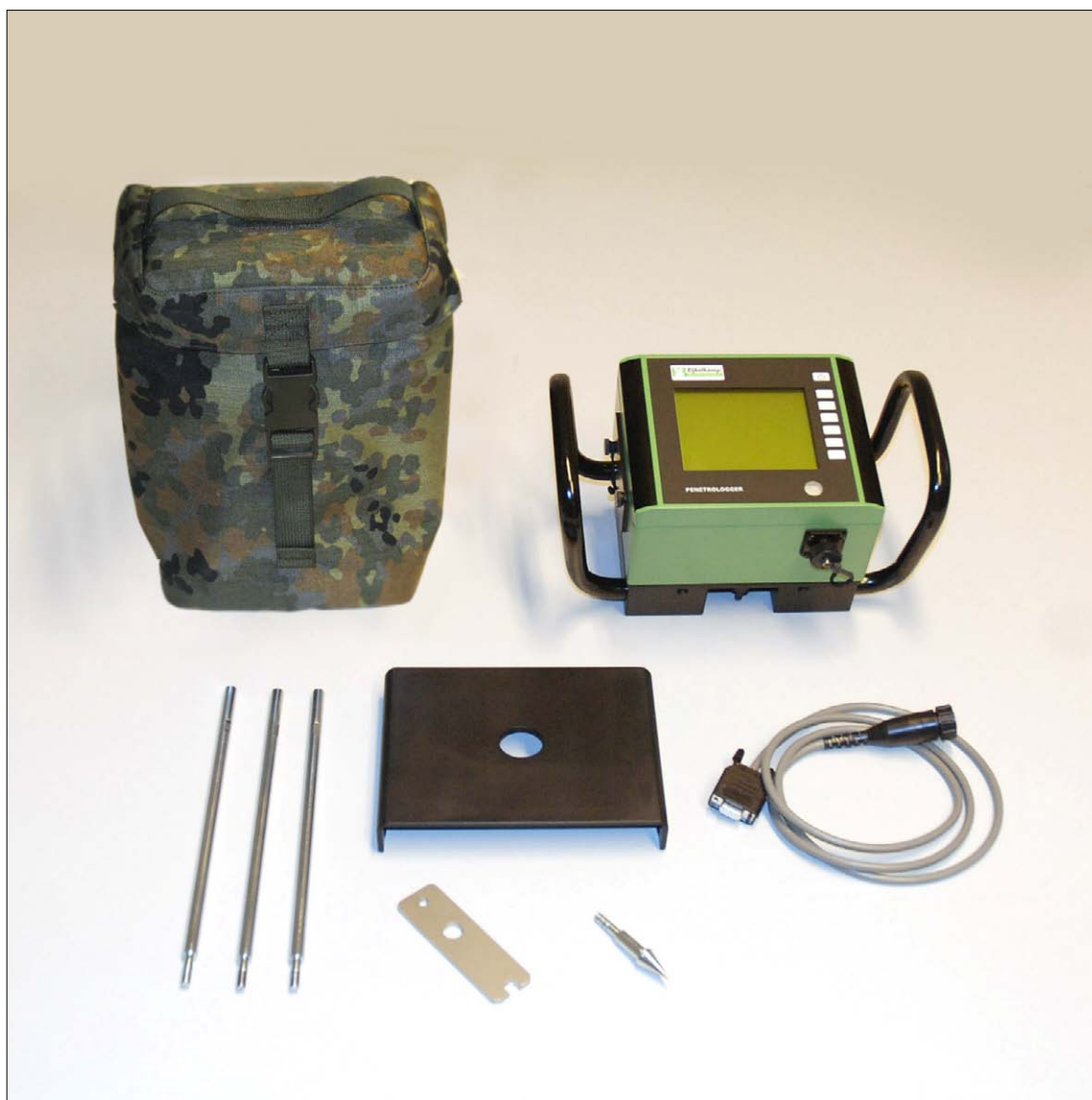




PENETROLOGGER

OPERATING INSTRUCTIONS

Serial number :
 Hardware version : 6.00
 Software version : 2.21
 PenetroViewer version: 6.13
 NSN : 6635-12-396-3995



All it takes for environmental research

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About these operating instructions



Symbols (as shown left) are meant for technical requirements of which the user must take special note.



Caution (symbol shown at left) is meant for work and operation processes that must be strictly adhered to in order to prevent danger to persons. The user is responsible at all times for complete personal protective equipment.

Refers also to working and operation processes that must be strictly adhered to in order to prevent damage to or destruction of the Penetrologger.

Text

Text between inverted commas "..." (or italics) means that the text is exactly as shown on the screen.

Introduction

The CBR-Penetrologger is a device specially designed for measuring the CBR value (= Californian Bearing Ratio) of the soil; at the same time this instrument automatically saves the measuring results obtained and thus makes possible their further processing on a PC.

The Penetrologger is distinguished by an ergonomic design, its low weight and its user-friendliness. It permits measurements up to a depth of 70 cm. The Penetrologger displays the CBR value for each measurement.

The Penetrologger contains a GPS system for exact determination of the measurement position. The coordinates displayed by the Penetrologger can be allocated with the aid of certain software (or somewhat less accurately over the Internet) to a site or a map.

Optionally a soil moisture sensor (Art.-No.: 06.15.50) can be connected to it in order to determine and save the soil moisture percentage (single-point measurement) of the measuring position.

The Penetrologger permits the direct storage and processing of 1500 measuring data (CBR data including GPS and soil moisture data). For this reason this instrument is suitable above all for comprehensive test series.

The Penetrologger possesses a built-in arrangement for displaying the penetration speed, as a too-quick or impact method of advance will result in values that are not representative of the measured soil. This method is precise and possesses a measuring range of von 668 N (15% CBR).

1. CBR (Californian Bearing Ratio)

The Californian Bearing Ratio investigation (short CBR) is a method of testing with the help of which the carrying capacity of soils and hydraulically bound layers (rather seldom) can be investigated. The procedure was originally developed for compaction of airport surfaces and is meanwhile also used in road construction. It was developed by the "Californian Department of Transportation". Basically the investigation displays the force needed by a plunger pressed into a sample of soil in order to achieve a defined penetration speed up to a defined depth. The better the carrying capacity of the soil sample, the higher the generated plunger pressure.

A soil CBR value is an index of the shear resistance under standard loading as compared to the shear resistance of a standard material (crushed limestone) under the same loading.

The CBR investigation is described in the MIL CRD-C 654-95, ASTM Standards D1883-05 (for samples prepared in the laboratory) and D4429 (for field soils) and AASHTO T193.

It is necessary to carry out measurements in depths, taking into account deviations, of the soil capacity for air traffic with and without prepared start and landing strips.

The measuring results of the Penetrologger are validated in order to characterize the CBR values of the soil as described in the TTRL Report 901.

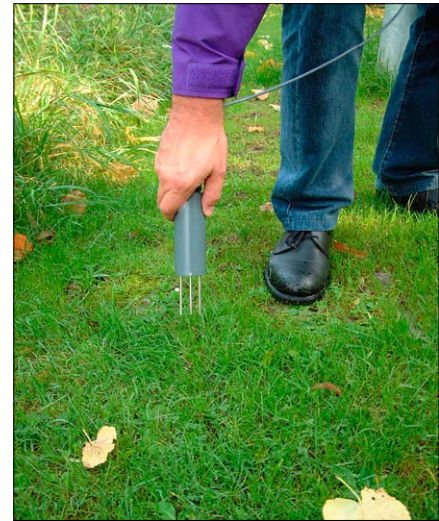
1.1 Average CBR value; calculation per penetration

The penetration depth (70 cm) is divided into 5 customer-specific, adjustable depths. The CBR value (1 to 5) is measured at these depths.

CBR 1 (first value) and CBR 5 (last / deepest measurement) are the determining CBR values and saved as individual values per cm. Values 2, 3 and 4 are supplementary information.

1.2 Influence of the soil moisture content and the content of the organic contents

The penetration resistance of the soil depends, among others, on the soil moisture content. The higher the degree of moisture of the soil, the lower its penetration resistance and the lower its carrying capacity. In the comparison of penetration resistances that are measured at different points in time (for instance before and after a particular soil processing), one must ensure that the soil moisture conditions during the measurement are comparable. In practice, comparable moisture values are best ensured in that the penetration resistance is determined at field capacity (pF-2). The soil moisture content of the measuring point can be defined and saved with the aid of the optional soil moisture sensor (Art.-No.: 06.15.50).



Measuring soil moisture

1.3 Influence of the spatial variability

In the determination of the penetration resistance the spatial variability of the soil must also be taken into account. The differences with regard to texture, the structure or content of organic content can differ substantially on a parcel level. As all these factors determine the penetration resistance, it is first necessary to make repeat measurements in order to receive a representative value. The number of necessary repeat measurements is oriented to the desired precision and the natural variability of the soil. The literature (for instance Campbell & O'Sullivan, 1991) recommends 10 measurements per plot because of the soil formation due to the impression of the cone. The spacing between the individual measuring points is at least 50 to 60 cm. The Netherlands standard for electrical penetrations (NEN 5140, 1996) promotes a spacing of at least 100 cm between penetrations.

2. Description

The CBR Penetrologger is normally supplied as a complete set for measurements to a depth of up to 70 cm. Such a set is comprised of the Penetrologger itself, suitable CBR cones, conecheck key, probe rods, a depth reference plate, cable, software and a test protocol. Accessories such as soil moisture sensor (06.15.60) are obtainable as option. All these parts are packed into a carrying bag.

The complete Penetrologger (see picture) consists of a housing (a) with GPS antenna (7), a LCD display (8), a key pad (9), a level (10), and a force absorber (2). The logger has a spray-water protected housing with hand grips (11). The Penetrologger is provided with power by means of batteries.

The cone-shaped point or "Cone" (4) is screwed on below the three-part probe rod (3).

When the cone is forced into the soil, the Penetrologger registers the depth up to 70 cm with great precision by means of an internal ultrasound sensor whereby the depth reference plate (5) comes into use.

The measured penetration resistance, the GPS data and – if the optional soil moisture sensor is connected to the communication port (6) – the percentage of soil moisture are saved into the internal Logger of the Penetrologger.

The average value of the CBR values and the standard deviation can be calculated automatically. If the cable (13) is connected to the communication connection port (6) and to the PC, then data can be exchanged between the Logger and the PC. The accompanying software permits the reading out of the data to the PC, the graphic and numerical representation and the printing out of the data.

The Conecheck key (12) is used for checking the wear on the cones. The cone must be replaced when it fits through the hole.

3. Technical specifications

Environment

Temperature	-10 to +70 °C
Moisture	0..100%RH
Temperature shock	50 °C

Physical

Dimensions of bag	30x25x15 cm (h x w x d)
Total weight	5.5 kg
IP classification	IP 54 (spray water / watertight)

The cone is CBR standard with adherence to NATO specification.

