 1 T 660/L	5 kg calibrated weight
N° 7 T 660/M	10 kg calibrated weight

The succession of pressure multiples of 0.125 kgf/cm² is obtained by placing the weight hanger at position (x 10) of the lever arm.

PRECISION \pm 0.1%

CONSOLIDATION BENCH FOR SHEAR BOXES T 667

The consolidation phase of soil of low permeability can be very lengthy, thus it is convenient to consolidate specimens simultaneously but not on the direct shear machine itself.

The consolidation bench fulfils this purpose.

It is only available in single place form thus allowing complete flexibility of the number of benches to buy and their rational positioning within the laboratory.

Specifications:

- Single place bench
- Rust-proof shear box container
- Weight hanger and leverage system supplied as standard
- Dial gauge transducer support

DIMENSIONS: 900 x 200 x 1350 (l x w x h) mm

WEIGHT: 77 kg

PACKED DIMENSIONS: 1200 x 600 x 500 (h) mm

PACKED WEIGHT: 113 kg

N.B.: THE FOLLOWING ITEMS, NECESSARY FOR TESTS, ARE NOT INCLUDED AND SHOULD BE ORDERED SEPARATELY:

- shear box
- calibrated weights
- instrument for strain measurement

To complete the equipment refer to the information provided on the previous pages

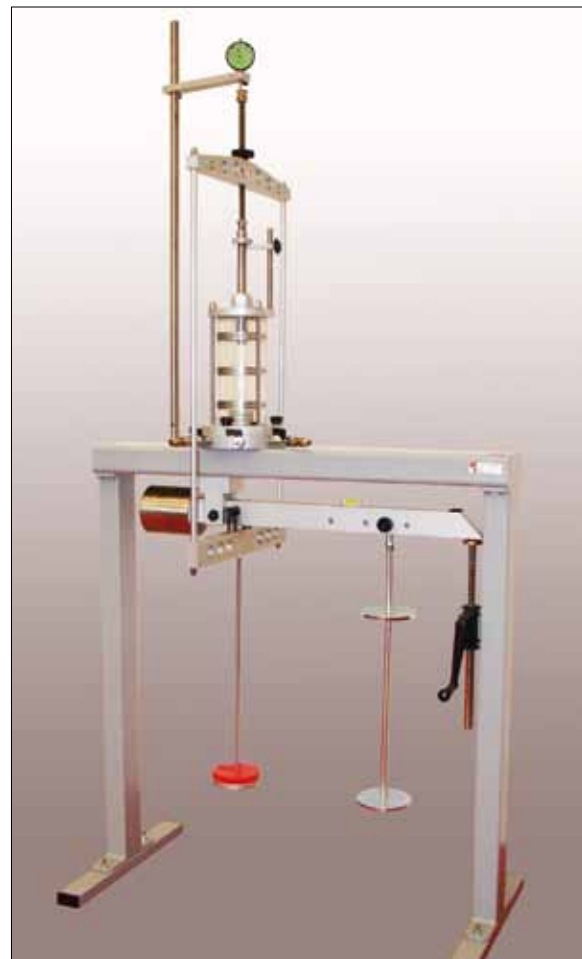
The load piston is used for extruding the sample from the mould.

ACCESSORIES FOR PERFORMING ANISOTROPIC CONSOLIDATION ON T 667 BENCH:

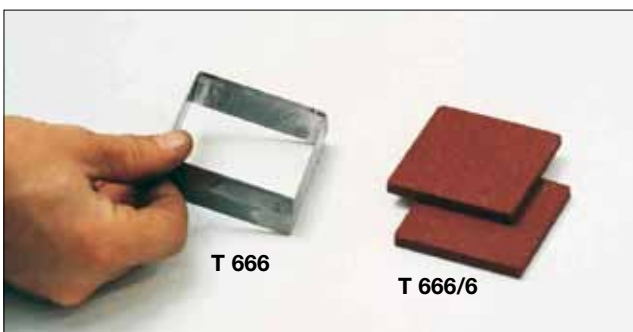
T 667/D	Load hanger for weights for triaxial cell
T 667/P	Triaxial cell housing platen



T 667
T 666
AD 100/011
AD 002



T 667
T 667/D
T 667/P
TR 205
DV 922/C



1.2.2 DIRECT SHEAR TEST

TECNOTEST

INSTRUMENTS FOR TRANSDUCER AND DIAL GAUGE CALIBRATION

AD 161 MICROMETER

Economically priced with essential equipment only. Supporting frame and micrometric head, 25 mm travel (0.001).

AD 163/D DIGITAL MICROMETER

Travel 50 mm (0.001) complete with frame for transducers and dial gauges.

AD 160 PROFESSIONAL MICROMETRIC INSTRUMENT

Support with micrometric head, 0.001 mm divisions. Measurement range from 0 to 25 mm.

A support bracket holds instruments having diameters measuring 8 and 17.5 mm.

DIMENSIONS: 200 x 140 x 340 (h) mm.
WEIGHT: 7 kg.

AD 162 SLIP GAUGES

In special steel, of known and calibrated thickness, they are normally used for checking and calibrating displacement transducers. Housed in a small case, complete with calibration certificate. Assortment of 32 pieces.

Composition	Size range (mm)	Progression (mm)	Tolerance (micrometers)
1	1.005	-	± 0.20
9	1.01 ~ 1.9	0.01	± 0.20
9	1.1 ~ 1.9	0.1	± 0.20
9	1 ~ 9	1.0	± 0.20
3	10 ~ 30	10	± 0.40
1	50	-	± 0.80



AD 161 WITH TRANSDUCER AND READOUT UNIT DURING CALIBRATION

AD 161



AD 163/D



AD 162



AD 160



DIRECT SHEAR TEST ON ANNULAR SPECIMENS

This test is highly recommended for measuring residual shear strength on annular specimens.
The sample is subjected to a normal stress on level faces and to a single torque parallel to same.

ELECTRONIC APPARATUS FOR DIRECT SHEAR

TEST ON ANNULAR SPECIMENS

T 800

ELECTRO-MECHANICAL DRIVE UNIT

- Stepper motor and pressure reducer
- Max. torque in use = 100 N.m
- Max. rotation of the box = 1 turn

CONTROL AND FEEDING UNIT

- Rotation speed can be selected steplessly (max. 12°/s, 0.00002°/s)
- Automatic cut-out device after 1 complete turn
- Commands for clockwise, anticlockwise, rapid and test rotation.
- Continual display of shear strain

SHEAR BOX

- Materials: corrosion-resistant metal and Perspex
- May be fully taken apart for cleaning purposes
- Compression rings are in permeable, sintered bronze and are radially toothed
- Sample dimensions: outside diameter 100 mm, inside diameter 70 mm, thickness 20 mm

VERTICAL LOADING SYSTEM

- Low friction pneumatic piston (rolling membranes)
- Travel 11 mm
- Max. force 3000 N
- Precision pneumatic valve to regulate and maintain load.

N.B.

THE LOADING SYSTEM NEEDS TO BE SUPPLIED WITH COMPRESSED AIR, DULY DEHUMIDIFIED AND FREE FROM OIL, AT A PRESSURE OF NOT LESS THAN 500 KPA.

SENSORS AND DISPLAYS

- Strain gauge type torque meter to measure the torque values; 100 N.m capacity, non-linearity within 0.3%
- Linear transducer to measure the vertical strain; 10 mm travel, non-linearity within 0.3%
- Pressure extensometric transducer to measure the vertical loading: 1000 kPa capacity, non-linearity within 0.3%
- 3 microprocessor liquid crystal display units; discrimination ± 30000 dots, output in engineering units, serial interface
- 1 control manometer for input air pressures

POWER SUPPLY: 220 V, 50 Hz, single phase, 450 W

DIMENSIONS: 560 x 400 x 840 (h) mm

WEIGHT: 95 kg

PACKING DIMENSIONS: 600 x 500 x 1000 (h) mm

PACKED WEIGHT: 110 kg



T 800

1.2.2 DIRECT SHEAR TEST

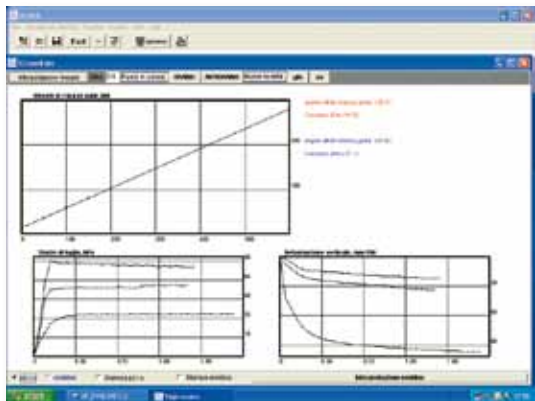
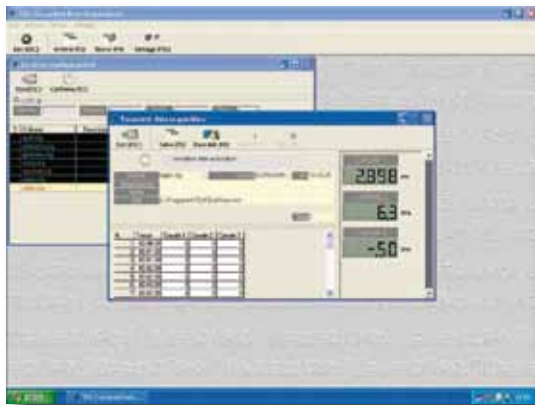
TECNOTEST



T 800



T 800



This apparatus differs greatly from the traditional units in which shearing stress is measured by means of an arm acting on two proving rings or load cells.

Here a strain gauge type torque meter, directly keyed onto the rotational axis, is used.

This solution, besides allowing greater precision, also enables the specimen to be positioned more easily.

Stress is displayed in digital form on a special readout unit. The vertical loading device is also new: the traditional weight lever has been replaced by an axial jack with Bellofram rolling membranes operated by compressed air.

A precision valve enables load to be selected and maintained constant, whilst a strain gauge type transducer and relevant digital readout unit continues displaying the applied load measurement. A third strain gauge type transducer and respective digital readout unit also provide axial strain of specimen during consolidation and shearing.

Angle of rotation is measured, again in digital form, at stepper motor with precision Harmonic drive gear box.

OF PARTICULAR INTEREST IS THE POSSIBILITY OF USING WITH A PC INTERFACE IN ORDER TO ACQUIRE TEST DATA AUTOMATICALLY.

The apparatus is already equipped with the appropriate interfaces for connecting to Tecnotest's data acquisition system .

IF THE CUSTOMER DOES NOT HAVE SUCH A SYSTEM, IN ORDER TO CREATE A COMPUTER NETWORK CAPABLE OF MANAGING UP TO 32 PERIPHERAL GEOTRONIC UNITS, THE FOLLOWING EQUIPMENT IS NECESSARY:

AD 021/010 **MULTIPLEXER FOR CONNECTING THE VARIOUS GEOTRONIC UNITS IN A NETWORK RS 232 32 CHANNEL, CURRENT-LOOP GENERAL INTERFACE**

AD 021/012 **NETWORK CABLE (10 m long) with connectors**

AD 021/003 **3-WAY CONNECTOR BLOCK**

AD 050/001 **PC/GEOTRONIC COMMUNICATIONS PROGRAM, WINDOWS ENVIRONMENT**

Also necessary is a Standard PC equipped with RS 232 interface. This computer serves the sole purpose of instructing and loading each one of the peripheral readout units, as well as that of recovering the data memorised during the test.

