The resistance to penetration is a means of determining the ground load-bearing capacity, and the ease with which roots will grow through the ground (important when agricultural, rural- and civil engineering techniques are involved).

The resistance to penetration is a mechanical characteristic that, given a certain texture, depends on changing parameters such as degree of humidity, density and the strength of the connection between mineral particles.

Measuring the resistance to penetration of the soil in a great number of measurements is best executed applying an electronic penetrometer together with a data logger, allowing for immediate storage and processing of the data in the data logger.

To this purpose Eijkelkamp developed the penetrologger:

An electronic penetrometer with a built-in data logger for storage and processing of a great number of measuring data (1500 measurements).

The resistance to penetration is greatly influenced by the speed of penetration, dimension and top-angle of the conus.

Penetrologger
By exercising an equal amount of pressure on both (electrically insulated) grips the conus is pushed vertically into the soil.

The penetrometer is fitted with a built-in checking mechanism for the speed of penetration (pushing too fast and too irregular yields data that are not representative for the soil).

The resistance that is experienced during the pushing procedure is stored in the datalogger.

It is also possible to show the measuring results (in MPascal or Newton) on the display, in a graph or in a table with numeric measuring data, immediately.

The penetrometer is fitted with an adjustable LCD screen for a clear display, also in direct sunlight.

The logger is battery fed.

The standard set, among other items, contains: the penetrometer, a cable for the connection of the penetrometer to the PC, a manual for the penetrometer and for the PC-software, the software itself, a battery charger, probing rods, various cones, cone check and a bag of tools. The whole is carried in an aluminium carrying-transport case.

**Advantages**

The advantages of the penetrometer are:

- Ergonomic design, easy to use, light weight.
- Splash-water proof.
- Large measurement range (0-10 MPa).
- Accurate (resolution 0.1 kPa).
- Accurate depth registration.
- Possibility of adjustment.
- Easy and flexible programming of the field work that can be executed on a PC as well as on the penetrometer itself.

If the maximum measuring depth has been reached the whole can be extracted from the soil.

The penetrometer is fitted with touch control.
The penetrometer now also has a precise internal GPS-system to determine the exact place of the measurement. It also includes new PC software, a larger storage capacity and French and Spanish language functions. Optional is the possibility of soil moisture measurement with an external soil moisture sensor (1 measurement per penetration).

- Execution of the programming of the penetrometer on a PC is the fastest.

- The measuring results can be displayed graphic as well as numeric.

- Automatic calculation of average values and standard deviation.

- In addition the option exists to store the data in the penetrometer for further processing on the PC.

- The logger has a substantial data storage capacity (1500 measurements).

- The graphic software enables you to read out the data directly, display them as graphics or numerically, or to print them on a printer or a plotter.

- Language options regarding the program: Dutch, English, German, Spanish or French.

- The data files can be used in spreadsheet programs for further data-processing.

- Universal application.

- Low power consumption.

- Good price/quality ratio.

- Built-in clock for date- and time registration.

- Programmable project planning.

- Cone index measurements.

- Penetrologger, probing rod and cone

- Soil Moisture sensor

Depending of the resistance to penetration that is expected one of the cones provided is mounted.

The cone check is used to inspect the wear of the cones.
PENETROLOGGER

PC software

- User friendly software.
- Mouse controlled.
- Graphic user interface.
- Data output to display, printer and plotter.
- Windows 95, 98, 2000, NT, ME, XP

Applications
The penetrologger can be applied in the agricultural- as well as in the civil engineering sector:

- General soil science research.
- Foundation technology.
- Checking whether or not the soil is suitable for agricultural purposes.
- Research into (expected) growing conditions for plants.
- The detection of compacted (possibly impermeable) sub-soil layers (e.g. layers compacted below depth of ploughing).
- Research into poor growing conditions of for instance trees in the city or in parks.
- Checking artificially-made compactions.
- Checking the suitability of soils for carrying vehicles or pedestrians.
- Suitable for golf-courses.

Graphic display on a monitor

The data stored in the logger are processed on the PC.
### Penetrologger (P1.52)

The penetrologger is supplied as a complete set (incl. aluminium carrying case).

**06.15.SA** Penetrologger with GPS, standard set for measurement to a depth of 80 cm. Complete set with penetrologger, cones, sounding rods, depth reference plate, battery charger, penetrologger cable, software Penetroviewer, tools and aluminium carrying case.

**06.15.31** Penetrologger with internal GPS. Force sensor for measurements till 10 MPa, LCD display. Memory for 1000 measurements, ultrasonic depth measurement till max. 80 cm. Measurement interval 1 cm. NiMH battery supply. Soil moisture measurement for every penetration possible with article number 06.15.50. Excl. battery charger and software.

**06.01.02.01** Cone, base area 1 cm², angle 60 deg.

**06.01.03.02** Cone, base area 2 cm², angle 60 deg.

**06.01.04.03** Cone, base area 3 1/3 cm², angle 60 deg.

**06.01.05.04** Cone, base area 5 cm², angle 60 deg.

**06.15.10** Probing rod (for cone 1 cm²), Ø 8 mm, bi-partite screwable design, total length 80 cm, with quick-coupling for connection to penetrologger.

**06.15.11** Probing rod (for cones 2 cm² up to and including 5 cm²), Ø 10 mm, bi-partite screwable design, total length 80 cm, with quick-coupling for connection to penetrologger.

**06.15.35** Battery charger for penetrologger (06.15.31), input 100/240 Vac, 50/60 Hz, output 15 Vdc, incl. 9-pins connector.

**06.15.32** CD-rom with Penetroviewer software. For processing and displaying data and configuration of the penetrologger. Suitable for Windows 95, 98, NT, ME, 2000 and XP. CD-rom with operating instructions in Dutch, English, German, Spanish and French.

**06.15.09** Cable for penetrologger; RS232/IBM PC, type 9 pins plug (incl. 9-25 pins adaptor), length 150 cm, for connection to penetrologger from serial no. 99258000 on

**06.15.13** Depth reference plate

**06.15.20** Aluminium carrying case for penetrologger set. Dimensions 58x29x25 cm (outside)

**99.70.01** Bag for tools

**99.50.07** Spanner 7x9 mm

**99.50.12** Spanner 12x13 mm

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### Optional items

- **06.15.50** Soil moisture sensor Theta-probe, measuring range 5-55% volume percentage soil moisture, accuracy +/- 5%, with 4 measuring pins, length 60 mm, Ø 3.2 mm. Cable length 5 m, incl. 9-pins connector. Suitable for measurements in mineral soils.

### To be used optionally for soil moisture measurements

- **06.15.30** Inspection of penetrologger: making a calibration certificate and eventual a repair advice when deviations occur.

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**PARTS LIST**