Diameter	0.5 inch (1.27 cm) /upper edge of cone
Top angle	30 °
Surface	0.2 Inch ² (1.27 cm ²) cone

Penetration depth	0-70 cm
Penetration resolution	1 cm
Penetration speed	1-5 cm/sec
Penetration force	0 - 700 N (0 - 15% CBR)
Penetration resolution	0.1% CBR
Penetration accuracy	2% (re-calibration with error >5%)

GPS accuracy	2 m CEP Circular Error Probable 3.5 m SEP Spherical Error Probable (Egnos compensated) CEP, 50% 24-hour static, - 130 dBm (type µBlox LEA-6H)
--------------	---

Display	LCD monochrome green/black
Background lighting	LED intensity + contrast adjustable

Power supply	Battery pack Lithium SEM52 8.4 V or BH8AA 12 V
Battery life	> 600 measurements
Memory	1500 penetration measurements

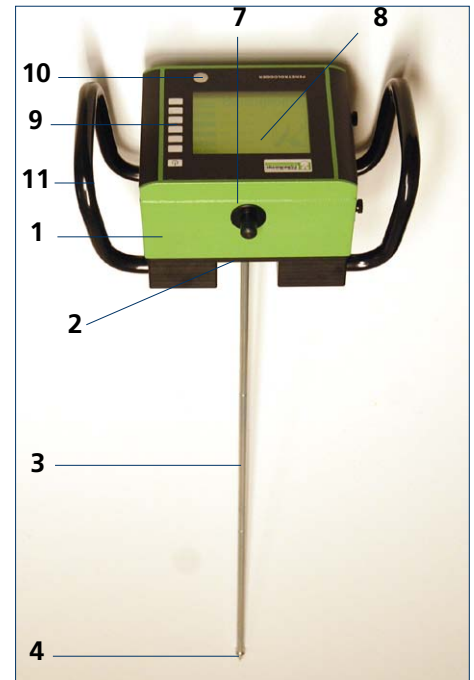
Levelling	Spirit level (bubble level)
Moisture	Optional sensor available

Measuring mode

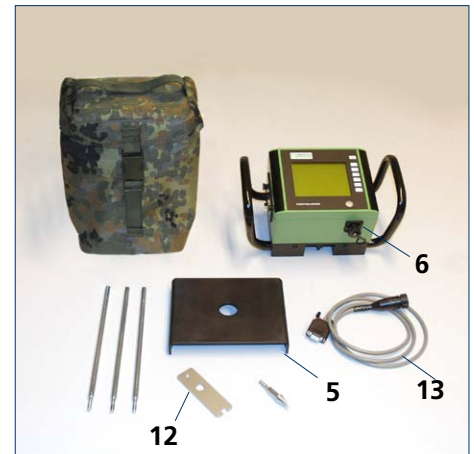
Calculating the average value: $\bar{C}BR = (\text{measuring values CBR depth 1 (X) to measuring values CBR depth 4 (Y)}) / n$
(= No. of measuring values between X and Y = per centimetre of a measurement).

$\bar{C}BR$ average value is rounded down (e.g. CBR 7.9 → CBR 7)

Range for calculations: $\bar{C}BR$ average value can be entered for 2 (CBR depth 1 (X) and CBR depth 4 (Y)) users.



Penetrologger



Penetrologger Set

4. The procedure

Before starting the measurements with the Penetrologger, a plan for the field measurements must first be established (see 5 “Plan for field measurements”). Such a measurement plan contains the definition of the field measurement positions, the number of measurements that will take place at the individual measuring points, and the settings of the Penetrologger (for instance the speed of penetration).

If desired, the desired measuring plan can be created on the PC or on the Penetrologger itself (see 7 “Creating a plan with the aid of the Penetrologger”). Practically, it is more convenient to make use of a PC (see 6 “Creating a plan on the PC”). However, the accompanying software must be installed on the PC for this purpose. If the PC is now connected to the Penetrologger via the communication cable, then the created measuring plan is transferred from the PC to the Penetrologger.

After creating the plan, the Penetrologger is ready for use and thus permits the measurement of the penetration resistance. Now the prescribed measurement are carried out at each measuring point in the field (see 8 “Carrying out the measurements”). The corresponding results are automatically saved in the Logger where there is an upper limit of 1500 measurement results. It is also possible to adapt the measurement plan in the Penetrologger on site (Paragraph 7.4).

The measuring results can be called up on site on the Penetrologger in graphic or in numerical depiction (see 9 “Processing the measuring data”). The software also permits the reading out of the data on the PC, the processing of these data, transfer to other programs, and printing out on a printer.

5. Planning the measuring for field measurements

5.1 Creating a plan

This type of plan consists of a hierarchical structure of projects, plots and penetrations (see picture). A project consists of several plots (measuring positions). A penetration resistance is determined at each individual plot. In this, one or more penetrations (measurements) are carried out per plot in order to arrive at a representative average value for the plot.

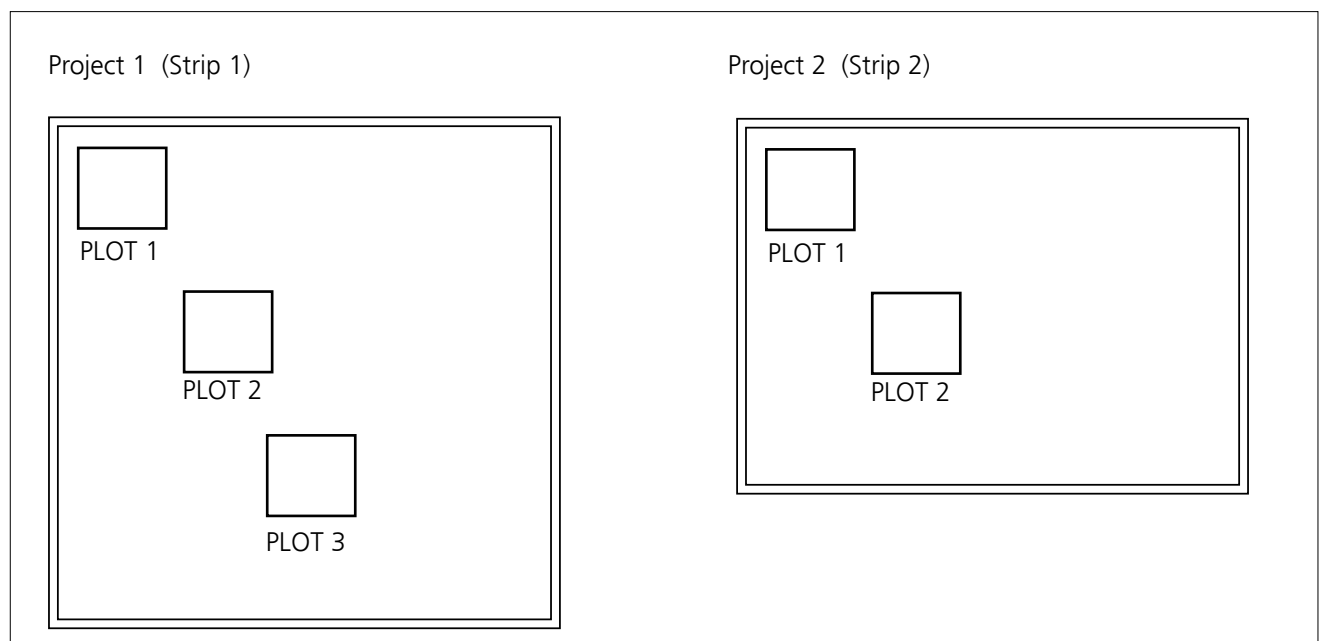
The following general parameters are created for each project:

- ☐ Project designation
- ☐ User name (e.g. BW)
- ☐ Plot designation
- ☐ Penetration speed
- ☐ No. of plots
- ☐ Quantity of soundings per plot (max. 20)

5.2 Example

An example of one such measuring plan is "Plan X":

PLAN X	
Project 1	
Plotname	1
Penetration	1
Penetration	2
Penetration	3
Penetration	4
Plotname	2
Penetration	1
Penetration	2
Penetration	3
Penetration	4
Plotname	3
Penetration	1
Penetration	2
Penetration	3
Penetration	4
Project 2	
Plotname	1
Penetration	1
Plotname	2
Penetration	1



Example of a measuring plan

6. Creation of a plan on the PC

The creation of a plan on the PC and the later transfer to the Penetrologger has the advantage that the entry via the keyboard of the PC is often easier. This method saves much time, especially when special plot designations are to be used, which can be time-consuming as regards the typing effort. One or more projects can be defined per plan, in fact up to a maximum of 1500 penetrations.

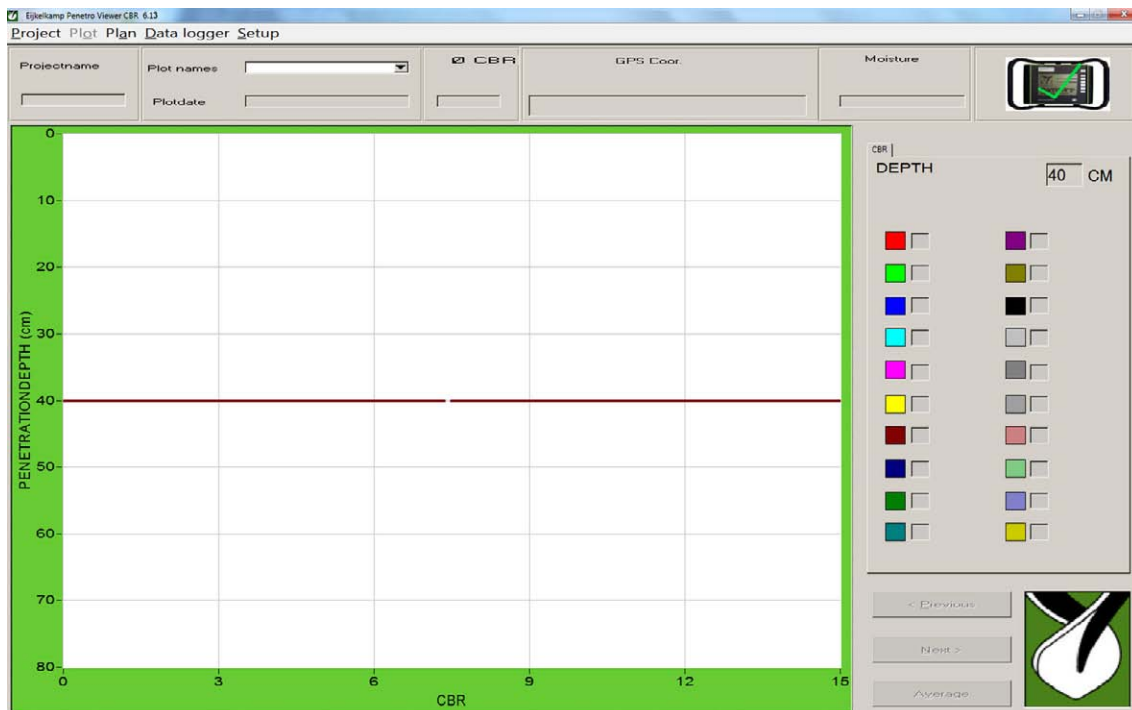
Several plans can be saved on the PC and these can be called up later as required. However, the Penetrologger can only save one plan. This plan can contain several projects. In the case that several plans are used in the field, then it is advisable to use a Laptop.

6.1 Installation of the software

System requirements:

☐ Windows XP/Vista

1. First insert the "PenetroViewer CBR" CD into the CD-ROM drive. The Auto-Run program starts, follow the instructions of the screen. If the Auto-Run program does not start, then the Setup file can be started manually. Select "Setup" and click on "Open". To confirm, click on the command button "OK".
2. In order to now select a different folder for the PenetroViewer, click on "Change" and enter the desired folder. The standard target folder is "C:\Program Files\PenViewer". To confirm, click on the "OK" command button.
3. Click on "Next" in order to start the installation or "Abort" to stop the installation process.
4. The PC must be restarted to activate the changes. Click "YES" to start automatically or "NO" if it is intended to start later.



Penetroviewer main window

6.2 Starting and ending the PenetroViewer

1. To start the PenetroViewer, click the *Eijkelkamp PenetroViewer* shortcut in the Windows Start menu under *Programs, Eijkelkamp PenetroViewer, Penviewer*.
Then a window with the Eijkelkamp logo appears and disappears again a few seconds later to be replaced by the main window of the PenetroViewer (see picture).
2. When used for the first time, the main window has an English language menu bar. If the German language is desired, select "*Language*" under "*Tools*" in the menu bar and place an X in the "*German*" box.
3. To close the PenetroViewer, click "*Close*" in the menu bar under "*Project*" or click the X at the top right of the window.