During any other stage, the computer may be switched off or used for other purposes.

The data acquisition unit returns the data in ASCII format files.

For processing and printing the test certificates, we recommend:

AD 225/014 **"DIRECT SHEAR ON ANNULAR SPECIMENS" PROGRAM**

TRIAXIAL TESTING APPARATUS FOR SOILS

BS 1377:7 BS 1377:8 ASTM D 2850 ASTM D 4767
UNI CEN ISO/TS 17892-8 UNI CEN ISO/TS 17892-9

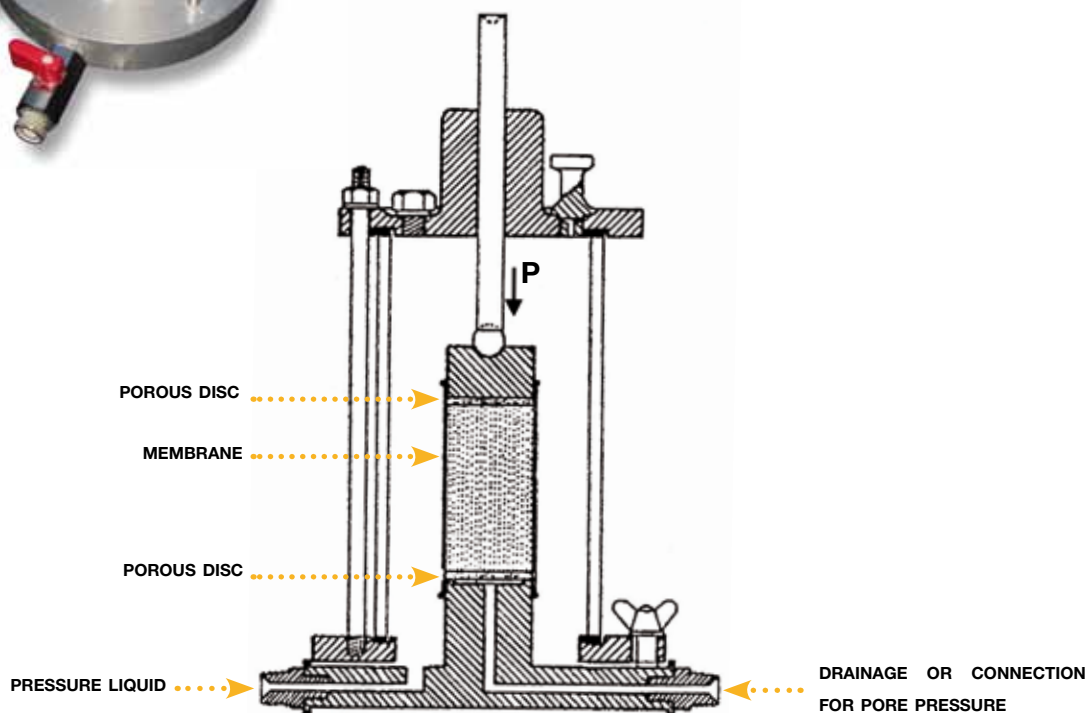
In the classic Triaxial Test the sample is cut or reconstructed in a cylindrical form, covered by an impermeable membrane, subjected to hydraulic pressure within a special cell and then tested to failure under an axial load.

The purpose of the test is to ascertain the shear strength of the sample and determine the relationships between stresses and strains.

The advantage of the Triaxial Test over the Direct Shear Test is in the recreation of real conditions: the failure plane is no longer conditioned by the apparatus itself but develops along the plane of lesser resistance within the sample.

The control of drainage and pore pressure allows the study of the effect fluids have on the mechanical properties of the solids in the sample.

The triaxial test also allows radial strain of the sample under load, a feature not present in consolidation tests performed with oedometers. Therefore the triaxial test may be useful in identifying deformations where the Poisson Ratio of the material is of importance.



COMPOSITION OF THE APPARATUS

The Triaxial Test Apparatus may be composed in various ways, in order to ensure the most rational choice of component parts we recommend that the following guide is followed step by step so as to identify the apparatus which most fully satisfies all tests likely to be encountered.

1. SAMPLE DIMENSIONS

The most frequent sample diameter is 38.1 mm (1.5"). Larger diameters may be necessary if the sample contains coarse grains. Small diameter samples are preferred with fine grained soils so as to reduce the time needed for drainage and consolidation.

2. SAMPLE PREPARATION

Samples of cohesive soil are normally taken from undisturbed specimens by either boring or turning on a lathe. The former method is acceptable in soils of medium consistency whilst the latter is preferred for soft or hard material. With the boring method, as well as a **Sampling Tube** of suitable diameter with relative accessories, it is advisable to have a **Hand Extruder** to extrude the sample from the tube. A special **Electric Lathe** is available for turning samples to the required diameter. Naturally, the lathe must be equipped with **Support Platens** of the same diameter as that of the required sample. Once the sample has been turned or bored it can be cut to its correct length (two times its diameter) with level and parallel faces by placing it in a **Two-Part Split Mould** and trimming the ends with a trimming knife or wire saw. To reconstruct sand samples a **Three-Part Split Former** of suitable diameter is used.

3. ELEMENTS USED WITHIN THE TRIAXIAL CELL

The Triaxial Test may be programmed so as to allow or exclude the hydraulic connection between the inside of the sample with the ambient outside the triaxial cell or with special measuring instruments. Such connections require the use of special drainage mediums around the sample, in particular: **Porous Discs** on the top and bottom of the sample and **Filter Drains** around its sides. However, if the sample must be isolated, the bottom porous disc is replaced by an impermeable **Base Disc** whilst the upper porous disc is removed. In each case the sample is placed on a **Pedestal** and a **Top Cap** is placed on top of the sample. These elements will have the same diameter as the sample.

To isolate the sample from the water within the triaxial cell, it is covered with a very thin **Membrane** made of natural rubber (of appropriate diameter) which is placed over the sample using a **Suction Membrane Stretcher** and a water-tight fit is guaranteed at the junction with the pedestal and top cap by using **Sealing Rings** of appropriate diameter.

4. TRIAXIAL CELLS

The **triaxial cell** is a water-tight container with hydraulic connections at the base and a sliding load piston in the top. The cell can be readily opened to allow the positioning of samples and cell accessories.

The pedestal on which the sample sits is interchangeable with pedestals of different diameter provided that these are compatible with the cell itself. Three different cell sizes are available, the choice of cell is determined by the size of sample to be tested. The Triaxial Apparatus may include one or more cells (normally three). Multiple cell systems are justified inasmuch that a complete Triaxial Test normally requires three samples to be tested under different confining pressures. Therefore, considerable time savings can be achieved by using three cells in series, particularly if the test includes sample saturation and long consolidation times before the samples are subjected to axial loading.

5. CONSTANT PRESSURE SOURCES

Normally, the confining pressure around the sample is furnished by pressurised water, thus the triaxial cell must be connected to a system capable of providing pressurised water. This system must also be capable of compensating for eventual volume changes of the sample by providing or receiving the corresponding volume of water without change in water pressure.

The system must also be capable of controlling the water pressure to a high degree of accuracy. These systems are commonly known as **Constant Pressure Sources** and are available in various forms based on different working principles and thus have differing characteristics.

Tecnotest suggests a valid alternative to the classic water-mercury system: the **Bladder Air-Water System** more modern and efficient. This system envisages the use of a normal **Air Compressor** and an **Interface Cylinder** where a thin rubber membrane separates the air and water and prevents their mixture whilst allowing both mediums to maintain equal pressures.

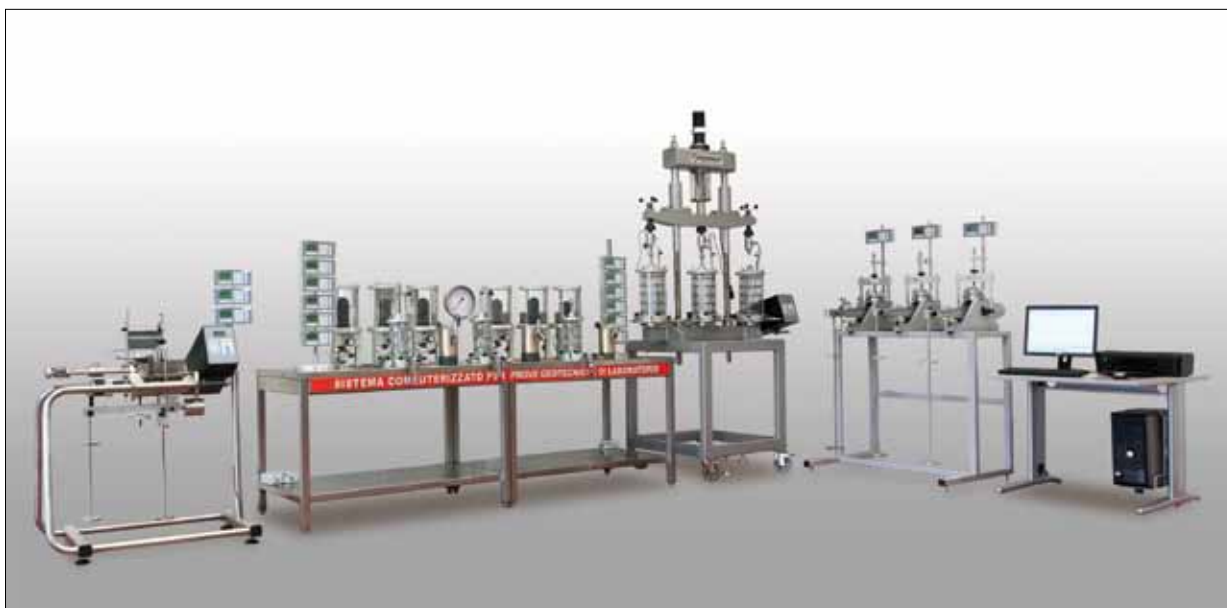
The pressure is controlled by a special valve on the compressed air feed line, whilst it is read by a Manometer on the line of compressed water.

The accuracy and response of this system depends upon the quality of the pressure regulating valve; long term reliability is achieved by ensuring the supply of clean dry air to the valve, therefore it is advisable to provide an **Air Filter** and **Dehumidifier** with **Refrigerator Cycle** to the air supply line.

The advantages of the Bladder Air-Water system are many; it is compact, extremely easy to use, readily expandable, and able to compensate for large volume changes. It should be noted that long interruptions to electric mains supply can cause problems to this system, indeed if the tank of the compressor is allowed to discharge there will inevitably be a decompression of the system as a whole.

A simple and economic pressure source is provided by the **Air-Water Cylinder and Foot Pump System**. In reality this system should not be considered as a serious alternative to the aforementioned system due to the fact that its limited capacity of compensation demands frequent adjustments to be made by the operator.