6.3 Set-up

The following parameters are shown in the Set-up

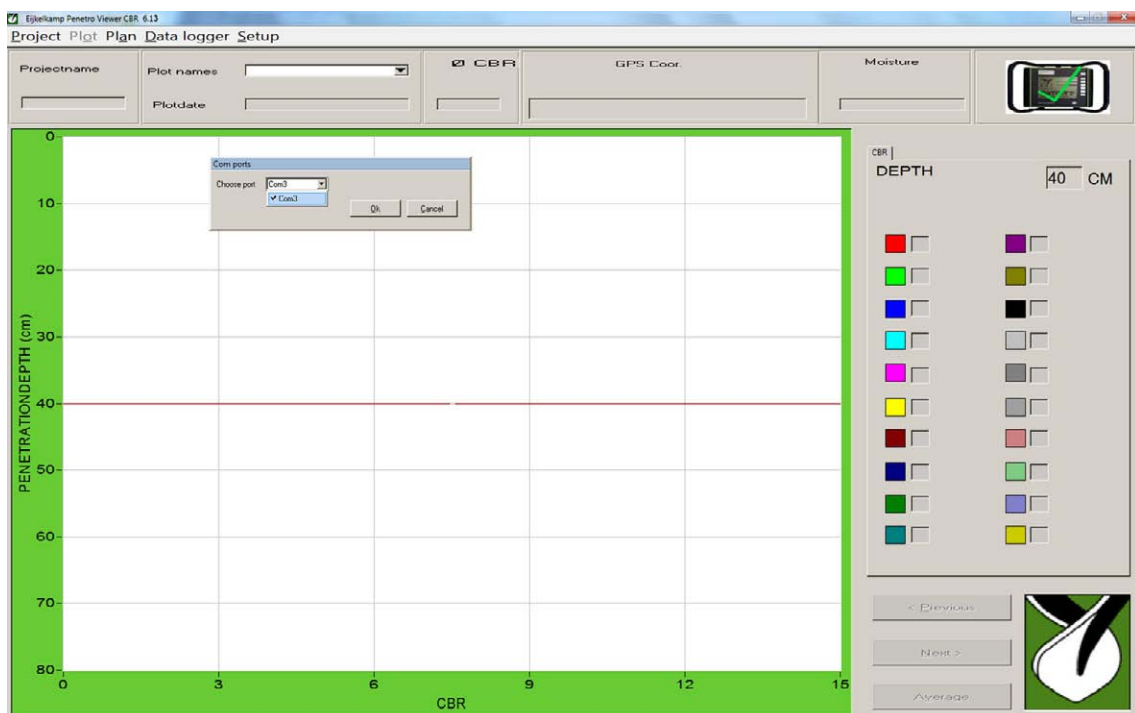
- ☐ Export
- ☐ Language
- ☐ Comm.Port
- ☐ Info

When used for the first time, the main window has an English language menu bar. If instead the German language is desired, select "*Language*" under "*Tools*" in the menu bar and place an X in the "*German*" box.

The software automatically finds the available communication ports on the Computer. The correct communication ports must be selected when the Penetrologger is first connected.

Connect the Penetrologger to the computer and switch it on. Go to Tools → Comm. Port and select one of the available communication ports.

When you have selected the correct Port a green tick (‘✓’) appears in the small depiction of the Penetrologger (top right in the picture). If the incorrect port is selected, a red X will appear instead and another port must be selected.



Setting up the communication port

Either a long or a short version can be selected as export format. The long version is suitable for further processing in Excel. For this, select *Export TXT file pro cm depth* under *Set-up / Export* in the menu bar (for further information see 9.2.4).

The short version is suitable for the "Go-book". For this, select *Export TXT Average value* under *Set-up/Export* in the menu bar (for further information see 9.2.4).

6.4 Standard parameters

Certain standard parameters are set before the creation of a measuring plan. The corresponding values are filled in automatically in a time-saving method when creating a plan

The following standard parameters are filled in for "Standard" under "Plan" in the menu bar:

<i>Company</i>	Enter a maximum 8-character company name – without spacing. A difference is made here between upper and lower case letters. Normally the name appears between square brackets In the first use, this is: [COMPANY].
<i>Number of plots</i>	Here the desired number of plots that will be used within the scope of a given project is entered with a max of 1500. Normally this number appears in square brackets. In the first use, this is: [1].
<i>Pen. per Plot</i>	Select the desired number of penetrations that are to be carried out per plot. Normally the number of penetrations per plot is: [1] (max. 20)
<i>Pen. speed</i>	Select the desired penetration speed (cm/sec) for the measurements. The recommended value is 2 cm/sec (see Paragraph 7.2). Normally the penetration speed is set to: [2].
<i>CBR depth</i>	Normally all values between 0 cm and 60 cm are used for average calculations of the CBRs per penetration. It is possible for the project to pre-select other areas (e.g. measurements between 10 cm and 50 cm).
<i>Type of cone</i>	The CBR cone type is pre-selected.

6.5 Creating a measurement plan

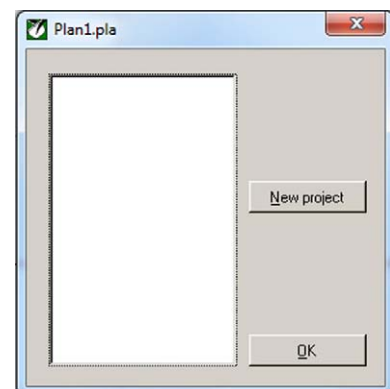
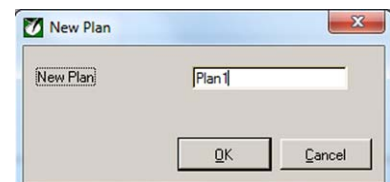
6.5.1 Entering a measurement plan

1. A plan is created by selecting "New Plan" in "Plan" in the menu bar.
This opens the "Add Project" window.

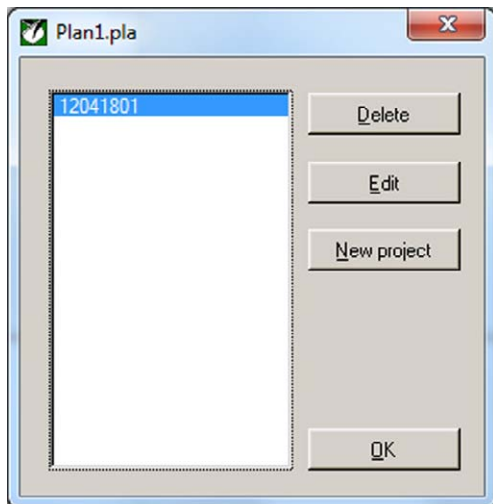


If a new plan is to be created, then no other plan must have already been loaded in the PenetroViewer. Therefore first close the already loaded plan (see Paragraph 6.5.2).

2. In the next step, click *New Project* in order to define a new project within the plan.
This opens the "EDIT PROJECT" window.



Add project window



From	CBR 1	CBR 2	CBR 3	To	CBR 4	End	CBR 5
	1	24	30		38		60

Edit Project window

3. Now the following entries can be changed

<i>Project name</i>	Normally based on the date (Year-Month-Day) and the sequential number; enter a unique designation, maximum 8-character entry.
<i>Company</i>	Maximum 8-character entry.
<i>Type of cone</i>	CBR cone (cannot be changed)
<i>CBR depth</i>	CBR-1 (X) starting depth average calculation Ø CBR CBR-4 (Y) End depth average calculation Ø CBR CBR-5 (End depth penetration)
<i>Penetr. speed</i>	1, 2, 3, 4 or 5 cm/s.
<i>No. of plots</i>	1 ... 1500
<i>No. of penetrations per plot</i>	1 ... 20
<i>Plot name</i>	Normally all plots within a given project possess a unique name, i.e. they are named on the basis of a sequential number. These numbers have a maximum length of 8 characters.



The same penetration speed should always be used with several measurements in order to ensure that the results are reproducible.

4. The project is defined by a mouse click on "OK" when everything is entered as desired (also the whole project can be removed with *Back*).

5. Repeat steps 2-4 until all the desired projects have been entered.

In this connection, it should be pointed out that a total of maximum 1500 penetrations can be reserved in the Penetrologger. If this limit is reached during creation (the PenetroViewer calculates this automatically), then the New Project button no longer appears in the "SELECT PROJECT" window. Also, in this case no additional plots and penetrations can be defined anymore.

6. Save the completed plan (see Paragraph 6.5.2).

6.5.2 Saving and ending the measuring plan



As soon as the changes of the settings have been carried out, a window appears (irrespective how) with the query whether the changes should be saved or not (Yes/No/Abort). The saved plan can then later be used again or can be processed (see Paragraph 6.5.3)

1. Now select the "Save" option in "Plan" in the menu bar and enter a name for the plan. Then select the desired folder in which the plan file is to be saved. The file will have the suffix "pla".
If the file name already exists, then the operating guide in the dialogue window asks whether the existing file is to be overwritten. If the file is to be overwritten, confirm by means of a mouse click on Yes; otherwise, click No and enter a new name.
2. If (after successful saving) the plan is to be closed, select Close in "Plan" in the menu bar.
Then a dialogue window appears with the query whether you really want to close the plan. With Yes the plan is closed and No annuls the command (this does NOT delete the plan from the hard disk!).

After successfully closing the plan, the PenetroViewer can be used to create a new plan or to load an existing plan.

6.5.3 Opening and processing a measuring plan

1. If an already existing plan is to be opened, select "Open" in "Plan" in the menu bar.
However, the PenetroViewer can only save one plan at a time. For this reason, if a processed plan is already open, a dialogue window will appear with the request to save the current plan.
2. Now open the desired folder in which the file with the "pla" suffix is located and select the file. The file is loaded with *Select* and the process is aborted with *Abort*.
3. If the loaded plan is to be processed, select "Edit Plan" in "Plan" in the menu bar. After successful selection of a plan, the settings can be adapted using *Edit project*.

6.6 Transferring a measuring plan to the Penetrologger

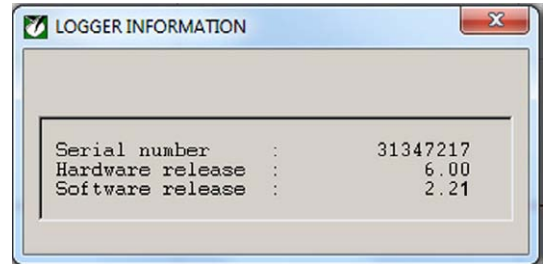
The plan created on the PC can now be transferred to the Penetrologger. For this purpose, the Penetrologger must first be connected to the PC.

1. Remove the protective cap on the communication connection of the Penetrologger. Then connect the communication cable to the communication connection. The connection only fits if properly installed. Insert the plug firmly and fasten the connection by screwing up the rotating ring.
2. Connect the other end of the communication cable to a serial communication connection of the PC.
3. Place an X next to the correct communication connection for the PenetroViewer at *Comm. Port* under "Tools" in the menu bar.
4. Now the Penetrologger can be switched on by pressing the top white button. If there are no batteries in the Penetrologger, these must now be inserted (see 11.1 "Power supply").
The PC will now automatically recognise the Penetrologger and activate the Datalogger menu in the menu bar.
5. In the next step, select *Identify* under *Datalogger* in the menu bar.

Then the Penetrologger is recognised by the PC. The display of the Penetrologger then shows the text "COMMUNICATION WITH YOUR PC WAS SUCCESSFULLY ESTABLISHED!".

The PenetroViewer possesses a "LOGGER INFORMATION" window with the serial number of the hardware and software versions.

Close this window to continue.



Logger Information window

6. Use *Send plan* in *Datalogger* in the menu bar to transfer the plan to the Penetrologger.

In a window, the operator guidance asks whether the plan is really to be transferred to the Penetrologger. Transfer the plan with *Yes*; abort the procedure with *No*.



When transferring a plan to the Penetrologger, all existing data in the Penetrologger (the plan including the possibly existing measuring data) are deleted. This is because the Penetrologger can only save one plan at a time. Before this, a warning will appear on the screen.

The Penetrologger is now ready for operation and can carry out measurements. If desired, the plan in the Penetrologger can still be adapted (see 7: "Creating a plan with the aid of the Penetrologger").

7. Finally remove the communication cable and screw the protective cap back on again.

7. Creating a plan with the aid of the Penetrologger

The direct creation of a plan in the Penetrologger has the advantage that the measuring plan can be created or processed in the field. This is of help, above all if one does not know exactly in advance how many and which plots are to be measured or which cone is to be used. As the default parameters can be used in the creating, the creation on site need not necessarily be time consuming.



The creation or processing of a measuring plan can only be carried out by means of Admin or PC software!

7.1 Operating the Penetrologger

The Penetrologger has 7 function buttons. The functions of the individual buttons can be seen in the display; in this the text appears in a dark block besides the respective keys. All menu functions are described in Appendix 2.

Key Function

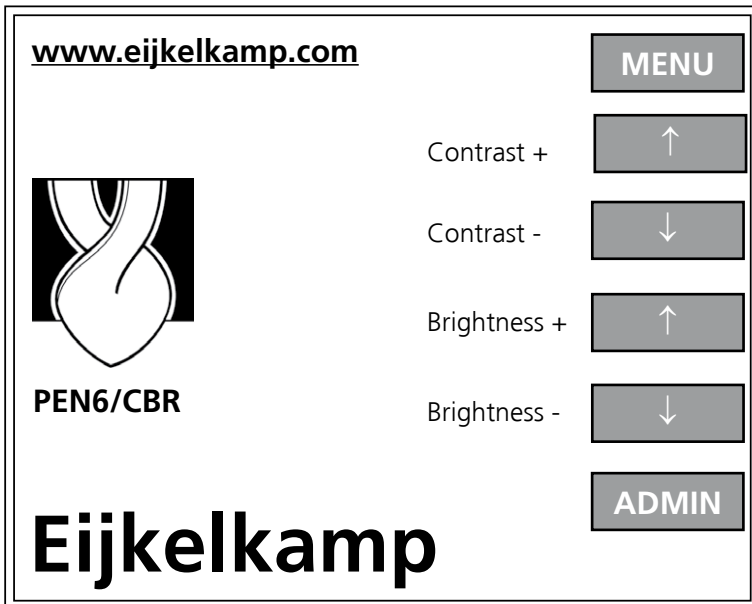
- | | |
|-----|--------------------------------|
| 1 | Switch-on button |
| 2 | Menu selection |
| 3-7 | Dependent on the selected menu |

1. Press Key 1 to switch on the Penetrologger. The start menu appears.



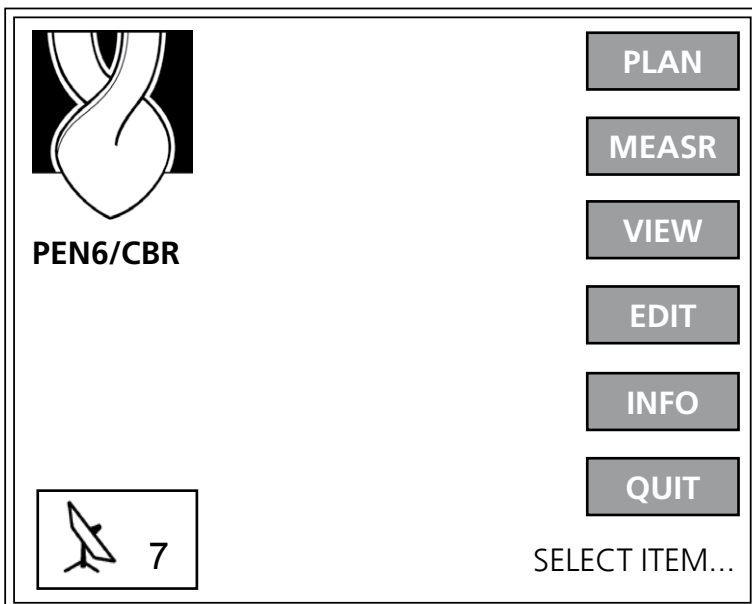
Operation of the Penetrologger

2. If desired, set the contrast and brightness of the LCD display with the arrow buttons.
A brighter screen adversely affects the battery life.



Setting contrast and brightness screen

3. Open the main menu with "MENU" (after the plan has been created either by means of Admin or PC software!)



Main menu screen

- * *PLAN* and *EDIT*, only visible as ADMIN
MEASR, only visible when a plan has been created.
VIEW, only visible after a measurement.
4. If a different language is desired, you can switch into your preferred language.
 1. For this, activate *EDIT* in the menu bar (depending on the current language).
 2. With the aid of the arrows, go to *SPRACHE [DEUTSCH]*, German, *IDIOMA Español*, *LANGUE Français* or *LANGUAGE [ENGLISH]* and confirm your choice with OK.
 3. In the next step, select *ENGLISH* depending on the chosen language. After a short period of time, the English language is activated.

7.2 Standard parameters and settings

Certain parameters are prescribed before creating a measuring plan. The corresponding values are then automatically applied during the creation of a plan and this saves a lot of time. In addition, certain settings of the Penetrologger can be defined.

1. Activate the "EDIT" key in the main menu. The "EDIT SYSTEM MENU" appears.

Edit system menu screen

2. In the "EDIT SYSTEM MENU", enter the standard parameters and the setting data of the Penetrologger. Here it is pointed out that the standard values are set without reference to the PenetroViewer. Thus, it is possible that there are different standard values on the PC and the Penetrologger!

However, the individual objects can be reworked in that the selected entry is chosen using the arrow buttons and confirmed with "OK". In the next step, use the horizontal arrows to go to the desired position and change the sign using the vertical arrows. The changes are confirmed with "OK" and the processing is ended; with "MENU" the display returns to the previous menu. The following is an overview of the "EDIT SYSTEM MENU".

Standard parameters

COMPANY	[BUNDESWR]	User name
DEPTHS CBR		CBR-1 (X) starting depth average calculation Ø CBR CBR 2 and 3 inactive CBR-4 (Y) End depth average calculation Ø CBR CBR-5 (End depth penetration)
PEN. SPEED	[2]	Penetration speed in cm/s The recommended constant speed is 2 cm/s with a maximum deviation of 0.5 cm/s (according to NEN 5140, 1996)
NR. OF PLOTS	[1]	No. of plots for the project (1 ... 1500).
PENETR./PLOT	[1]	No. of penetrations per plot (1... 20).
SHUT-OFF TIME	[10]	Time in minutes after which the Penetrologger shuts itself off. Choice poss. 1... 60 Min. Five beeps are heard immediately prior to the automatic shut-off function.
GPS	[On]	Switching the GPS function On and Off
MOISTURE	[Off]	Switching the optional soil moisture sensor On and Off.
LANGUAGE	[English]	Languages: Dutch, German, French, Spanish or English
DATE	[13-04-11]	Current date
TIME	[11:48:21]	Current time
CALIBRATION		The user cannot calibrate the Penetrologger himself!



The user cannot calibrate the Penetrologger himself. The calibration occurs in the factory and usually does not need to be adapted by the user.
Eijkelpamp Agrisearch Equipment recommends an annual works calibration control.

CLEAR MEMORY

Deleting the Penetrologger memory. After selection a box will appear with the question "DO YOU REALLY WANT TO DELETE THE MEMORY?" Confirm this with "YES" and depress this button for 5 seconds (whereby five beeps can be heard) in order to delete the memory of the Penetrologger. The procedure can be aborted with NO and the display returns to the "EDIT SYSTEM MENU".



The memory should only be deleted when it is certain that the current data (the plan and the possible measuring data) in the Penetrologger will no longer be used. The existing data are completely deleted!

7.3 Creating a measurement plan

1. In the Penetrologger only 1 plan can be created and saved at any one time. Therefore, before creating a new plan a possibly existing plan must be removed from the Penetrologger (if desired, first save the existing plan on a PC). The procedure is as follows:
 - ☐ Delete the memory of the Penetrologger (see Paragraph 7.2), or
 - ☐ Create the plan on the PC and transfer this to the Penetrologger, whereby the memory of the Penetrologger will first be automatically deleted.
2. In the next step, select "PLAN" in the main menu. This brings up the "PLAN MENU".
3. Now select a project and a plot with \uparrow PROJ, \downarrow PROJ, \uparrow PLOT or \downarrow PLOT.

Except for an already defined project, there now exists a new undefined project that can be recognised by the text "NEW PROJECT" at the bottom of the display. The corresponding project designation consists of a unique number that contains the following information: Year number – Month – Time - sequential number. A new project is created on the basis of this undefined "Empty project".

PLAN MENU		MENU
SELECT PROJECT		
PROJECT:	11041316	\uparrow PROJ
COMPANY:	BUNDESWR	\downarrow PROJ
PLOT:	PLOT-001	\uparrow PLOT
CONE CBR:	1.2 cm ² 30°	\downarrow PLOT
PEN. SPEED:	2	
NR. OF PLOTS:	4	
PENETR./PLOT:	3	
DEPTHS CBR:	10 - 20 - 30	
	40 - 50 cm	
NEW PROJECT		OK

Plan menu select project screen

The desired project is created with "OK". The "EDIT PROJECT" sub-menu now appears.

PLAN MENU
EDIT PROJECT

PROJECT: 11041316
COMPANY: BUNDESWR
PLOT: PLOT-001
CONE CBR: 1.2 cm² 30°
PEN. SPEED: 2
NR. OF PLOTS: 4
PENETR./PLOT: 3
DEPTHS CBR: 10 - 20 - 30
40 - 50 cm

NEW PROJECT

MENU
↑
↓
SAVE
EDIT

Plan menu Edit project screen

4. To edit the project, process the entries with "EDIT". There now appears the sub-menu with which various items can be adapted.

PLAN MENU

PROJECT: 11041316

MENU
←
→
↑
↓
OK

Plan menu Edit screen

The entries in the sub-menu can be changed with the aid of the arrow buttons. The changes are saved with "OK" or are aborted with "MENU" whereby the display returns to the "SELECT ITEM" menu. At this point it is pointed out that only the plot designations of the plot selected under point 3 can be changed.

5. The created project is defined with "SAVE".
Now the text "PROJECT DEFINED" appears at the bottom of the display.



The project is definitely saved with the definition. After this, neither the number of plots nor the number of penetrations per plot can be changed!

6. With "OK" or "MENU" the display returns to the "SELECT PROJECT" menu. If desired, the remainder of the plot designations of the defined project can be changed with the working steps 3 and 4.
7. If desired, more projects can be created with the process steps 3-5.
8. Return to the main menu with "MENU" and end the plan data entry.

7.4 Processing a measuring plan



Once a project has started, the number plots and the number of penetrations per plot can no longer be changed. It is also not possible to remove an individual project from the plan.

1. Switch on the Penetrologger and open the main menu.
2. Now run through the steps 3 and 4 of Paragraph 7.3.

If measurements within the scope of a project have already taken place, then the project can no longer be changed. However, the affected project can still be selected with "PLAN MENU" but in this case the OK button is not active. The text "PROJECT ACTIVATED" appears at the bottom of the display and "PLOT ACTIVATED" appears under the relevant plot.

3. Return to the main menu with "MENU".

Information

in the case that a project is unusable due to an entry error or a changed situation, then two possibilities present themselves:

- ☐ Definition of a new project, whereby the unusable project remains in the plan. However, here it must be ensured that only valid projects are selected for the measurements.
- ☐ Deletion of the whole plan in that the memory of the Penetrologger is deleted and a new plan is created. But here one must not forget that all the data saved in the memory of the Penetrologger (the plan as well as all the measuring data) will be deleted! Details on deleting the Logger memory can be found in Paragraph 7.2.

8. Carrying out the measurements

Before the measurement, certain aspects should be checked in the "SYSTEM INFO MENU" (select "INFO" in the main menu for this):

- ☐ GPS satellite information
- ☐ The current date and time
- ☐ The battery. The type of battery and the remaining capacity of the battery in % (is shown based on the battery voltage). A value of 100% corresponds to a full battery.
- ☐ Service counter: Overall counter.
- ☐ The serial number of the Penetrologger
- ☐ The software version.
- ☐ The hardware version.
- ☐ The number of carried out measurements (penetrations) in the memory.
- ☐ The number of remaining measurements ("Reserved").



Background lighting and contrast settings menu is selected with the accompanying button.



Switch loudspeaker On or Off with the relevant button.

1. Install the associated (three-part) probe rod and screw the cone on tightly. Use suitable tools for tightening. Then screw the probe rod with the coupling into the Penetrologger and tighten the screw.



The fastening should be carried out by light hand-tightening (in order to avoid damaging the force sensor).

The cone wears out with use. For this reason, its dimensions must be checked before use with the Conecheck key. If the cone can be pushed through the Conecheck key (see 2 "Description"), then the cone is unsuitable for reliable measurements. Also asymmetrically worn sounding points are impermissible.

3. Optional: Connect the soil moisture sensor to the communication port of the Penetrologger.

The instrument is ready for use after completed data entry (Plan/project/plot) and installation of the Penetrologger.

4. Switch on the Penetrologger.

The GPS determination takes longer when the Penetrologger is used in a particular area for the first time. The time for subsequent measurements is shorter (< 8 seconds),

5. Select "MEASR" in the main menu.

This brings up the "MEASUREMENT MENU" in which the desired project is selected. Also the project settings entered appear here.