However, this system may prove valid if only quick tests are to be performed (**Unconsolidated, Undrained**).



The apparatus consists of an **Air-Water Cylinder** which acts in the same way as an autoclave, a **Foot Pump** to pressurise the cylinder, a **Pressure Gauge** with relative mounting **Bracket and Clamp** and a set of **Flexible Nylon Hoses** for connection to the triaxial cell. The number of independent constant pressure sources required in a triaxial system may vary and will depend upon the number of triaxial cells in use, the type of tests to be performed, the degree of flexibility of the system and the amount of money to be invested. In all cases each cell will require at least one independent constant pressure source to pressurise the water which surrounds the sample in the triaxial cell.

However, it is advisable to provide the cell with a second independent pressure source so as to furnish back pressure. In a relatively modest system with limited flexibility, one source of back pressure may be sufficient, this being connected to each cell as the need arises. More refined systems will require separate back pressure sources for each cell in use. The need for back pressure is due to the frequent necessity to saturate samples and eliminate even the smallest air bubbles trapped within the hydraulic circuit connected to the inside of the sample.

In practice the technique used is to increase the back pressure and cell pressure appropriately so as to force any air to dissolve into the water without creating a difference in pressure between the inside and outside of the membrane surrounding the sample. In this way it is possible to saturate the sample without giving act to the consolidation of the sample itself. Once saturation has been achieved variations in pore pressure may be accurately monitored during the axial loading of undrained tests, thus providing data for the correct interpretation of the test.

Naturally, back pressure should not be provided by the air-water cylinder and foot pump system because the process of air dissolving into the water will occur within the cylinder and not where it is necessary, that is within the sample.

6. LOAD FRAME

Once the operations of hydraulic pressurisation and consolidation have been completed, the triaxial cell is placed under a **Load Frame** which has the function of applying an increasing axial load on the sample up to sample failure. The characteristics of the load frame are very demanding unless only quick tests (Unconsolidated, Undrained) are to be made.

In fact, the increase in strain in certain slow tests is minimal and expressed in terms of micro meters per minute. On the other hand, it is necessary to be able to regulate the rate of strain applied to the sample within a very large range and, ideally, fully variable so as to allow the correct selection of strain for each particular test. Another requisite of the load frame is the accuracy and continuity of strain rate independently of the forces encountered.

The load frame should be selected in function of the maximum load force required which in turn will depend upon the consistency of the material to be tested and sample diameter. A load of 10 kN is more than sufficient for 1.5" samples. A load of 50 kN is recommended for larger diameter samples or if the load frame is to be used for other laboratory tests (e.g. C.B.R.). Three-place version (50 kN) is particularly interesting: it allows simultaneous testing of 3 samples, thus saving time.

EXAMPLE OF A SYSTEM USING 12 CONSTANT PRESSURE SOURCES FOR SATURATING AND CONSOLIDATING 6 SAMPLES SIMULTANEOUSLY, WITH SUBSEQUENT FAILURE IN COMPRESSION ON THREE PLACE LOAD FRAME.



7. MEASURING INSTRUMENTS

Instruments for measuring load and axial strain will need to be applied to the load frame; if analog readings are sufficient for these two parameters then normally a Proving Ring and Dial Gauge are used.

If digital readings are required, Electronic Sensors described elsewhere in this catalogue are used.

The capacity of the load measuring instrument should be compatible with the loads to be measured which will depend upon the resistance and diameter of the sample. It may well be necessary to purchase various capacity load measuring instruments.

As a general rule, if only 1.5" samples are to be tested, a load measuring instrument with a capacity of 200 kgf is normally sufficient. The travel of the axial strain measuring instrument is also dependent on the diameter of the sample and should not be less than 20% of said diameter.

Other measuring instruments may be connected to the triaxial cell, these include:

- Pressure Sensors
- Volume Change Sensors

The former are used to measure pore pressure during sample saturation and during axial loading in undrained tests. The latter are used to measure volume changes of the sample during consolidation or during axial loading in drained tests. For rapid Unconsolidated Undrained tests on clay samples these instruments are not normally used. In the past, pressure measurements were normally made with instruments known as "Null Indicators" which consisted of small transparent siphons containing mercury. One side of the null indicator is connected to the triaxial cell whilst the other side is connected to manometers and a volumetric pump.



This pump is used to form a back pressure to equalise the pressure from the triaxial cell, the correct pressure is that which keeps the mercury in the correct position within the siphon, the resultant back pressure, which equals the pore pressure, is read on the manometers. In practice the use of this instrument demands great care and lack of attention by the operator or misuse can easily lead to the loss of important test data and the annulment of the test.

For this reason, nowadays preference is given to Electronic Pressure Transducers connected to Digital Displays.

The transducer is fitted to the triaxial cell via a **De-airing Block**, and the pressure is expressed in engineering units directly on the display. When the triaxial apparatus is connected to a **Data Acquisition System**, the use of these electronic transducers is compulsory. The number of transducers necessary is normally one per each cell in use, however one transducer with relative de-airing block may be transferred from one cell to another.

With reference to the measurement of volume change, the trend is for the traditional **Twin Burette Volume Change Measuring Units** to be replaced by **Twin Chamber Hydraulic Volume Change Units**.

In the twin burette system the flow of water is measured by the movement of an interface of water and an insoluble liquid of lower density than water (kerosene) within a graduated transparent tube. The twin chamber hydraulic cell uses a different principle; a piston is housed within a cylinder using two rolling membranes which allows its movement without friction and guarantees perfect water tightness.

The positioning of this piston in the middle of the cylinder creates an upper and lower chamber which are isolated one from the other. The lower chamber is connected to a constant pressure source whilst the upper one is connected to the triaxial cell. The equalisation of the pressures in each chamber is automatic because the piston membrane group acts as a deformable interface without rigidity. The volume change is calculated by the movement of the piston due to the flow of water into, or out of, the chamber.

In practice the movement of the piston is measured by a dial gauge and the corresponding volume change is obtained by multiplying this movement by the calibration coefficient of the instrument.

This device lends itself to the use of electronic transducers so as to obtain digital display of the results directly in engineering units (with relative control unit) or to be connected to a data acquisition system. This system therefore is to be preferred to the former system which does not offer such possibilities.

The number of volume change measuring devices to be used will normally be equal to the number of triaxial cells in use, they are connected to the line of back pressure or cell pressure; in more refined systems both lines may be fitted with a volume change measuring device.

In conclusion we recall the traditional volume change measuring device using **Graduated Burettes** fitted to a drainage line.

Naturally this device only works at ambient pressure (without back pressure).

In order to use the graduated burette the triaxial cell must be fitted with a **Universal Valve Group**.

8. ACCESSORIES

In tests where pore pressure measurement is required, de-airing equipment is particularly important: Tecnotest proposes the classic vacuum method using pump, tank and valve assembly.

LISTED HEREBELOW IS THE RELEVANT EQUIPMENT FOR THE ITEMS HIGHLIGHTED IN THE INTRODUCTION.

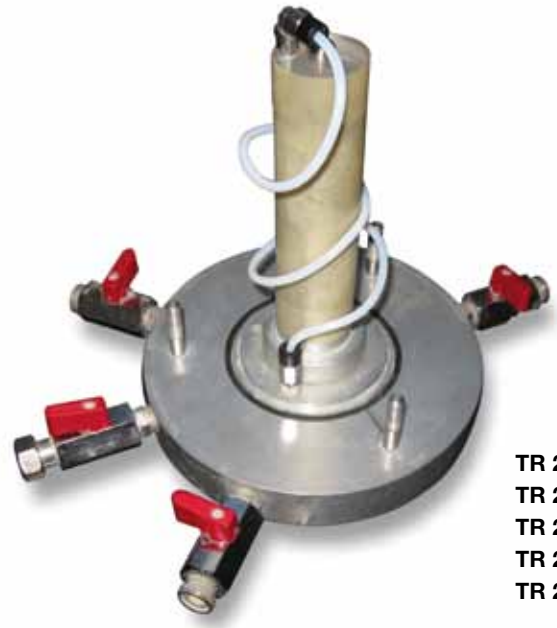
1. SAMPLE DIMENSIONS

The production of cell components is coded in the following standard series:

Code	Sample diameter (mm)
TR 205	35.0
	38.1
	50.0
TR 206	70.0
TR 207	100

Components for samples of other diameters may also be supplied although these may not be immediately available from stock, for example:

Sample diameter (inch)	Triaxial Cell
2.0"	TR 205
2.8"	TR 206
3.0"	
4.0"	TR 207



TR 205
TR 205/001
TR 205/002
TR 205/009
TR 205/007

2. APPARATUS FOR SAMPLE PREPARATION

SAMPLING TUBE

Made of thin-walled stainless steel with cutting edge and calibrated internal diameter, the tube height is twice the diameter. Accessories for sample extrusion are supplied as standard with each tube, these include a plunger and receiving tube made of brass. The stainless steel sampling tube may also be ordered separately.

Standard dia. (mm)	Special dia. (inches)	Codes	Spore part code
35.0		N 212	N 212/1
38.1		N 205	N 205/1
50.0		N 206	N 206/1
	2.0"	N 214	N 214/1
70.0		N 207	N 207/1
	2.8"	N 215	N 215/1
	3.0"	N 216	N 216/1
100		N 208	N 208/1
	4.0"	N 217	N 217/1

HAND EXTRUDER N 210

This apparatus allows the insertion of sampling tubes into a soil sample with a rack and pinion mechanism with minimal disturbance, it is then used to extrude the resultant sample from the sampling tube.

MAX. CLEARANCE BETWEEN PLATENS: 435 mm
MIN. CLEARANCE BETWEEN PLATENS: 0 mm
DIMENSIONS: 310 x 460 x 740 (h) mm
WEIGHT: 21 kg.



N 205

N 208

N 210

1.2.3 TRIAXIAL TEST



N 204



N 204/T



TR 205/005

TR 205/004

TR 207/016

TR 207/014

TWO-PART SPLIT MOULDS

These moulds have highly accurate guide pins to ensure precise alignment so as to allow the trimming of turned samples with flat and parallel ends. Height equivalent to two times the diameter.

Standard dia. (mm)	Special dia. (inches)	Code
35.0		TR 205/025
38.1		TR 205/005
50.0		TR 205/045
	2.0	TR 205/035
70.0		TR 206/025
	2.8	TR 206/005
	3.0	TR 206/015
100.0		TR 207/016
	4.0	TR 207/005

TECNOTEST

ELECTRIC LATHE

N 204

An electric motor with variable speed control is used to turn the sample. A cutting disc can then be moved both horizontally and vertically so as to trim the sample to the required diameter. The lathe is supplied complete with 38.1 mm diameter support platens. Support platens of other diameters, which should correspond to sample diameter required, should be ordered separately.

Max. sample diameter: 106 mm

Max. vertical movement of cutting disc: 220 mm

Turning speed: 100 rpm.

POWER SUPPLY: 220 V, 50 Hz, 1 ph. 200 W

DIMENSIONS: 240 x 340 x 490 (h) mm.

WEIGHT: 15 kg.