MEASUREMENT MENU		MENU
SELECT PROJECT		
PROJECT:	11041316	↑ PROJ
COMPANY:	BUNDESWR	
PLOT:	PLOT-001	↓ PROJ
CONE CBR:	1.2 cm ² 30°	
PEN. SPEED:	2	
NR. OF PLOTS:	4	
PENETR./PLOT:	3	
DEPTHS CBR:	10 - 20 - 30	
	40 - 50 cm	
PROJECT DEFINED		OK

Measurement menu window

Now select the desired project and confirm your choice with "OK".

This brings up the measurement screen. Now the first plot of the selected project can be measured.

MEASUREMENT MENU		
L D E P T H C M S 0 70	PROJECT: 11041316	X-V CM
	PLOT: PLOT--001	Ø CBR
	PENETR.: 1	---

		MENU
		START
		Act
		0
		Depth
		70
		CBR (0-15)
0 3 6 9 12		

Measurement screen

☞ The plots can only be measured in the sequence of their definition.

6. Place the depth reference plate horizontally on the ground with the two turned-up edges facing downwards. Push the cone of the Penetrologger through the opening of the depth reference plate into the ground. For the following reasons, attention must be paid to an optimal vertical direction:
 - ☐ Distribute the force as evenly as possible over both grips (too-great force differences can damage the force sensor).
 - ☐ The vertical direction is checked by the level gauge of the Penetrologger. In this the slant angle of the Penetrologger must not deviate by more than 3.5° from the vertical. This is to prevent that the friction between the rod and the soil influences the penetration resistance value.
 - ☐ In order to ensure correct depth measurement, an ultrasound sensor serves for measuring the penetration depth. The ultrasound signals sent by this sensor are reflected at the depth reference plate and return from it to the sensor.

☞ In order to obtain reliable measurements from the ultrasonic sensor, it is recommended in strong wind to place oneself with the back to the wind (certain wind noises can disturb the ultrasonic measurements).




Measuring with the Penetrologger

7. Select "START" to begin the measurement.
 - If "Moisture" is on "Yes" (see Paragraph 7.2) then the Penetrologger displays: *Set Thetaprobe and press Start*. Then the soil moisture percentage is shown first: *SAVE Thetaprobe...% VOL. ?*
 - If this is OK, select YES (percentage is saved).
 - With a renewed press on START, a start can be made with the penetration resistance measurement.

8. After pressing "START" the penetrologger wants to null the force sensor.

In the nulling proces you may be asked to relief the force ("RELIEF FORCE !!")of the sensor by lifting the instrument and confirm with the "OK" key.


MEASUREMENT MENU		
PROJECT:	11041316	X-V CM
PLOT:	PLOT--001	Ø CBR
PENETR.:	1	---

RELIEF FORCE !!		
OK		
 0		

Measurement screen

If the nulling proces is not within specifications you can continue but the message "UNCALIBRATED" will appear and the file name will be changed for the first four characters by "!!!!" (i.e. filename 11041316 will change in !!!!1316).

MEASUREMENT MENU		
PROJECT:	!!!!1316	X-V CM
PLOT:	PLOT--001	Ø CBR
PENETR.:	1	---

UNCALIBRATED !!		
OK		
 0		

Measurement screen

Confirm with the "OK" key.

9. Now press the Penetrologger evenly and as vertically as possible with constant speed into the soil according to the measuring plan. At the recommended speed of 2 cm/s, the prescribed depth of 70 cm is reached in about 40 seconds.

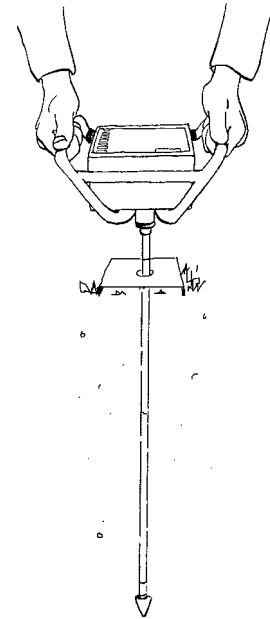
In the display there appears the deviation from the prescribed speed (± 40 percent) in form of a speed indicator. If the penetration depth falls above or below the permissible range (whereby the Logger will emit a beep at 30 percent), the measurements are aborted as in this case no representative result can be obtained.

If the speed display shows a deflection downwards (to "S"), then the advance is too fast. In this case, one should press slower into the soil.

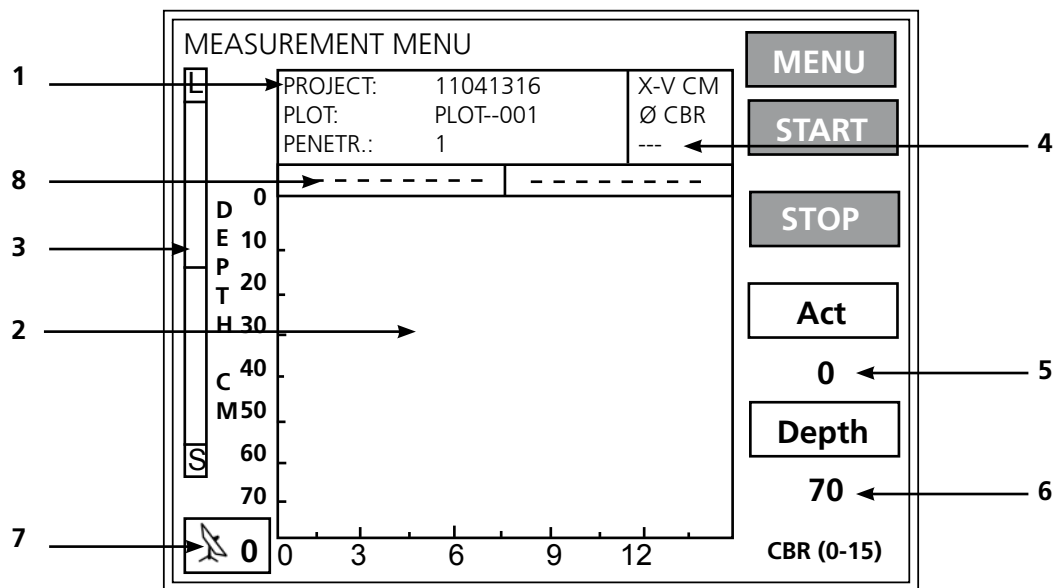
If, in contrast, there is a deflection upwards (to "L"), then the advance is too slow. In this case, one presses the instrument quicker.

With a penetration speed that is too fast, a warning appears on the screen "MEASUREMENT INVALID". Select "STOP" to end the measurement; the data are not saved.

With a penetration speed that is too slow, a warning also appears on the screen "MEASUREMENT INVALID". However, here it is possible to save the data.



The Penetrologger is pushed into the soil



Measurement screen

Various parameters can be read off in the "MEAS MENU" window.

1. Short project description (PROJECT)
2. Graphic representation of depth and associated CBR.
3. Penetration speed
4. Average value CBR ($\bar{C}BR$)
5. Current CBR (ACT)
6. Penetration depth in cm (DEPTH)
7. Status of GPS connection
8. GPS coordinates

The average Ø CBR is an indicative value that is rounded down. It is always rounded down to whole numbers. The current and graphic CBR values are un-rounded measuring values.

If the sensor during the measuring is not in a position to receive the ultrasonic signals and no correct depth measurement can be measured, then the sign " - - - " appears in place of the actual depth display. In this case the measurement should be aborted.

10. When the end depth of, for instance, 70 cm is reached, then the measurement is ended. The measurement can be aborted early with "STOP" if one cannot reach the maximum depth or does not want to. Answer the question as to whether the measurement is to be saved with "YES" (measurement, GPS coordinates, possibly soil moisture percentage are saved) or "NO" in order not to use the measurement or to repeat it.

In the case that the depth belonging to CBR 1 is not reached, then the message "MEASUREMENT INVALID" appears. Select Canc. to end the measurement, the data are not saved.

The screenshot shows the 'MEASUREMENT MENU' interface. On the left is a vertical depth scale from 0 to 70 cm, with a black bar indicating the current depth. Below the scale is a small icon of a probe and the number '5'. The top section contains project data: PROJECT: 11041316, PLOT: PLOT--001, PENETR.: 1. To the right of this is a box for 'X-V CM' and 'Ø CBR', which currently shows '---'. The center of the screen displays a large box with the text 'MEASUREMENT INVALID'. On the right side, there are several buttons: 'MENU', 'START', 'CANC.', 'Act', '0', 'Depth', '70', and 'CBR (0-15)'. The bottom of the screen has a horizontal axis with markers at 0, 3, 6, 9, and 12.

Measurement screen measurement invalid

11. If desired (depending on the prescribed number of penetrations per plot) a further repeat measurement at the same plot can be carried out. For this purpose, choose a position at least 1 m away from the other measuring position(s) so that the measurements do not influence one another. Also the remaining penetrations are now carried out.

The screenshot shows the 'MEASUREMENT MENU' interface. The top section contains project data: PROJECT: 11041316, PLOT: PLOT--001, PENETR.: 1. To the right of this is a box for 'X-V CM'. Below the project data are two boxes for coordinates: 'N51°59.335' and 'E006°03.332'. The center of the screen displays a large box with the text 'PLOT READY'. On the right side, there are several buttons: two empty buttons at the top, and an 'OK' button at the bottom. The bottom of the screen has a horizontal axis with markers at 0, 3, 6, 9, and 12. A small icon of a probe and the number '5' are visible in the bottom left corner.

Measurement screen plot ready

9. Processing the measuring data

9.1 Reading out on the PC

1. In order to read out the measuring results, connect the Penetrologger to the PC. See working steps 1-4 in Paragraph 6.6
2. Now select "*Read data*" under "*Datalogger*" on the menu bar.
All measuring results (only the actual measurements) are transferred from the Penetrologger to the PC.
3. After the reading out of the data on the PC, a separate file with the suffix "**.pen*" is created for each defined project. A window appears for each individual project, in which the file name is entered: here also select the desired folder.
4. Finally, switch the Penetrologger off, remove the communication cable, and screw the protective cap of the communication connection tight.



Processing data on the PC

9.2 Display on the PC



The file name is displayed on the title bar.

The measuring results can be displayed on the PC. In this, the measuring results – broken down according to projects – can be shown selectively in graphic or numeric form. The project data are also suitable for processing in spreadsheet format.

9.2.1 Opening and closing a project file

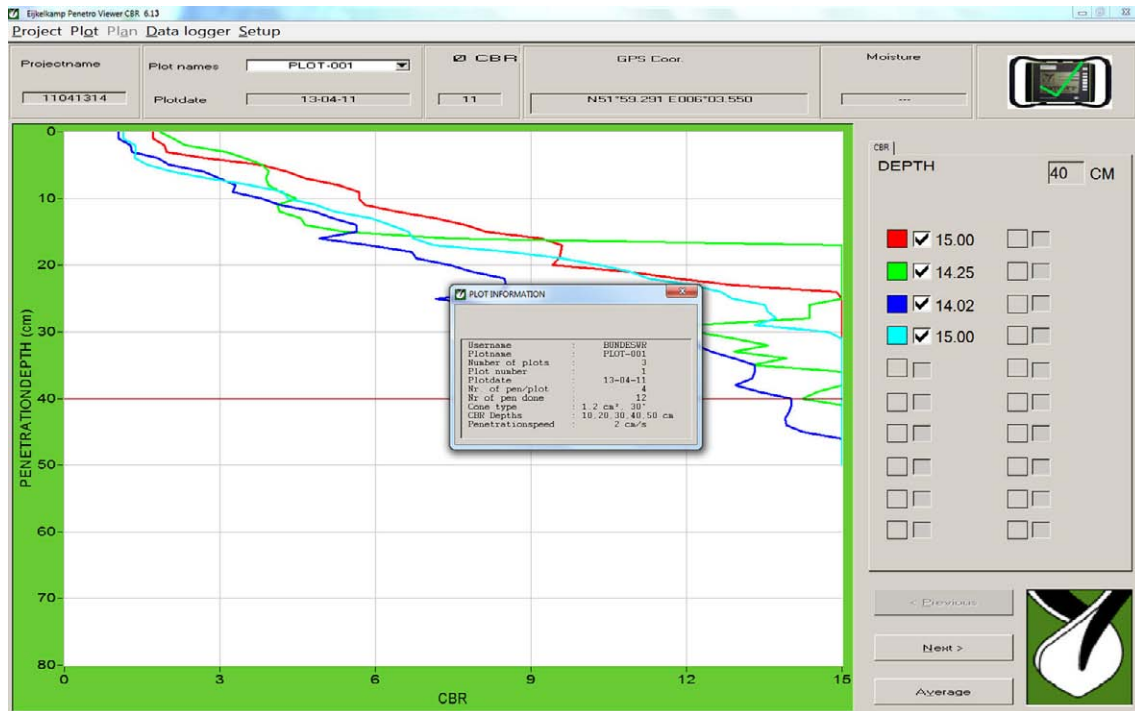
1. First select *Open* under *Project* in the menu bar. Then select the desired "*.pen*" file (Project) in the folder in question. The file is opened with *Select*.
The example file "*Example.pen*" is a standard file in the program folder of the PenetroViewer.