N 204/R Cutting disc (spare part)

SPECIMEN SUPPORT PLATENS

Standard dia. (mm)	Special dia. (inches)	Code (set of 2)
35.00		N 204/A
38.1		N 204/C
50.0		N 204/D
	2.0	N 204/E
70.0		N 204/F
	2.8	N 204/G
	3.0	N 204/H
100.0		N 204/I
	4.0	N 204/L

MANUAL LATHE/TRIMMER

N 204/T

Soil sample can be trimmed with the aid of a wire saw.

The cutting guides have to be positioned for obtaining

dia. 35- 38.1- 50- 70 and 100 mm. Max height of sample: 200 mm.

SPLIT FORMERS

Used to construct samples of incoherent soils. Once the lower porous disc, membrane and sealing ring have been fitted to the pedestal affixed to the base of the triaxial cell, the former is placed around the pedestal, the membrane is stretched up over the former and the sample soil is placed in the former in layers and tamped appropriately. The second porous disc and top cap are then positioned and the membrane sealed to the top cap with another sealing ring. At this point the three-part split former is opened. Models of 100 mm and those with 4" dia. may be divided into four parts. The models up to 76.2 mm (3"), into three parts. Particular care has been taken in their design, guide pins being highly accurate. Precision machined and made of brass for diameters up to 70 mm, and of aluminium for larger diameters.

Standard dia. (mm)	Special dia. (inches)	Code
35.00		TR 205/024
38.1		TR 205/004
50.0		TR 205/044
	2.0	TR 205/034
70.0		TR 206/024
	2.8	TR 206/004
	3.0	TR 206/014
100.0		TR 207/014
	4.0	TR 207/004

3. ELEMENTS USED WITHIN THE TRIAXIAL CELL

Porous Discs: made of silicon carbide, they have particularly high permeability to water and are easily de-aired.

Filter Drains: with vertical bands obtained from filter paper. Supplied in packs of 50 pieces.

Base Disc: in Perspex (small diameters) or aluminium (large diameters).

Pedestal: made of non-corrosive aluminium, has two drainage ducts, base gasket and stainless steel fixing screws.

Top Cap: made of Perspex (small diameters) or aluminium (large diameters) and provided with a stainless steel loading sphere. A drainage duct with relative fittings and cut out valve (for undrained tests) are fitted as standard .

Membranes: made of high quality natural rubber. Supplied in packs of 30 pieces.

Suction Membrane Stretcher: used for placing membranes, made of brass and supplied complete with rubber tube.

Sealing Rings: made of Neoprene. Supplied in packs of 30 pieces.



STD. DIA. (mm)	SPEC. DIA. (")	PEDESTAL	TOP CAP	BASE DISCS	POROUS DISCS	SUCTION MEMBRANE STRETCHER	MEMBRANES	SEALING RINGS	FILTER DRAINS	CELL COMPATIBILITY
35.0		TR 205/021	TR 205/022	TR 205/023	TR 205/029	TR 205/006	TR 205/017	TR 205/018	TR 205/020	TR 205
38.1		TR 205/001	TR 205/002	TR 205/003	TR 205/009	TR 205/006	TR 205/007	TR 205/018	TR 205/010	
50.0		TR 205/041	TR 205/042	TR 205/043	TR 205/049	TR 205/036	TR 205/037	TR 205/038	TR 205/040	
	2.0	TR 205/031	TR 205/032	TR 205/033	TR 205/039	TR 205/036	TR 205/037	TR 205/038	TR 205/040	
70.0		TR 206/021	TR 206/022	TR 206/023	TR 206/029	TR 206/006	TR 206/027	TR 206/008	TR 206/030	TR 206
	2.8"	TR 206/001	TR 206/002	TR 206/003	TR 206/009	TR 206/006	TR 206/027	TR 206/008	TR 206/010	
	3.0"	TR 206/011	TR 206/012	TR 206/013	TR 206/019	TR 206/006	TR 206/007	TR 206/028	TR 206/020	
100		TR 207/011	TR 207/012	TR 207/013	TR 207/019	TR 207/006	TR 207/017	TR 207/018	TR 207/020	TR 207
		TR 207/001	TR 207/002	TR 207/003	TR 207/009	TR 207/006	TR 207/007	TR 207/008	TR 207/010	

4. TRIAXIAL CELLS



TR 205

The transparent tube, made of spun Perspex, and stainless steel reinforcing rings are blocked between the non-corrosive aluminium head and lower flange using stainless steel tie rods. The base which is also made of non-corrosive aluminium is connected to the lower flange by stainless steel bolts.

Thus the cell is essentially composed of two parts, the base and the bell cylinder which is readily removed for access to the interior of the cell.

The load piston is made of machine-finished stainless steel which passes through a precision-made hole in the head of the triaxial cell. Water tightness is guaranteed by a sealing ring made of a special low friction material. Four no-volume change valves are fitted as standard to the base. The piston block device/anvil for dial gauge/transducer is also fitted as standard and is made of stainless steel and non-corrosive aluminium. Each cell undergoes stringent controls to their full pressure before despatch to verify the overall water tightness of the cell.

TR 205 CELL FOR SAMPLES UP TO 2" DIAMETER

TR 206 CELL FOR SAMPLES UP TO 3" DIAMETER

TR 207 CELL FOR SAMPLES UP TO 4" DIAMETER



TR 207

	TR 205	TR 206	TR 207
SAMPLE DIAMETER (mm)	35-38.1-50-50.8	70-71.1-76.2	100-101.6
MAX. SAMPLE HEIGHT (mm)	101.6	152.4	203.2
MAX. WORKING PRESSURE (mm)	1700 KPa	1700 KPa	1700 KPa
DIMENSIONS (mm)	330 x 250 x 445	410 x 300 x 545	430 x 330 x 550
WEIGHT (kg)	6	10	22

PEDESTAL ADAPTOR

TR 206/205

This accessory allows small diameter samples to be tested in the medium size triaxial cell TR 206 thus increasing the range of possible sample diameters for this cell (from 35 mm to 76.2 mm).



5. CONSTANT PRESSURE SOURCES

BLADDER AIR-WATER SYSTEM

This compact, accurate system has been designed to provide a constant pressure which can be controlled between 0 and 1000 kPa. It requires connection to an air compressor. Naturally, the maximum pressure which can be reached over long periods of time is that which activates the recharge motor of the compressor. The system itself consists of one or more interface cylinders connected to each other and one or more manometers for reading the pressure. The manometer has six inlets to allow connection to a maximum of six interface cylinders. The interface cylinder consists of a cylinder in which a bladder is lodged, regulation valve, hydro-pneumatic circuit, complete with no volume change valves, air vents, conduits and junctions. This design eliminates the traditional centralised control panel which had the disadvantage of severely limiting subsequent expansions to the overall system. All the component parts are of non corrosive material and the regulating valve is of the highest standard and extremely accurate.

AIR-WATER INTERFACE CYLINDER TR 305

Max. working pressure: 1000 kPa.
Max. input air pressure: 1700 kPa.

REGULATION RANGE: 0-1000 kPa.

CYLINDER CAPACITY: 3500 cc

DIMENSIONS: diameter 240 x 550 (h) mm.

WEIGHT: 20 kg.

ACCESSORIES AND SPARE PARTS:

TR 205/T	Rilsan tube diameter 6 x 8 mm: 20 m
TR 305/1	Pack of 6 bladders
TR 305/2	Pack of 10 bladder sealing rings
TR 305/3	Pack of 5 bladder centering rings
TR 305/4	Bladder sealing ring placing tool

PRESSURE MULTIPLIER TR 305/M

This device doubles the hydraulic pressure output from the TR 305 and enables confined triaxial tests to be performed up to 20 bar provided an air compressor capable of maintaining a pressure of 10 bar is used.

Made in anodized aluminium it has two special membranes which reduce friction to a minimum while increasing precision. The amplification factor is guaranteed by special testing and calibration performed in our facilities: output pressure (pressure source manometer) is multiplied by this factor.

An autonomous digital manometer, 0-20 bar, is available as an option for direct readout of pressure.

A by-pass valve shuts off amplification so there is no need to remove the device when not needed.

MAXIMUM DISPLACEMENT: 400 cm³.

DIMENSIONS: diameter 150 x 350 (h) mm.

WEIGHT: 8 kg.

ACCESSORY:

TR 305/031	Digital manometer with 0-20 scale and autonomous, battery-run power supply
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TR 305



TR 305/M

ANALOG MANOMETRIC UNIT TR 305/010

Support column with 6 inlets and no-volume change valves. Dial gauge class 0.5, diameter 200 mm, scale 0-10 bar (0.1 bar resolution).

DIMENSIONS: diameter 220 x 470 mm.

WEIGHT: 12 kg

DIGITAL MANOMETRIC UNIT TR 305/020

Same as TR 305/010 but provided with digital manometer (microprocessor based), linearity-hysteresis $\leq \pm 0.10\%$ FS, range 0-10 bar (0.001 bar resolution).

Internal batteries (alkaline: 4 pcs - 1.5 V. size AA).

DIMENSIONS: diameter 220 x 370 mm.

WEIGHT: 10 kg

ACCESSORY:

TR 305/030	Digital manometer, scale 0-10 bar
-------------------	-----------------------------------



TR 305/020



TR 305/010

1.2.3 TRIAXIAL TEST

TECNOTEST



D 816/2

D 816

D 816/1



D 815



TR 301 WITH ACCESSORIES

IMPORTANT NOTE

- 1) IN ORDER TO OPTIMIZE USAGE AND ENSURE VALIDITY OF TESTS, A CONSTANT PRESSURE OF 10 BAR MUST BE MAINTAINED.
 - 2) IF THE COMPRESSOR IS LOCATED IN THE WORK ENVIRONMENT THEN THE SILENT AIR COMPRESSOR IS RECOMMENDED.
 - 3) CLEANLINESS OF COMPRESSED AIR DETERMINES LONG-TERM EFFICIENCY OF THE REGULATION VALVES SO WE STRONGLY RECOMMEND EQUIPPING THE COMPRESSOR WITH AIR DEHUMIDIFIER AND OIL FILTER.
- USE OF A STANDARD AIR COMPRESSOR (MAX. 8-10 BAR) FOR GENERAL LABORATORY USE COULD RESULT IN DIFFICULTIES IN PERFORMING THE WHOLE RANGE OF TESTS.

COMPRESSORS AND ACCESSORIES

D 816 SILENT AIR COMPRESSOR (63 dB)

Air delivery: 340 litres/min; pressure: 12 bar max pressure; tank capacity: 3 litres.

WORKING PRESSURE: 10 bars

POWER SUPPLY: 220 V, 50 Hz, 1 ph

DIMENSIONS: 700 x 500 x 840 (h) mm

WEIGHT: 110 kg

D 816/1 AUXILIARY VERTICAL TANK (50 litres): 15 bar for D 816

DIAMETER: 305 x 929 (h) mm

WEIGHT: 30 kg

D 816/2 AIR DEHUMIDIFIER (370 litres/min) with refrigerated cycle

POWER SUPPLY: 220 V, 50 Hz, single phase.

DIMENSIONS: 350 x 300 x 500 (h) mm.

WEIGHT: 30 kg.

D 816/3 AIR FILTER

DIMENSIONS: 150 x 570 x 360 (h) mm.

ELECTRIC COMPRESSOR

50 litre tank, 110 litres of air per minute, 10 bar max pressure. Working pressure 8 bars. Complete with pressure reduction unit, pressure switch and gauge. Exempt from ANCC test (Italy).

DIMENSIONS: 1000 x 800 x 450 (h) mm.

WEIGHT: 70 kg.

D 815 Power supply: 220/380 V, 50 Hz, three phase

D 815/H Power supply: 220 V, 50 Hz, single phase

ACCESSORY:

D 815/P Device for increasing working pressure up to 10 bar (It has to be ordered together with the air compressor)

AIR-WATER CYLINDER WITH FOOT PUMP (UU. TEST)

TR 301 AIR-WATER CYLINDER WITH INPUT AND OUTPUT VALVES

Max. working pressure 1000 kPa.

Capacity 3.5 litres.

WEIGHT: 4.5 kg.

TR 301/002 BRACKET AND CLAMP

Used to secure the pressure gauge to a column of load frame.

TR 301/004 PRESSURE GAUGE

Class 0.5, 150 mm diameter, graduated scale 0-16 bar with 0.2 bar divisions.

TR 301/006 FLEXIBLE HOSES AND CONNECTORS

TR 301/008 MAX PRESSURE 1000 kPa FOOT PUMP
WEIGHT: 2.5 kg,

6. LOAD FRAMES

COMPRESSION/TENSION MACHINE 50 kN

Thanks to their reduced dimensions and notable capacities, these are the "classic" multipurpose machines preferred by many laboratories. The continual speed selection range is wide enough to satisfy the requisites of standard triaxial tests. Naturally these can also be used for other tests such as unconfined compression, C.B.R. etc. The general design is such as to protect the electro-mechanical components from possible damage from water, dust and impurities. The drive mechanism is housed in the upper cross-beam, whilst the electronic control console can be separated from the main structure if desired.

The base is of reduced dimensions permitting the application of the optional accessories (loading hanger, weights, etc.) constant load tests or anisotropic consolidation can be made without problems. The horizontal clearance is such that it allows the use of special large diameter cells. The columns and cross-beam are over-dimensioned to ensure rigidity of the structure in both compression and tensile testing. The vertical span can be modified by moving the upper cross-beam; two spirit bubbles assist in the centering of the machine.

THE BALL SEATING ATTACHMENT FOR COMPRESSION TESTING AND THE LOWER BASE PLATE ARE SUPPLIED AS STANDARD. ALL ACCESSORIES SHOULD BE ORDERED SEPARATELY. SEE THE FOLLOWING PAGES, AND "BUYER'S GUIDE" ON PAGE 90-91.

SPECIFICATIONS:

- Max. capacity in compression and tension 50 kN
- Continual speed selection between 0.00001 and 12 mm/min
- Precise, constant response, irrespective of load
- Rapid approach/unloading speed 12 mm/min
- Useful piston travel 100 mm
- Accepts triaxial cells for samples up to 100 mm diameter
- electronic control console located in protected functional position, can be separated from machine
- Visible micro-switches to prevent piston overtravel
- Predisposition for command of micro-switch on load ring or electronic load cell.

MAX. VERTICAL CLEARANCE: 910 mm

HORIZONTAL CLEARANCE: 440 mm

LOWER PLATEN DIAMETER: 160 mm

DIMENSIONS: 800 x 540 x 1600 (h) mm

PACKED DIMENSIONS: 850 x 550 x 1750 (h) mm

PACKED WEIGHT: 200 kg

WEIGHT: 140 kg

MODELS:

TR 115	220-240 V, 50 Hz, SINGLE PHASE; 450 W
TR 115/01	110 V, 60 Hz, SINGLE PHASE; 450 W



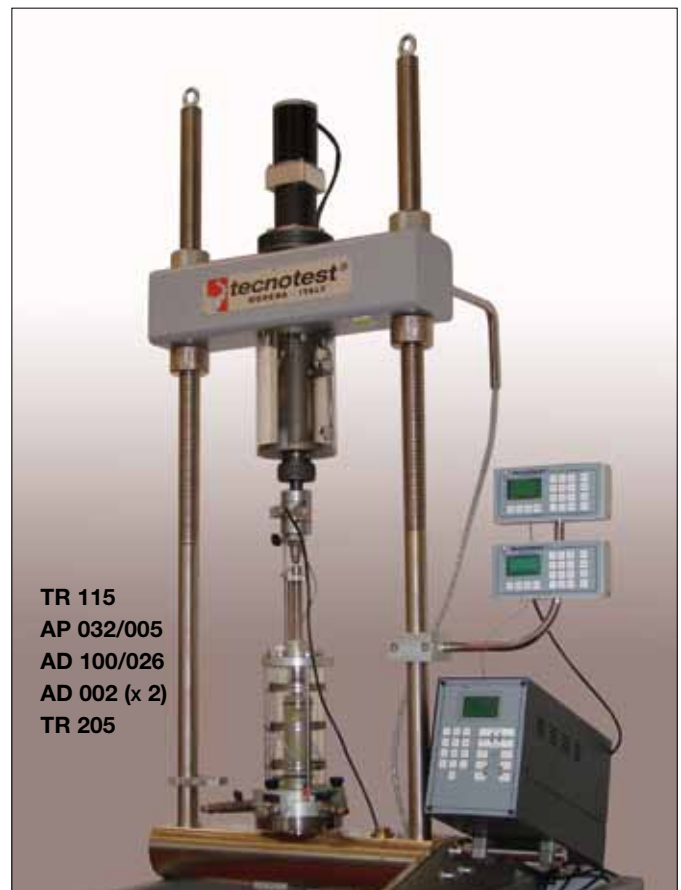
The series illustrated below has been specifically designed for triaxial tests on soils; however, they can also be employed for other tests both in compression and tension where particularly low, precise, constant speeds are required.

Our model utilises a sophisticated electromechanical operating device which permits continual speed selection without the use of gears, this greatly improves the response of the machine and the play inherent in traditional geared system is eliminated. The moving mechanism has been positioned in the upper part of the machine where there is far less possibility of infiltration of dirt and water. Furthermore, this results in a base of reduced dimensions which, with the application of optional accessories, allows the application of constant vertical loads.

The control console provides for the power supply and control for the motor. It also contains a fan for the forced ventilation of all parts subject to heating. The front panel of the control contains the following functions:

- numeric pad for selecting test speed and buttons- regulating forward/reverse of both test and rapid approach speeds. An alphanumeric display shows the selected speed whilst various warning lights on the panel indicate which functions have been selected. The RS 232 interface allows remote control via PC.

A full set of accessories is available, for example a set for unconfined compression tests and a special base bench which, along with a loading hanger and leverage system, allows the application of direct weights for constant load tests or anisotropic consolidation.



TR 115
AP 032/005
AD 100/026
AD 002 (x 2)
TR 205

1.2.3 TRIAXIAL TEST

TECNOTEST

LOAD FRAME WITH THREE TEST BAYS



TR 115/300
 AP 032/005 (x3)
 AD 100/026 (x3)
 TR 205 (x3)
 AD 002 (x6)
 TR 001/S3 (x2)

It allows failure of three samples in the three triaxial cells simultaneously.

In addition to standard drive mechanisms, a cross-beam is joined to the supporting columns by means of ball-bearing couplings. Vertical clearance may be adjusted with a certain approximation, but for fine adjustment the operator must regulate each test bay separately.

A force of 50 kN may be obtained in the central bay; those at each side enable a differential load of up to 5 kN to be obtained. Test speed (from 0.00001 to 12 mm/min.) and other specifications are the same of those of the TR 115, single test bay model.

DIMENSIONS: 1150 x 510 x 2600 (h) mm

WEIGHT: 200 kg

PACKED DIMENSIONS: 1300 x 700 x 2305 (h) mm

PACKED WEIGHT: 270 kg

MODELS:

TR 115/300 220-240 V, 50 Hz, SINGLE PHASE; 450 W

TR 115/301 110 V, 60 Hz, SINGLE PHASE; 450 W

SPECIFICATIONS:

- Max. capacity in compression and tension 50 kN
- Continual speed selection between 0.00001 and 12 mm/min
- Precise, constant response, irrespective of load
- Rapid approach/unloading speed 12 mm/min
- Useful piston travel 100 mm
- Accepts triaxial cells for samples up to 100 mm diameter
- Electronic control console located in protected functional position, can be separated from machine
- Visible micro-switches to prevent piston overtravel
- Predisposition for command of micro-switch on load ring or electronic load cell.
- Max. vertical clearance: 910 mm
- Horizontal clearance: 440 mm
- Lower platen diameter: 160 mm

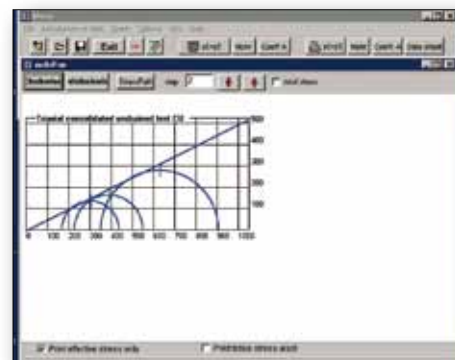
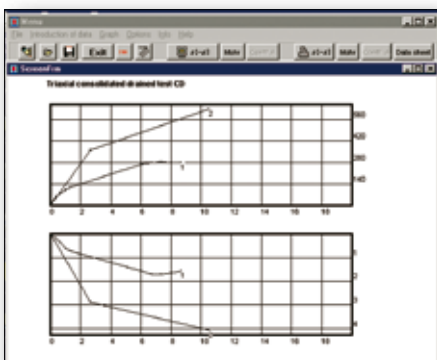
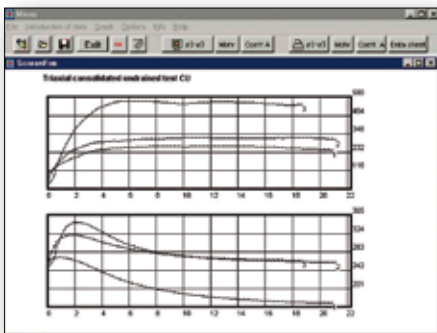
The ball seating attachment for compression testing and the lower base plate are supplied as standard.

All accessories should be ordered separately. See the following pages, and "Buyer's Guide" on page 90-91.

Table top supports for the Geotronic units are not included; herebelow two alternatives are recommended:

1 piece TR 001/S3 or

2 pieces TR 001/S3



ACCESSORIES FOR LOAD FRAMES

FOR TRIAXIAL TESTS WITH CONSTANT LOADING AND ANISOTROPIC CONSOLIDATION:

TR 115/B	SUPPORTING BENCH WITH OPEN TOP
TR 115/C	LOAD HANGER FOR DIRECT WEIGHTS
TR 115/L	LEVERAGE SYSTEMS TO AMPLIFY LOADING (x10)

A DEDICATED BENCH IS ALSO AVAILABLE:

TR 115/A	ANISOTROPIC CONSOLIDATION BENCH COMPLETE WITH TR 115/C AND TR 115/L
----------	--

Calibrated weights and measuring instruments excluded.