As soon as a file is opened, there will appear a graphic depiction of the plot results; now the Plot menu is also available in the menu bar.

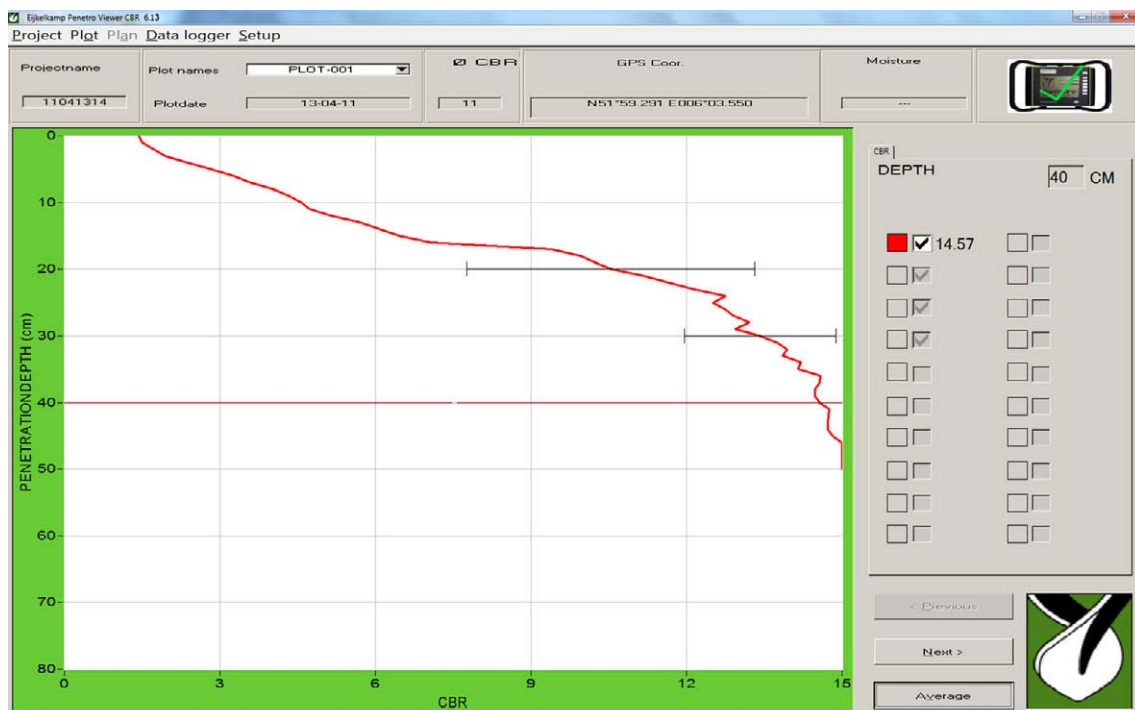
2. In order to close a given project file, select *End* under *Project* in the menu bar.

9.2.2 Graphic depiction

The following options are available in the graphic depiction of the results (see pictures):



All measurements are displayed



Graphic depiction of one measurement

- ☐ All measurements (penetrations) for the plot in question appear here as standard. A particular measurement can be faded out or selected again by means of a mouse click on a coloured box beside the graphic.

- ❑ The results of the previous or the next plot can be called up with the aid of the *"Previous"* or *"Next"* buttons at the right or under *"Plot"* in the menu bar.
- ❑ The average value of all selected measurements of the plot in question can be called up by activating the *"Average value"* button.
If only three of the ten measurements are selected (whereby the rest are faded out by mouse click on the coloured boxes), then the average value of these three measurement results are given. This is used in the case that disturbance values are to be eliminated. The average values of at least 2 measurements are calculated and will also give the standard deviation at every 10 cm.
- ❑ A repeated pressing on *"Average value"* brings all the individual lines up again.
- ❑ If the depiction of the lines is to be changed, use *"Line Type"* under *"Plot"* in the menu bar. Here there is a choice between *"Line"*, *"Points"* and *"Bold line"*.
- ❑ The matrix in the graphic depiction can be faded in or out in that a cross is placed next to *"Grating"* under *"Plot"* in the menu bar.
- ❑ The horizontal measuring line in the graphic area can be shifted upwards or downwards with a mouse click in that it is either pulled with the mouse or the desired position is clicked (alternatively one can make use of the cursor keys on the keyboard).
The depth (in cm) belonging to the depth display is shown under *"DEPTH"* next to the graphic area. Under *"PRESSURE"* the respective colour and the numerical value (MPa) for the depth mentioned in the measuring line is shown for all measurements of the plot.
- ❑ The corresponding measurement is shown under *"CBR value"* above the graphic display, the GPS coordinates are shown under *"GPS coordinates"*, and the soil moisture percentage is shown under *"Soil moisture"*.

9.2.3 Numeric depiction

First select "Numeric" under "Plot" in the menu bar in order to call up a numeric overview of the currently selected measurements (penetrations).

This brings up a measurement value for every centimetre of depth. If the average line is shown in the graphic depiction, then the numeric data of the average value and the respective standard deviations are displayed. In addition, all plot-referenced information appears.

Depth	Pen 1	Pen 2	Pen 3	Pen 4
0	1	1	1	1
1	1	2	1	1
2	1	2	1	1
3	1	3	1	1
4	2	3	1	1
5	3	3	2	1
6	4	3	2	2
7	4	3	2	2
8	5	3	3	3
9	5	4	3	4
10	5	4	3	4
11	5	4	4	4
12	6	4	4	5
13	7	4	5	5
14	7	4	5	6
15	8	5	5	6
16	9	7	4	6
17	9	15	5	7
18	9	15	6	8
19	9	15	6	9
20	9	15	7	10
21	10	15	7	10
22	11	15	8	11
23	12	15	8	12
24	14	15	8	12
25	15	15	7	12
26	15	14	8	13
27	15	14	8	13
28	15	14	9	13

Numeric depiction of all measurements

The minimum measuring value/penetration resistance determines the carrying capacity of the area.

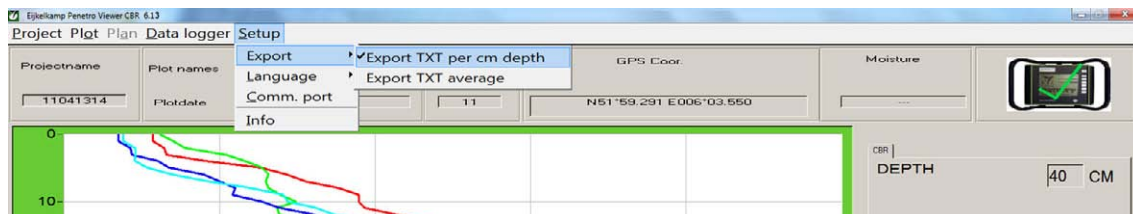
Depth	AVG	STD
0	1	0
1	1	0
2	1	0
3	1	0
4	2	0
5	2	1
6	3	0
7	3	0
8	4	0
9	4	0
10	4	0
11	4	0
12	5	0
13	5	0
14	6	1
15	6	1
16	7	1
17	9	3
18	9	3
19	10	2
20	10	2
21	11	2
22	11	2
23	12	2
24	12	2
25	12	3
26	12	2
27	12	2
28	13	2

Numeric depiction of the average value

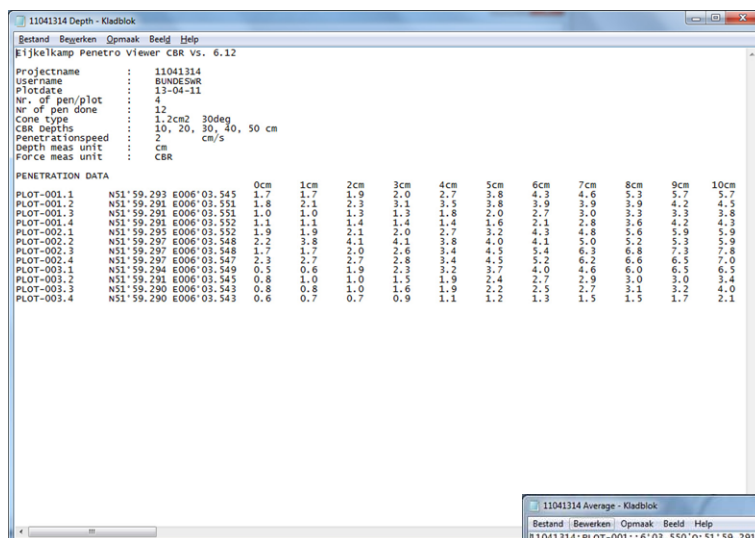
9.2.4 External processing of the measuring results

- It is possible to save the lists as a text file (ASCII) with the suffix **.txt*. For this purpose, select *Export TXT file per cm depth* under *Setup* / *Export* in the menu bar. In this the measuring results up to this point (selected measurements or average values with standard deviations) are saved.

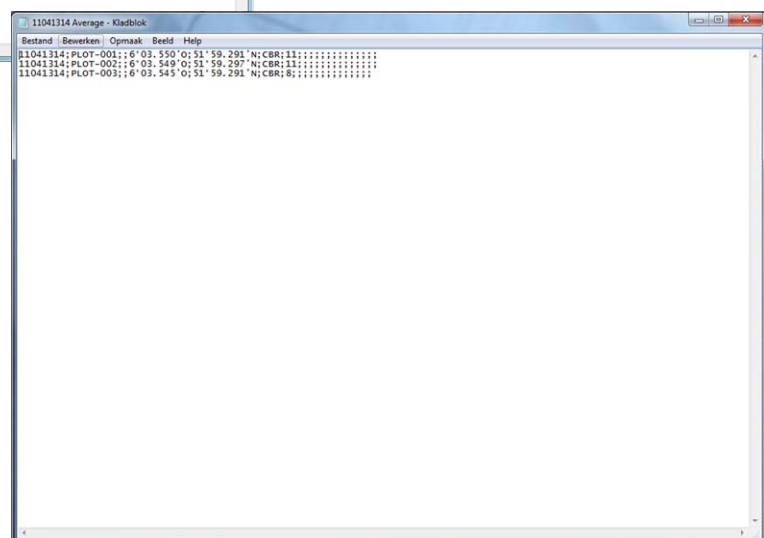
A choice can be made between a long and a short version in the **.txt* export format. The short version is suitable for further processing, for instance, in the *Go-Book* PC.



Saving data as text



Text file per cm depth



Text file average value

- ❑ The “*pen*” files can be read directly into a spreadsheet and can then be arranged horizontally. A maximum of 20 lines (a maximum of 20 measurements are possible per plot) contain 81 data columns (0-80 cm depth).
- ❑ The measuring data are saved in a file with the suffix “.*pen*” in CBR in percentage.

However, the measuring data can also be saved as a text file “*.txt” (menu option “*Project*”, “*Save as text*”). In this file the measuring data are saved as penetration resistance data in Megapascal). For reading in text files, for instance in Excel: “*Open file, Type of file: All files*”. Import in the *Wizard text*: then select *Type of file*, then *Tab and Space as a separator*, and end the routine with *Close*.

9.3 Display on the Penetrologger

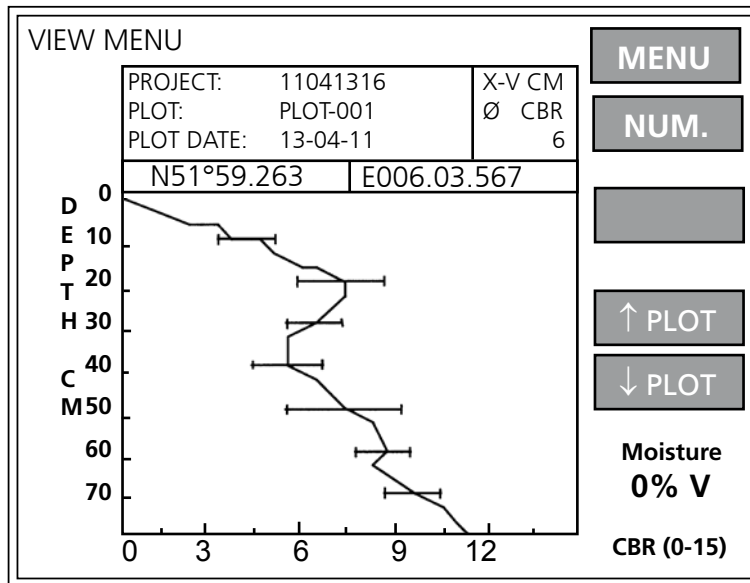
1. First select “*VIEW*” in the main menu in order to view the penetration measurements on the display of the Penetrologger. The “*VIEW MENU*” appears.
2. Now select a project and a plot and confirm this with *OK* in order to call up the graphic results.

VIEW MENU	MENU
SELECT PROJECT	
PROJECT: 11041316	↑ PROJ
COMPANY: BUNDESWR	
PLOT: PLOT-001	↓ PROJ
CONE CBR: 1.2 cm ² 30°	
PEN. SPEED: 2	↑ PLOT
NR. OF PLOTS: 4	
PENETR./PLOT: 3	↓ PLOT
DEPTHS CBR: 10 - 20 - 30 40 - 50 cm	
PROJECT COMPLETED	OK
PLOT COMPLETED	
30-03-11	

View menu screen

The “*GRAPHIC RESULTS*” window appears with the average values of the individual penetrations for the relevant plot. The standard deviation (as far as possible) is displayed for every 10 cm in a horizontal line. If the standard deviation is too small then this line will not appear.

3. A numerical depiction of the results can be called up with “*NUM*”.
In this the average CBR value per centimetre depth is shown for the relevant plot.
4. Return to the graphic display with “*GRAPH*”; the “*RESULTS MENU*” is again called up by opening *MENU*.
5. Return to the main menu with “*MENU*”.



Graphic results window

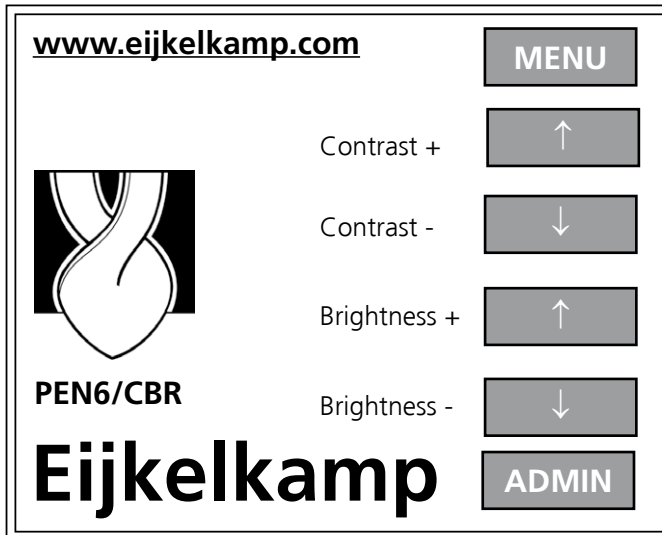
9.4 Printing out on a PC

The measuring results can be printed out in numerical or graphic form with PenetroViewer whereby a printer or plotter can be used as desired. Depending on the selected depiction, either the individual penetrations of a plot or the average value with the associated standard deviation can be printed out.

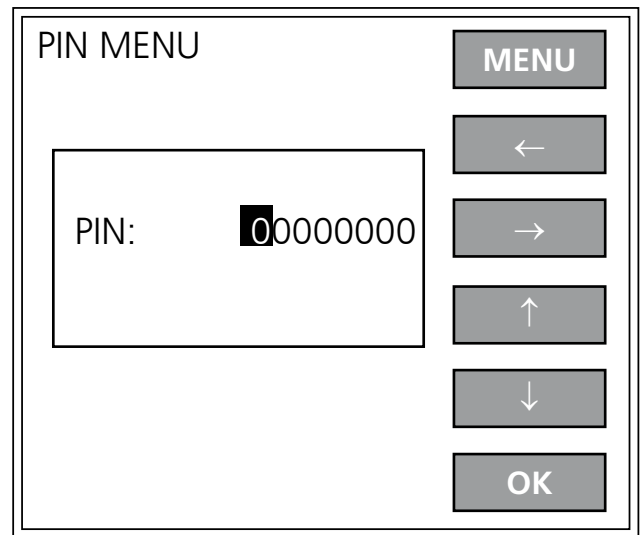
- ☐ Select "Graphic" with the "Print" entry under "Project" in the menu bar in order to print out the graph.
- ☐ Select "Numeric" with the "Print" entry under "Project" in the menu bar in order to print out the numeric results. The printer resolution is a maximum of 300 dpi. All the results of a plot are printed out as standard. In contrast to the spreadsheet, the selection of a measuring line is not possible in this case.

9.5 Programmable Administrator User

It is possible to protect the Penetrologger by means of a password. In this case, the "Plan" and "EDIT" menu points no longer appear in the Penetrologger menu. On switching on the Penetrologger, the standard mode is user. In this the "Plan" and "EDIT" functions are not available. "Administrator" rights are obtained with the entry of the correct PIN code.

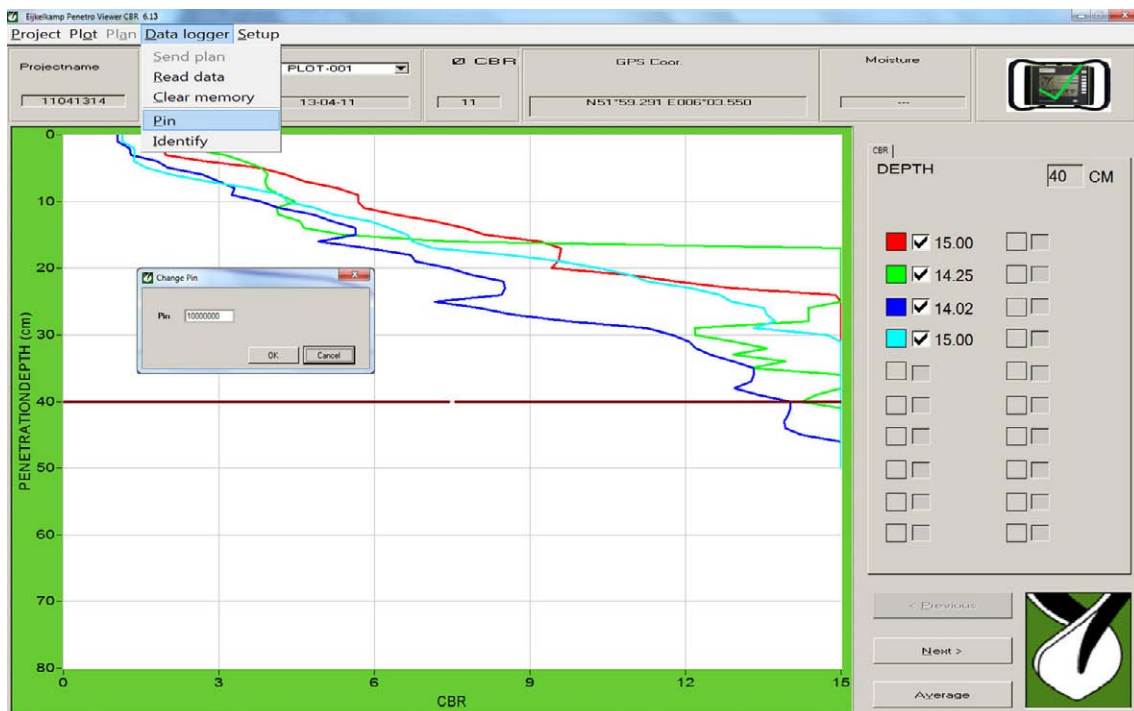


Start screen for Administrator



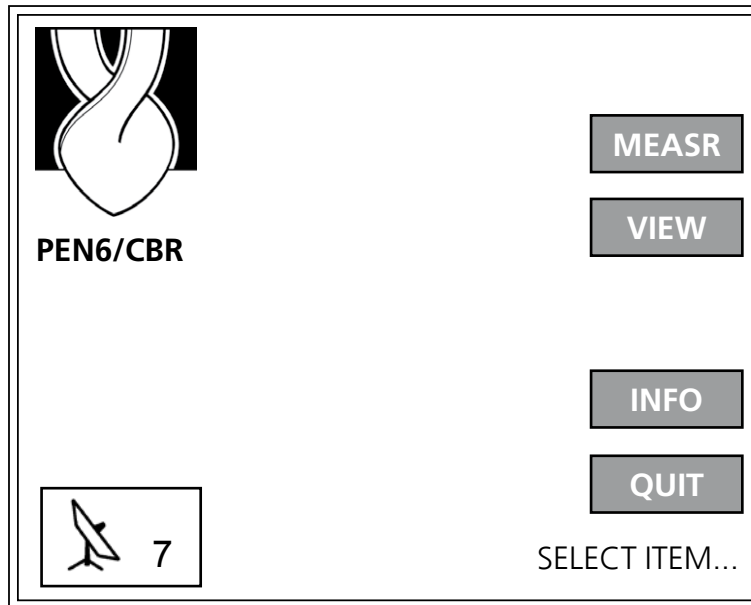
Enter PIN code screen

The PIN code (e.g. 10000000) for the administrator is defined at the computer via the PenetroViewer software. When the PIN code is set, e.g. to 10000000, the Penetrologger has "Administrator" with all functionalities.



Defining the PIN code

For the PenetroViewer CBR software the computer usually requires Windows Access passwords and User/Administrator rights. The utilisation as administrator is handled by Windows and can be defined by the user if necessary. The PIN code is transferred to the Penetrologger per communication and can be changed by the administrator in the PenetroViewer CBR.



Start screen for "User"

10. Problems and their removal

10.1 Communication between the PC and the Penetrologger

- ❑ The *Datalogger* menu of the PenetroViewer CBR is not available although the Penetrologger is connected to the PC via the communication cable.
 - First check whether the correct communication connection is set at the *Comm. Port* under *Tools* in the menu bar.
 - Check whether the Penetrologger is switched on (a menu appears on the display).
- ❑ The *Datalogger* menu of the PenetroViewer CBR is available although the Penetrologger is not connected to the PC via the communication cable.
 Another instrument is connected to the PenetroViewer CBR communication connection. However, this is no problem for the function of the PenetroViewer CBR.

10.2 Operating the Penetrologger

- ❑ The depiction of the display is fuzzy. Change the depiction settings with the vertical arrows in the start menu or in the *"CONTRAST"* or *"BRIGHTNESS"* entry in the *"START MENU"*.
- ❑ The *"MEASR"* option in the main menu is not available. First create a measuring plan on the PC or directly on the Penetrologger via *"PLAN"*.
- ❑ The *"VIEW"* option in the main menu is not available. First carry out the field measurements.
- ❑ The Penetrologger switches off between two measurements. Increase the switch-off time in the *"EDIT SYSTEM MENU"*.
- ❑ The batteries are empty. Replace the batteries.