FOR THE **C.B.R.** TEST:

TR 115/T	STABILISING BAR FOR THE PENETRATION PISTON
BA 201	PENETRATION PISTON
T 630	DIAL GAUGE TRANSDUCER SUPPORT
T 630/2	TRANSDUCER EXTENSION FOR T 630

FOR UNCONFINED COMPRESSION (IN ADDITION TO THE **C.B.R.** ACCESSORIES):

T 630/5	UPPER PLATEN 100 mm DIAMETER
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TR 630/3	ADJUSTABLE DATUM BAR AND DIAL GAUGE/SUPPORT TRANSDUCER
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TR 115/B
WITH ANISOTROPIC CONSOLIDATION ACCESSORIES
(TR 115/C - TR 115/L)
AND TR 115 LOAD FRAME WITH DIGITAL MEASUREMENT
INSTRUMENTS



CBR



UNCONFINED COMPRESSION



TR 115/T



TR 115/A + ACCESSORIES

7. MEASURING INSTRUMENTS



BA 005

BA 040

BA 050

LOAD (STRESS)

PROVING RINGS

Fixing blocks and microswitch to prevent damage to the ring. Linearity $\pm 1\%$ in the upper 80% full scale.

Repeatability better than 0.5%.

Made of special steel subjected to heat-treatment to improve the elastic properties. A dial gauge (RAMBOLD original) is positioned within the proving ring to read its deformation which is expressed in 0.001 mm.

Each BA model proving ring (with relevant dial gauge) is calibrated by an Accredited Laboratory which issues a calibration certificate. The BB models proving rings are calibrated in Tecnotest's laboratory and are supplied with in-house certificate.

Each proving ring is supplied with its own specific conversion table which enables individuation of the strength load of the sample corresponding to the ring deformation.

MODELS		CAPACITY N	CAPACITY kg
BA 001	BB 001	1000	100
BA 002	BB 002	2000	200
BA 003	BB 003	3000	300
BA 005	BB 005	5000	500
BA 006	BB 006	6000	600

- Linearity - hysteresis $\leq \pm 0.03\%$ F.S.
- Repeatability (%) $\leq \pm 0.01$ F.S.
- Nominal sensitivity (mV/V) 2
- Recommended supply voltage (V) 10
- Nominal supply voltage range (V) 1-15
- Maximum supply voltage (V) 18
- Protection class (EN 60529) IP67

EXTENSOMETRIC LOAD CELLS

Stainless steel built, cylindrical body "S" type load cells. Thermal compensation, optimum precision.

MODEL	CAPACITY N	CAPACITY kg
AP 032/003	3500	350
AP 032/005	5000	500
AP 032/010	10000	1000

DEFORMATION (STRAIN)

BOTH ANALOG OR DIGITAL INSTRUMENTS MAY BE USED:

DV 922	ANALOG DIAL GAUGE (RAMBOLD ORIGINAL) 30 mm travel, 0.01 mm accuracy
T 628/E	ANALOG DIAL GAUGE 30 mm travel, 0.01 mm accuracy
AD 100/026	EXTENSOMETRIC BRIDGE TRANSDUCER 25 mm travel, 0.001 mm accuracy
AD 113/026	EXTENSOMETRIC BRIDGE TRANSDUCER 25 mm travel, 0.002 mm accuracy
AD 115/026	ELECTRONIC POTENTIOMETRIC TRANSDUCER 25 mm travel, 0.01 mm accuracy

AD 115/011

AD 113/011

AD 100/011



AP 032/005

AD 100/026

VOLUME CHANGE

As stated in the introduction, Tecnotest has replaced the traditional twin burette system with the automatic volume change device incorporating a twin chamber cylinder with rolling membrane.

TR 440/ST VOLUME CHANGE DEVICE (DUAL CHAMBER)

Made of bronze with a measurement capacity of 100 cc.
Supplied with 2 rolling membranes.
Max. working pressure: 1000 kPa

DIMENSIONS: 220 x 105 x 250 (h) mm.

WEIGHT: 6.5 kg

MEASUREMENT INSTRUMENTS HAVE TO BE ORDERED SEPARATELY.

ANALOG VERSION:

T 628/E DIAL GAUGE, 25 mm TRAVEL, accuracy 0.01 mm

DIGITAL VERSION:

Three different models of transducers are available.

AD 115/026 ELECTRONIC TRANSDUCER 25 mm TRAVEL,
accuracy 0.01 mm

AD 002 GEOTRONIC DIGITAL CONTROL UNIT

AD 113/026 LINEAR EXTENSOMETRIC BRIDGE TRANSDUCER
25 mm TRAVEL accuracy 0.002 mm

AD 100/026 LINEAR EXTENSOMETRIC BRIDGE TRANSDUCER 25 mm TRAVEL
accuracy 0.001 mm

For measuring volume changes of more than 100 cc we suggest:

TR 440/V VALVE GROUP FOR FLOW CHANGE

This device, when connected to the TR 440/ST allows the measurement of volume changes above 100 cc.

Using four no-volume change valves the flow into the chambers is reversed whenever the piston nears its full travel.

TR 500 UNIVERSAL VALVE GROUP

Used to connect the triaxial cell to drainage burettes.

TR 500/001 10 cc DRAINAGE BURETTE

TR 500/002 20 cc DRAINAGE BURETTE

AD 002 GEOTRONIC DIGITAL CONTROL UNIT
microprocessor-based
(±) 30.000 divisions
5 digit graphic display
Current-loop interface
Internal storage of up to 300 data items
Tare function
Power supply:
220-110-240V, 50-60 Hz, single phase, 10 W



TR 440/ST
AD 115/026



TR 440/V



AD 002

1.2.3 TRIAXIAL TEST



TR 305/030



TR 697/D



V 899



TR 001/S3



TECNOTEST

PORE PRESSURE

WITH DATA ACQUISITION:

TR 205/510	DE-AIRING BLOCK for connecting transducer to triaxial cell
AD 002	GEOTRONIC digital control unit, microprocessor based
TR 205/500	PRESSURE TRANSDUCER 0 - 1000 kPa
TR 205/501	PRESSURE TRANSDUCER 0 - 2000 kPa

WITHOUT DATA ACQUISITION:

TR 205/500 and AD 002 have to be replaced by:

TR 305/030	DIGITAL MANOMETER
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Microprocessor based, linearity-hysteresis $\leq \pm 0.10\%$ FS, range 0-10 bar (0.001 bar resolution).
Internal batteries (alkaline: N° 4 - 1.5 size AA).

DIMENSIONS: dia. 80 x 50 x 135 mm.

WEIGHT: 0.5 kg.

DE-AIRING EQUIPMENT

TR 697/V 3-VALVE ASSEMBLY

TR 697/D DE-AIRING TANK

Made of transparent Perspex with aluminium caps and attachments for direct wall mounting.
De-airing jet inlet and flow outlet connection.
Capacity: 15 litres

DIMENSIONS: 800 x 220 x 220 mm.

WEIGHT: 10 kg.

V 899 VACUUM PUMP (66.6 litres/minute)

Particularly suitable for laboratory use for its small dimensions. Manometer with vacuum indication.
Max vacuum 1 Torr.

POWER SUPPLY: 220 V, 50 Hz, single phase, 300 W

DIMENSIONS: 350 x 450 x 280 (h) mm.

WEIGHT: 13 kg approx.

V 793 PVC TUBING

DIAMETERS: 6-9 mm, length: 2 m.

TABLE-TOP STAND FOR GEOTRONIC TR 001/S3

Indispensable for tidily arranging the various Geotronic units that comprise a complete triaxial system.

Made hold up to 6 Geotronic units.

Built in anodized stainless steel and stainless steel.

DIMENSIONS: dia. 220 x 700 (h) mm

WEIGHT: 3 kg

ACQUISITION AND AUTOMATIC PROCESSING OF TEST DATA

The direct shear apparatus, oedometer and triaxial apparatus may be fitted with electronic transducers compatible with the information system produced by Tecnotest.

Such system allows the automation of data acquisition of the tests, calculations and the presentation of the test results in the form of certificates or graphs.

Each transducer is coupled to a GEOTRONIC control unit acting as a data display device or single channel "stand alone" data acquisition unit. Each control unit has a current loop interface which controls information to be transmitted to a central PC.

A special program in the PC allows the various Geotronic units in the network to acquire data automatically according to a protocol regulating the time required for the specific kind of test to be carried out, after which the computer may be switched off or used for other purposes.

On commencing the test, each Geotronic measures and stores the data according to the previously established protocol.

When data needs to be transferred to the central PC, the various Geotronic units are interrogated by means of a special program and then transmit the measurements taken up to that point.

Once the data are stored and available in the PC, it is possible to create files compatible with the processing files such as those proposed by Tecnotest or those accepting input from ASCII files. The stored testing files can be operated also using Excel, Word etc.

Besides the transducers and relative on-board Geotronic control units, in order to create a network capable of managing up to 32 peripheral Geotronic units, the following equipment is required:

AD 021/010	MULTIPLEXER FOR CONNECTING THE VARIOUS GEOTRONIC UNITS IN A NETWORK (RS 232/32-channel current loop general interface)
AD 021/012	NETWORK CABLE (10 m long)
AD 050/001	PC/GEOTRONIC COMMUNICATIONS PROGRAM AND DATA ACQUISITION. WINDOWS ENVIRONMENT
AD 021/001	1-WAY CONNECTOR BLOCK
AD 021/002	2-WAY CONNECTOR BLOCK
AD 021/003	3-WAY CONNECTOR BLOCK
AD 021/004	4-WAY CONNECTOR BLOCK

An IBM-Standard personal computer, equipped with an RS 232 interface, is also necessary.

This computer serves the sole purpose of instructing and loading each one of the peripheral readout units, as well as that of recovering the data memorised during the test. During any other stage, the computer may be switched off or used for other purposes.

The data acquisition unit returns the data in the form of ASCII files.

FOR PRINTING AND PROCESSING THE TEST CERTIFICATES, WE RECOMMEND THE FOLLOWING SOFTWARE

AD 225/005	"CASAGRANDE DIRECT SHEAR" PROGRAM
AD 225/006	AD 225/005 EXPANSION SOFTWARE FOR TEST MEASURING "RESIDUAL SHEAR STRENGTH"
AD 225/004	"OEDOMETRIC SWELL TEST" SOFTWARE
AD 225/007	"OEDOMETRIC TEST" SOFTWARE
AD 225/008	EXPANSION SOFTWARE FOR "CV AND K DETERMINATION"
AD 050/B32	"TRIAxIAL UU, CU, CD" SOFTWARE
AD 225/014	"DIRECT SHEAR ON ANNULAR SPECIMENS" SOFTWARE

Each program may be purchased individually. Standard operating system is WINDOWS. If data acquisition hardware and software are not supplied, test data must be input by hand.

Tecnotest's data acquisition system is characterised by its innovative, highly-flexible modular design.

As we deal daily with laboratories, we have enough experience to realise that a hardware network designed to eliminate the problems encountered in the classic systems was necessary.

With these systems, in fact, it is necessary to determine various criteria (such as the number of channels to be activated, how many apparatus will be needed and where to locate them in the laboratory, as well as the length of cable required), before installation.

This inevitably results either in under-sized systems being chosen in order to keep initial costs involved to a minimum or, on the contrary, in going to unnecessary expense to implement over-sized systems.

Tecnotest has instead designed a system which, with a minimal initial investment, can be set up to satisfy individual requirements at any given moment, whilst allowing a virtually unlimited number of apparatus and relevant digital readout units to be added to the network: all that needs be purchased is a connector block.

ADVANTAGES OF THE GEOTRONIC NETWORK

Cost is proportional to the number of channels

The only really essential components are, in practice, the PC (unless one is already available), the multiplexer for network connection (AD 021/010), the CABLE (AD 021/012) and DATA ACQUISITION SOFTWARE (AD 050/001).

All that need be added are the connector block or blocks as appropriate for the number of Geotronic units to be used.

Large expandibility

The AD 021/010 multiplexer enables between 1 and 32 channels to be activated (although it is possible to have more multiplexers connected to more RS 232 PC interfaces) by simply connecting other Geotronic units and relevant connector blocks.

Computer is not dedicated to the system

Although its initial function is to INPUT and start the Geotronic units, afterwards it may be either turned off or used for a different purpose. When switched on again, a chart showing data acquired so far may be called up on the video screen to check progress or to conclude test and store results on disk.

Geotronic units may be supplied at 12 V AC/DC

(thereby allowing a system to be set up using relatively inexpensive buffer batteries).

All data continuously displayed in real time

Each measurement is displayed on the Geotronic unit on board the apparatus in engineering units as taken, thereby eliminating the need to interrogate the computer in order to observe progress of the test.

Data is transmitted in digital form

so that electrical interference on the cables is eliminated and there is no loss of signal.

Possible faults are restricted to the local area in which they arise

Problems arising in any given Geotronic risk jeopardising functions of the relevant channel only while the rest of the laboratory remains unaffected.

Data acquisition and data processing programs are totally separate.

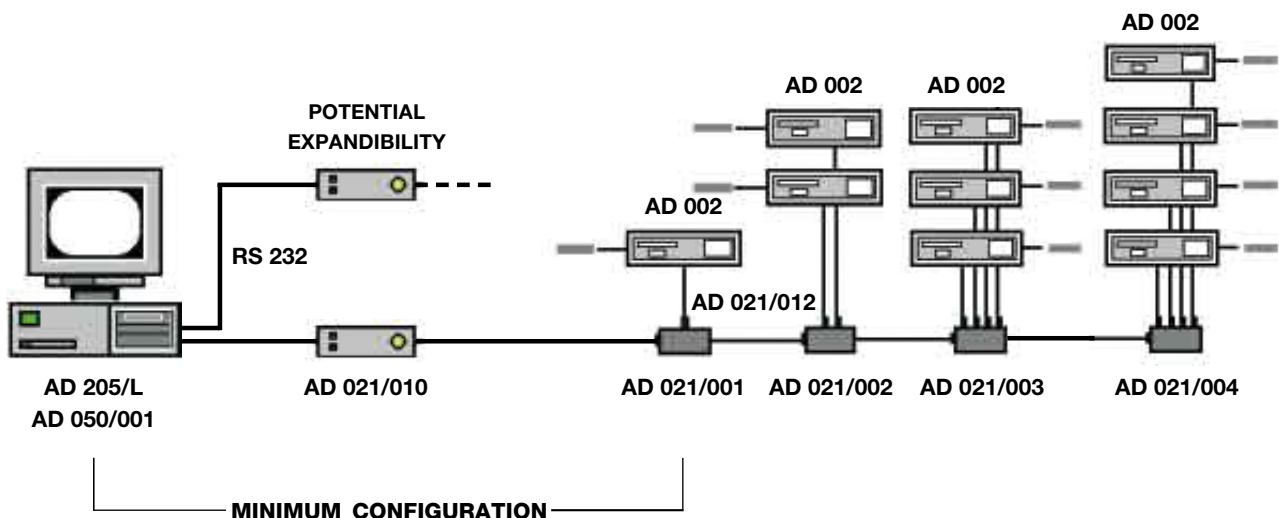
In other words, the Tecnotest data acquisition program OUTPUTS a FILE in ASCII format.

This FILE is then retrieved by any of the various Tecnotest test programs and then used for obtaining test certificates. It is not absolutely essential however to use these programs in particular because the ASCII format file can be easily read by any of the standard spreadsheet programs (such as MS Excel) and may be adapted to the various protocols in use for the data processing programs. Obviously, this file can be printed, edited, stored or processed using the software written by the user in his own language and devised to suit individual requirements.

Thus, since it is possible to connect to any ASCII format program, there is greater freedom of choice.

Wide choice of system configuration

Length of transducer cables no longer being an impediment, laboratory and network may be composed and re-arranged to best suit individual requirements.



TECNOANALISY

TRIAxIAL TEST SOFTWARE

AD 050/B32

This software allows processing of data for three types of tests managing up to 4 samples: UU, CU and CD triaxial tests, saturation phase with calculation of B Skempton parameter, display of table with various phases of cell pressure and back pressure, consolidation phase with volume change/time ratio diagram, pore pressure dissipation/time log diagram, t100 calculation, consolidation coefficient, compressibility coefficient, permeability coefficient.

During triaxial compression phase, the software calculates cohesion and friction angle with processing, in graphic format, of Mohr circles, stress/path diagrams, neutral/strain pressure (CU) diagrams, tension/strain diagrams, pore pressure/strain (CU) diagrams, volume change/strain (CD) diagrams.

Printout using customer's letter head and logo of test data, diagrams and results.

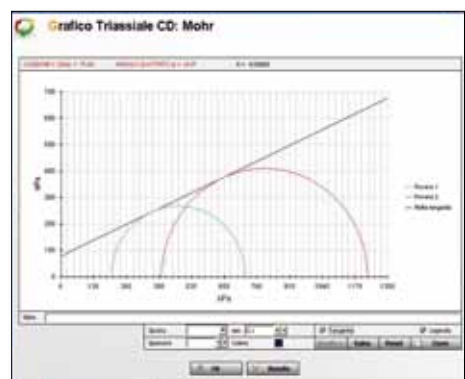
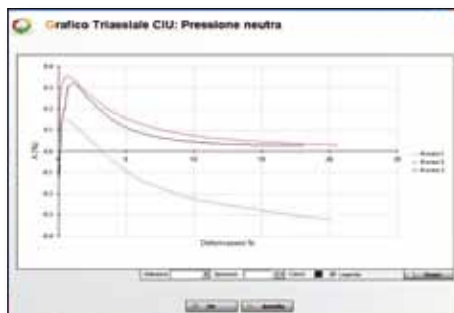
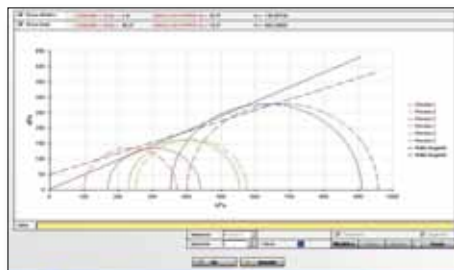
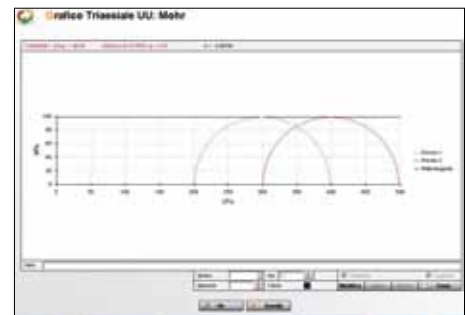
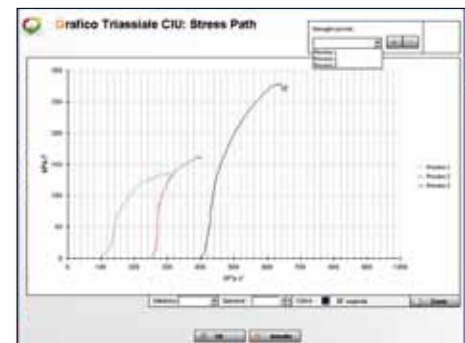
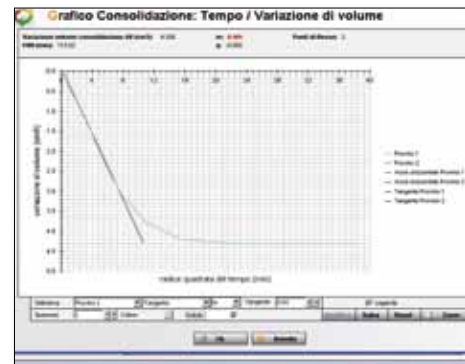
Software automatically recovers test data acquired using Tecnotest Data Acquisition Software (or TDA) AD 050/001.

Software may be used without AD 050/001 by introducing test data by hand via the PC keyboard and then proceeding to process manually acquired data.

The software also allows some customization.

All tests are saved in an MS Access data base.

The software also as per Ministerial circular EN 349/STC (Italy).



BUYER'S GUIDE

CONSOLIDATION TEST

	ANALOG VERSION	DIGITAL VERSION WITH GEOTRONIC	DIGITAL VERSION WITH UDA (PAGE 92)
<u>OEDOMETER</u>		T 663/020	
LOAD CELL 20 cm ² + WEIGHTS 64 kg		T 661 + T 661/10	
LOAD CELL 40 cm ² + WEIGHTS 128 kg		T 661/1 + T 661/11	
LOAD CELL 44,16 cm ² + WEIGHTS 160 kg		T 661/4 + T 661/12	
LOAD CELL 50 cm ² + WEIGHTS 160 kg		T 661/2 + T 661/12	
LOAD CELL 100 cm ² + WEIGHTS 160 kg		T 661/3 + T 661/13	
<u>BENCH FOR OEDOMETER</u>		T 663/050	
SINGLE PLACE BENCH (FIRST MODULE)		T 663/060	
EXTENSION BENCH (SINGLE PLACE)		T 662	
ALTERNATIVE: THREE PLACE BENCH			
<u>STRAIN MEASUREMENT</u>	T 628/E1		
DIAL GAUGE: 10 mm (0.01)		AD 113/011	AD 113/011
TRANSDUCER 10 mm (0.002 ALT. 0.001)		(ALTERNATIVE AD 100/011)	(ALTERNATIVE AD 100/011)
GEOTRONIC DISPLAY/READOUT UNIT		AD 002	
<u>DATA ACQUISITION</u>			
NETWORK CONNECTION UNIT		AD 021/010	AD 308
NETWORK CABLE (10 m LONG)		AD 021/012*	AND MULTIPLES OF 8 CHANNELS
CABLE EXTENSION (10 m LONG)			AD 021/015***
3-WAY CONNECTOR BLOCK		AD 021/003	
DATA ACQUISITION SOFTWARE		AD 050/001	AD 050/001
<u>DATA PROCESSING</u>		AD 225/007	
"OEDOMETRIC TEST" SOFTWARE		AD 225/008	
"CV E K DETERMINATION" SOFTWARE			