10.3 Creating a measurement plan

- ❑ The Penetrologger or the PenetroViewer CBR does not permit the creation of a new measuring plan. First delete the current plan (Paragraph 6.4.2); it can possibly be saved first.
- ❑ A new project cannot be defined.
The highest number of 1500 measurements is already reserved so that the plan is "full". Possibly a new measuring plan can be defined with the PenetroViewer CBR or one can arrange the current plan differently.
- ❑ The projects have been incorrectly defined or changed.
 - Penetrologger. A defined project cannot be individually deleted from the plan. This problem can be solved by defining new projects and simply ignoring the incorrectly defined projects in the measurements.
If, however, due to the incorrect creation, the highest number has already been reserved, then this measuring plan cannot be used any further. In this case, delete the whole plan and create everything from scratch.
 - PenetroViewer CBR. Delete or process the projects.
- ❑ During the measurements it becomes obvious that the number of plots and the number of penetrations per plot need to be changed. If additional plots are to be measured, then create a new project for the plots in question.
- ❑ Several measuring plans cannot be used at the same time.
Create all the measurements for a field measuring day within a single plan. If, however several plans are to be used, then this can be achieved in that in the field the measuring results are read into a laptop and then a new measuring plan is sent to the Penetrologger.

10.4 Carrying out the measurements

- ❑ " - - - " appears under "Depth" in the "MEASUREMENT MENU" (during the speed display it occasionally sends out signals).
This means that the depth measurement is interrupted in that the sensor does not receive the transmitted ultrasonic signals. In this case, abort the measurement without saving the results. The following must then be taken into account in the next measurement:
 - Check whether the Penetrologger is really aligned vertically (maximum deviation; 3.5°).
 - During measuring, turn your back to the wind; ensure that during the measurement there is no piece of clothing or similar between the ultrasonic sensor and the depth reference plate.
 - Ensure that during the measurement there is no clothing or similar between the ultrasonic sensor and the depth reference plate.
 - Also ensure that the depth reference plate is placed exactly horizontally on the ground.
 - Check whether the sensor is moist and this is falsifying the measuring values. If, for instance, the Penetrologger is taken from a cool room to a warmer one (or reverse), then condensate can form on the ultrasonic sensor of the Penetrologger and in this way influence the depth measurement. For this reason, one should allow the Penetrologger a certain acclimatising time so that this condensate can condense off before starting the measurements.
- ❑ The measurement is aborted due to the Penetrologger being pressed into the soil too quickly or too slowly.
If the speed display moves upwards (left in the display), then one should advance the instrument faster. If, on the other hand, the speed display moves downwards, then one should advance slower into the soil.
- ❑ During the measurement the cone at some point reached a depth limit and cannot be pushed deeper into the soil. This can be due to the cone having encountered an impermeable layer such as a gravelly or stony layer or a layer with waste products. In this case the measurement must be aborted.
- ❑ The internal GPS does not receive a signal. There are interfering objects in the vicinity, and satellite signals cannot be received. Choose another measuring position.

10.5 The PenetroViewer CBR

- ❑ The attempt to print out a graphic depiction of the plot results is unsuccessful. In this case, ensure that the printer is set to a maximum of 300 dpi (dots per inch).
- ❑ The graphic printout is broken off at the edge of the paper. In this case it is best to print out the data with a spreadsheet program.

10.6 Resetting the Penetrologger

The Penetrologger can be Reset (in case of a crash):

1. Switch off the Penetrologger.
2. Switch on the Penetrologger with the On/Off switch and keep the On/Off switch depressed for 3 seconds.
3. The Penetrologger is now reset and all screen functions are set again. The memory with all measurements is unchanged.

11. Power supply GPS, LCD and servicing

11.1 Power supply

The Penetrologger is provided with power by means of a battery pack

1. Battery

The proposed SEM52 (Friwo) battery of the German Armed Forces is used for the power supply. The 8.4 V lithium battery is not rechargeable. The internal battery chamber is easily accessible in the housing. Alternatively, use can be made of the 12 V battery holder type BH8AA Büro Becker GmbH. This can hold 8 non-rechargeable batteries type L91- Ultimate Lithium (1.5V/200mAh) of the Energizer Company. The type of battery is automatically recognized when using the 8.4 V/12 V batteries (E or F in the display: see Picture on Page 34).

All settings such as intensity and contrast settings are automatically saved in the permanent memory and are even saved when the battery is replaced or not installed.



Lithium batteries have a high energy density for a small size. Therefore this type of battery must be handled with particular care.



Never short-circuit lithium batteries or operate them with incorrect poles!

There is danger of overheating and explosion. Prevent random short circuits and for this reason, do not store them in metal containers and do not place them on metal surfaces. Store the batteries in dry rooms or protected from moisture.

Protect battery contacts in order to prevent short circuits.



Never recharge lithium batteries!

Lithium batteries are primary elements and cannot be recharged. Attempts to recharge lithium batteries lead to overheating and possible explosions.



Dispose of lithium batteries in an environmentally-friendly manner!

Do not open lithium batteries and never throw them in the fire; danger of explosion!

Do not dispose of lithium batteries in house waste but in an environmentally-friendly manner according to the communal regulations.

2. Checking the remaining capacity:

The battery display (in 10-percentage steps) also appears in the "SYSTEM INFO MENU" on the display of the Penetrologger (see also 8 "Carrying out measurements"). The Penetrologger emits a clanking sound when the batteries are empty. There now remains a measuring time of 5 minutes after which the Penetrologger switches itself off.

With a remaining capacity of 2%, the Penetrologger begins to beep (three short beeps every 5 seconds). However, with a remaining capacity of 0%, the "Battery empty" message appears after which the Penetrologger switches in 5 seconds.

3. Battery life:

Minimum use / battery life is 600 measurements in the temperature range of -10°C to 50°C. The useful life depends on the intensity of the background lighting. Carrying out of 300 measurements presents no problems with the use of the recommended SEM52 battery. A duration of use of 6-8 hours is realistic.

11.2 GPS Receiver





The GPS makes use of different corrections in the receipt of SBAS satellites (WAAS, EGNOS) with DGPS corrections and is equipped with an active GeoHelix-H 20dBi antenna.

Information can be found in the *SYSTEM INFO MENU*.

The number of satellites received is shown ("S 7") and if there is no satellite reception possible then the measurements can also be saved without GPS registration.

Communication NMEA protocol (CATI coordinates C). Letter *E*: (from Egnos) *S* refers to standard GPS measurements. *E* refers to Egnos satellite found.

The satellite corrections are implemented and the specifications are checked to 2 exact reference points by Eijkelkamp.

SYSTEM INFO MENU		MENU
	S: 7 -N51°59.318	
	E: S E006°03.407	
Datum:	30-03-12	
Time:	13:29:43	
Batt:	F  99%	
Service counter	14	
Serial number	31347217	
Software release	2.21	
Hardware release	6.00	
Penetrations done	1	
reserved	35	
available	1464	

System info menu window

11.3 LCD screen with background lighting

The colour of the screen is green with black characters. The intensity of the background lighting and the contrast setting can be controlled by the user during the start window display. It is only thought of for dark surroundings. The background lighting is switched off completely when the intensity is set to minimum. All settings such as intensity and contrast are automatically saved in the permanent memory.

11.4 Service

- ☐ Care must be taken that the instruments are kept clean during and after use. Soil that has dried on the cone increases the measuring values for the penetration resistance.
- ☐ During use the ultrasonic sensor must be kept dry in order not to falsify the depth measurements.
- ☐ Eijkelkamp Agrisearch Equipment recommends that the Penetrologger is serviced and calibrated once a year by the manufacturer.

Literature

W.P.M. Black, 1979. TRRL Laboratory report 901. The strength of clay subgrades, its measurement by a penetrometer

Erik W. Hansen, Major, USAF AFIT/GMO/ENS/02E-06 (2002 GRADUATE RESEARCH PROJECT) EVALUATING THE C-17 SEMI-PREPARED RUNWAY CAPABILITY – AN OFF-ROAD MAP

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Appendix 1 Penetrologger menus

START MENU

MENU	The MAIN MENU opens
↑	Contrast setting of the display (+)
↓	Contrast setting of the display (-)
↑	Brightness of the display (+)
↓	Brightness of the display (-)
ADMIN	Administrator log-in screen

ADMIN MENU

PIN MENU

MENU	Annul the successful changes and return to the SELECT ITEM menu
←	Go back one step
→	Go forward one step
↑	Replace with the following number (choice of 0 .. 9)
↓	Replace with the previous number (choice of 0 .. 9)
OK	Confirm change and return to the SELECT ITEM menu

MAIN MENU

PLAN	Open the PLAN MENU in order to create the measuring plan
MEASR	In connection with the measurements open the MEASUREMENT MENU (available when the measuring plan is defined)
VIEW	For depicting the measuring results, open the VIEW MENU (available when measurements have been carried out and have been saved)
EDIT	Open the EDIT SYSTEM MENU in order to set the preference parameters
INFO	System information is to be taken from the SYSTEM INFO MENU
OFF	Switching off the Penetrologger

PLAN MENU

SELECT PROJECT

MENU	Return to the MAIN MENU
↑ PROJ	Select the previous project
↓ PROJ	Select the next project
↑ PLOT	Select the previous plot
↓ PLOT	Select the next plot
OK	Select this project and this plot and open the SELECT ITEM menu

PLAN MENU

SELECT ITEM

MENU	Return to the SELECT PROJ menu
↑	Select the previous entry
↓	Select the next entry
SAVE	Define the project (available when creating a new plan)
EDIT	If the settings of the selected entry are to be changed, open the EDIT ITEM menu.
OK	Return to the SELECT PROJ menu (Only available with a defined project)

PLAN MENU

EDIT ITEM

MENU	Annul the successful changes and return to the SELECT ITEM menu
←	Go back one step
→	Go forward one step
↑	Replace with following characters (choice of 26 letters, 10 numbers, "-" or empty space)
↓	Replace with previous characters (choice of 26 letters, 10 numbers, "-" or empty space)
OK	Confirm change and return to the SELECT ITEM menu

MEASUREMENT MENU

SELECT PROJECT

MENU	Return to the MAIN MENU
↑ PROJ	Select the previous project
↓ PROJ	Select the next project
OK	Select project and open the MEAS MENU

MEASUREMENT MENU

MENU	Return to the SELECT PROJ menu
START	Start measuring
STOP	End measuring

VIEW MENU (result menu)

SELECT PROJECT

MENU	Return to the MAIN MENU
↑ PROJ	Select the previous project
↓ PROJ	Select the next project
↑ PLOT	Select the previous plot
↓ PLOT	Select the next plot
OK	Select this project and this plot and open the GRAPHIC RESULT menu

GRAPHIC RESULT

MENU	Return to the VIEW MENU (result menu)
NUM.	Numerical representation of the measuring data (average values of the selected plot)
GRAPH.	Graphical representation of the measuring data (average values for the selected plot)
↑ PLOT	Representation of the measuring data of the previous plot
↓ PLOT	Representation of the measuring data of the next plot

EDIT SYSTEM MENU (1)

MENU	Return to the MAIN MENU
↑	Select the next entry
↓	Select the previous entry
OK	Select the present entry and then automatically open the EDIT SYSTEM MENU (2) or the EDIT SYSTEM MENU (3)

EDIT SYSTEM MENU (2)

- MENU Annul changes and return to the EDIT SYSTEM MENU (1)
- ← Go back on step (only available when required)
- Go forward on step (only available when required)
- ↑ Replace with following characters (choice of 26 letters, 10 numbers, "-" or empty space)
- ↓ Replace with previous characters (choice of 26 letters, 10 numbers, "-" or empty space)
- OK Save changes and return to the EDIT SYSTEM MENU (1)

EDIT SYSTEM MENU (3)

- YES Carry out the task when the button is pressed for the duration of 5 beeps.
(nothing happens when pressed for a shorter period)
- NO Annul the job and return to the EDIT SYSTEM MENU (1)

SYSTEM INFO MENU

- MENU Return to the MAIN MENU

The undersigned, representing the manufacturer:

Eijkelkamp Agrisearch Equipment BV
Nijverheidsstraat 30
6987 EM Giesbeek
The Netherlands

Herewith declare for the following product.

Type: Penetrologger CBR
Art.no.: 06.15.SC-CBR

Function: Apparatus for measuring California Bearing Ratio (CBR) , a penetration test for evaluation of the mechanical strength of road subgrades and base courses

conformity with the following directives:

R&TTE 1999/5/EC

Applied standards

EN 301 489-1 V1.8.1
EN 301 489-3 V1.4.1
EN 300 440-2 V1.4.1
EN 60950-1

Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment" (RoHS)

Directive 2002/95/EC

Giesbeek, December 2, 2011

Manufacturer:

Signature

Frank Tillmann
General Manager



Royal
Eijkelkamp
Earth Sampling Group

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