* Not necessary for a single connector block

** Digital dial gauge (0.01 mm) without data acquisition
DV 923/10 - 10 mm travel; DV 923/30 - 30 mm travel

*** At least one cable extension for each sensor

BUYER'S GUIDE

DIRECT SHEAR TEST

	ANALOG VERSION	DIGITAL VERSION WITH GEOTRONIC	DIGITAL VERSION WITH UDA (PAGE 92)
TEST APPARATUS	T 665/N		
SHEAR BOX 60 x 60 mm - 36 cm ² + CUTTER + WEIGHTS (31.5 kg) SHEAR BOX DIAM. 67.7 mm - 36 cm ² + CUTTER + WEIGHTS (31.5 kg) SHEAR BOX DIAM. 63.5 mm - 31 cm ² + CUTTER + WEIGHTS (31.5 kg) SHEAR BOX 100 x 100 mm - 100 cm ² + CUTTER + WEIGHTS (78.75 kg) ADAPTOR FOR FITTING THE SMALLER BOXES IN THE LARGE HOUSING OF T 666/1	T 666 + T 666/A + T 660/6 T 666/4 + T 666/D + T 660/6 T 666/2 + T 666/5 + T 660/6 T 666/1 + T 666/B + T 660/7 T 666/12		
LOAD MEASUREMENT PROVING RING: 3 kN (SHEAR BOXES T 666 -T 666/2 -T 666/4) PROVING RING: 6 kN (SHEAR BOX T 666/1) ELECTRIC LOAD CELL: 5 kN GEOTRONIC DISPLAY/READOUT UNIT	BB 003 ALT. BA 003 BB 006 ALT. BA 006	AP 032/005 AD 002	AP 032/005
STRAIN MEASUREMENT** DIAL GAUGE: 10 mm (0.01) - VERTICAL DIAL GAUGE: 30 mm (0.01) - HORIZONTAL TRANSDUCER 25 mm (0.01) GEOTRONIC DISPLAY/READOUT UNIT	T 628/E1 T 628/E	AD 115/026 (x 2) AD 002 (x 2)	AD 115/026 (x 2)
DATA ACQUISITION NETWORK CONNECTION UNIT CABLE (10 m LONG) CABLE EXTENSION (10 m LONG) 3-WAY CONNECTOR BLOCK DATA ACQUISITION SOFTWARE		AD 021/010 AD 021/012* AD 021/003 AD 050/001	AD 308 AND MULTIPLES OF 8 CHANNELS AD 021/015*** AD 050/001
DATA PROCESSING "DIRECT SHEAR" SOFTWARE "RESIDUAL SHEAR" SOFTWARE		AD 225/005 AD 225/006	

* Not necessary for a single connector block

** Digital dial gauge (0.01 mm) without data acquisition
DV 923/10 - 10 mm travel; DV 923/30 - 30 mm travel

*** At least one cable extension for each sensor

BUYER'S GUIDE

TRIAXIAL TEST (UU.CU.CD) MINIMUM CONFIGURATION, COMPRISING ONE TRIAXIAL CELL

	ANALOG VERSION	DIGITAL VERSION WITH GEOTRONIC	DIGITAL VERSION WITH UDA (PAGE 92)
LOAD FRAME (50 kN STRUCTURE)	TR 115		
OPTIONAL BENCH IN COMPLETION	TR 115/B		
STRESS AND STRAIN MEASUREMENT PROVING RING: 2 kN DIAL GAUGE: 30 mm (0.01 mm) LOAD CELL: 5 kN GEOTRONIC DISPLAY/READOUT UNIT TRANSDUCER 25 mm (0.01) GEOTRONIC DISPLAY/READOUT UNIT	BB 002 ALT. BA 002 T 628/E	AP 032/005 AD 002 AD 115/026 AD 002	AP 032/005 AD 115/026
CELL AND ACCESSORIES TRIAXIAL CELL PEDESTAL TOP CAP WITH DRAINAGE BASE DISC SUCTION SLEEVE STRETCHER MEMBRANE (30 PIECES) O-RING (30 PIECES) POROUS DISC (NOT NECESSARY FOR UU TEST) FILTER DRAIN (50 PIECES) (NOT NECESSARY FOR UU TEST)	DIA. 38.1 * TR 205 * TR 205/001 * TR 205/002 * TR 205/003 TR 205/006 TR 205/007 TR 205/018 * TR 205/009 (x2) TR 205/010	DIA. 50 * TR 205 * TR 205/041 * TR 205/042 * TR 205/043 TR 205/036 TR 205/037 TR 205/038 * TR 205/049 (x2) TR 205/040	DIA. 100 * TR 207 * TR 207/011 * TR 207/012 * TR 207/013 TR 207/006 TR 207/017 TR 207/018 * TR 207/019 (x2) TR 207/020
SAMPLE PREPARATION SAMPLER RACK AND PINION SAMPLE EXTRUDER BENCH MODEL TWO PART SPLIT MOULD ELECTRIC AUTOMATIC LATHE (NOT NECESSARY FOR UU TEST) THREE PART SPLIT FORMER (NOT NECESSARY FOR UU TEST)	DIA. 38.1 N 205 N 210 TR 205/005 N 204 TR 205/004	DIA. 50 N 206 N 210 TR 205/045 N 204 + N 204/D TR 205/044	DIA. 100 N 208 N 210 TR 207/016 N 204 + N 204/I TR 207/014 (4 PART)

* Multiply these components by 3 to obtain test configuration with 3 triaxial cells.

** AD 021/012 not necessary for configuration with one triaxial cell only.
1x AD 021/002, 2x AD 021/003, 2x AD 021/012 are necessary for configuration with three triaxial cells.
For performing a simple "UU" TRIAXIAL TEST the following equipment are not necessary:
Pore pressure measurement, volume change measurement, constant pressure sources, air compressor.
It is sufficient to buy the kit TR 301 - TR 301/002 - TR 301/004 - TR 301/006 - TR 301/008 (see page 78).
The following accessories for the cell are not necessary: TR 205/009 - TR 205/004 - TR 205/010 - N 204.

*** At least one cable extension for each sensor

BUYER'S GUIDE

TRIAXIAL TEST (UU.CU.CD) MINIMUM CONFIGURATION, COMPRISING ONE TRIAXIAL CELL

	ANALOG VERSION	DIGITAL VERSION WITH GEOTRONIC	DIGITAL VERSION WITH UDA (PAGE 92)
<u>PORE PRESSURE MEASUREMENT</u> DIGITAL MANOMETER ELECTRIC TRANSDUCER (0-1000 kPa) DE-AIRING BLOCK GEOTRONIC DISPLAY/READOUT UNIT	* TR 305/030 * TR 205/510	* TR 205/500 * TR 205/510 * AD 002	* TR 205/500 * TR 205/510
<u>VOLUME CHANGE MEASUREMENT</u> VOLUME CHANGE MEASUREMENT DEVICE DIAL GAUGE: 30 mm (0.01) TRANSDUCER 25 mm (0.01) GEOTRONIC DISPLAY/READOUT UNIT	* TR 440/ST * T 628/E	* TR 440/ST * AD 115/026 * AD 002	* TR 440/ST * AD 115/026
<u>CONSTANT PRESSURE SOURCES</u> AIR-WATER CYLINDER MANOMETER BLADDER SEALING RING PLACING TOOL	* TR 305 (x 2) TR 305/010 ALT. TR 305/020 TR 305/4		
<u>SILENT AIR COMPRESSOR</u> COMPRESSOR 12 BAR 50 LITRES AUXILIARY TANK DE-HUMIDIFIER AIR FILTER	D 816 D 816/1 D 816/2 D 816/3		
<u>DATA ACQUISITION</u> NETWORK CONNECTION UNIT CABLE (10 m LONG) CABLE EXTENSION (10 m LONG) 4-WAY CONNECTOR BLOCK TABLE SUPPORT FOR 6 GEOTRONIC UNITS ACQUISITION SOFTWARE		AD 021/010 ** AD 021/012 AD 021/004 TR 001/S3 AD 050/001	AD 308 AND MULTIPLES OF 8 CHANNELS AD 021/015*** AD 050/001
<u>DATA PROCESSING</u> "TRIAXIAL TEST UU.CU.CD" SOFTWARE		AD 050/B32	

* Multiply these components by 3 to obtain test configuration with 3 triaxial cells.

** AD 021/012 not necessary for configuration with one triaxial cell only.
 1x AD 021/002, 2x AD 021/003, 2x AD 021/012 are necessary for configuration with three triaxial cells.
 For performing a simple "UU" TRIAXIAL TEST the following equipment are not necessary:
 Pore pressure measurement, volume change measurement, constant pressure sources, air compressor.
 It is sufficient to buy the kit TR 301 - TR 301/002 - TR 301/004 - TR 301/006 - TR 301/008 (see page 78).
 The following accessories for the cell are not necessary: TR 205/009 - TR 205/004 - TR 205/010 - N 204.

*** At least one cable extension for each transducer.



AD 332

**RANGE:**

AD 308	UDA 8 - 8 Channel Data Acquisition Unit (expandable to 32 channels)
AD 316	UDA 16 - 16 Channel Data Acquisition Unit (expandable to 32 channels)
AD 324	UDA 24 - 24 Channel Data Acquisition Unit (expandable to 32 channels)
AD 332	UDA 32 - 32 Channel Data Acquisition Unit
AD 310	UDA 8 - 8 Channel Data Acquisition Expansion for UDA 8 – UDA 16 – UDA 24

UNIVERSAL DATA ACQUISITION UNIT

UNIVERSAL DATA ACQUISITION UNIT**AD 308**

The basic instrument has 8 analog input channels each of which may be managed individually in order to supply power to and read bridge type or potentiometric transducers.

User interface comprises a 240 x 128 pixel, backlit graphic display and is operated via touch screen.

There are 24 bit analog-digital converters of which 16 are effectively used (thus obtaining 65000 stabilised divisions); sampling rate is 4 Hz.

On-board memory capabilities for software and data amount to 1128 k bytes so as to allow “stand alone” operation.

External links are possible via interfaces using 4 different serial protocols (RS 232, 422, 485 and current loop).

Upon request an Ethernet port can be provided as Web Server. Calibration of each channel is arranged along 11 programmable points between zero and full scale.

An ample choice is available for units of measurement.

Data acquisition timing may be programmed either directly or via PC (using our TDA software).

Clock/calendar has a buffer memory.

Optional 8-channel expansion modules are available (for housing inside the unit) up to a maximum of 32 channels.

Each module has a memory capability of 1MB.

The UDA is fully compatible with Tecnotest Geotronic networks.

FOR CONNECTION TO TRANSDUCERS AND LOAD CELLS:

AD 021/015	EXTENSION CABLE (10 m LONG)
AD 021/016	EXTENSION CABLE (20 m LONG)

DATA ACQUISITION SOFTWARE:

AD 050/001	SOFTWARE PACKAGE FOR TRANSMISSION OF TEST DATA TO A PC
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AD 308

