



Manual

Digital Soil Compaction Meter

penetro**LOG**

PLG2040

Revision B

06/2020

MAN_PLG2040

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To facilitate understanding and highlight important aspects, some information has special formatting, as indicated below.

Note:

They present some detail or better explain some point of the text.

ATTENTION:

Indicate points to be observed by the user for correct use and maintenance of the equipment.

CAUTION:

Warn of situations that can permanently damage the equipment or cause other serious damages.

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1 Introduction

PenetroLOG, Digital Soil Compaction Meter, model PLG2040, is an equipment intended for precision agriculture and allows obtaining precise numerical data on the compaction of the different soil layers.

Excessive soil compaction reduces its water absorption and aeration capacity, limiting the development of the plant's root system, thus restricting its ability to absorb nutrients and water. Compaction is also a possible cause of root diseases in plants, especially under unfavorable climatic conditions.

This manual covers all aspects related to the use of the equipment and guidelines for starting to use Falker Compact Web Application and App, which allow the visualization and analysis of collected data. However, this document is not an agronomic manual, and does not include post-measurement actions related to compacted soil management.

Thank you for choosing Falker!



2 The Equipment

The equipment is supplied in a carrying case, with a protective foam cradle, suitable for use in the field. The following items are provided:

- Carrying case with carrying handle
- Electronic module with handles and fixed part of the rod
- Removable rod with type 2 cone
- Reflective base
- Gauging template
- USB-A - USB-C cable

Figure 1: Equipment set



Figure 2: Electronic module, removable rod with cone

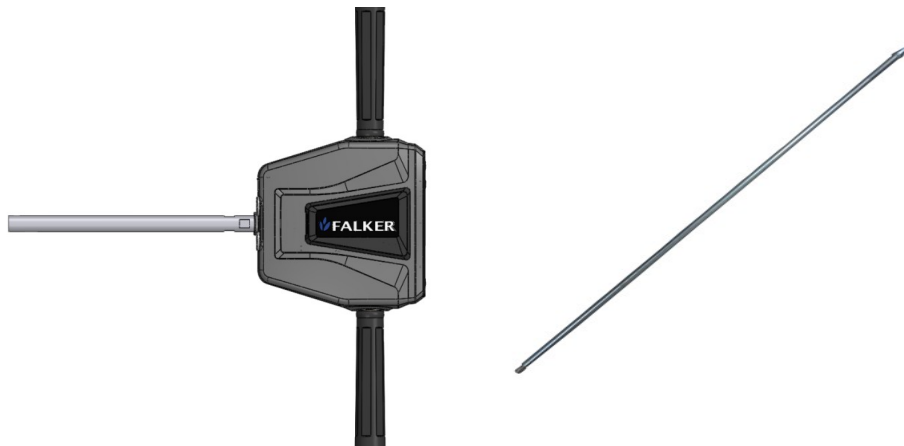


Figure 3: Reflective base, cone gauging template, USB-A - USB-C cable



ATTENTION:

As it is an accurate measuring equipment, it must be transported with care. The equipment case was designed to protect it in the best possible way for transportation, but combined with practicality of use. It is not a package for transportation as cargo.

2.1 Assembly

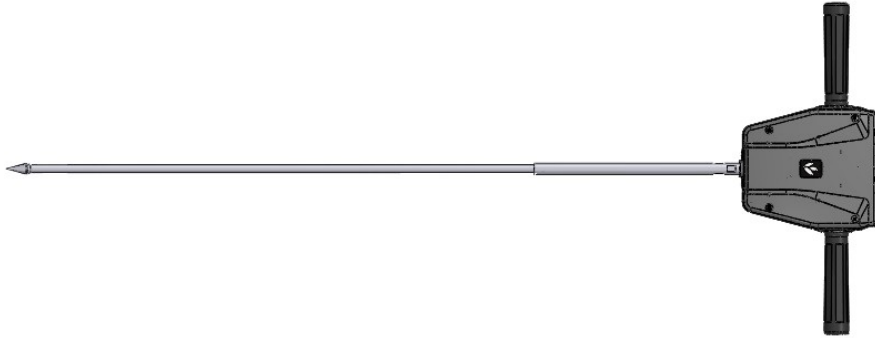
To use the equipment, the removable rod must be threaded on the fixed rod of the equipment.

No tools are required for assembly, as the tightness to be given between the parts does not have to be great. Just make sure that the threads are connected to the end.

ATTENTION:

Check the rod tightness periodically during work.

Figure 4: Equipment assembled with removable rod.



2.2 Accessories


In addition to the items that come with the equipment, the following codes can be used to purchase accessories or replacement items.

Table 1: Accessory Commercial Codes

PLG8011	Removable rod with type 1 cone
PLG8021	Removable rod with type 2 cone
PLG8030	Removable rod with type 3 cone
PLG8210	Reflective base
FLK9020	USB-A - USB-C cable
FLK9030	Socket charger USB-A outlet (Brazilian standard)

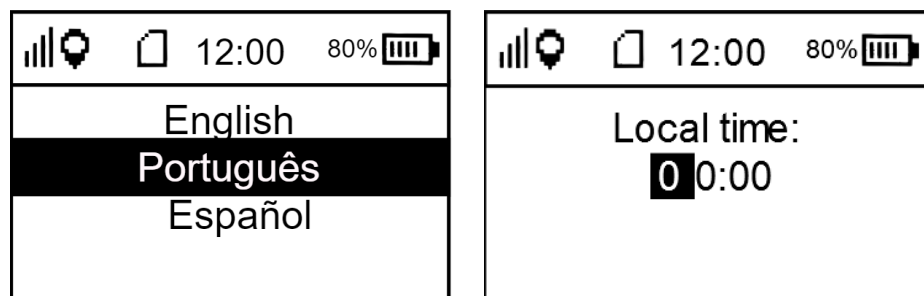
3 Operation

3.1 First Use

To turn on the equipment, hold the power key  on the left side of the panel.

In the first use of penetroLOG, the language and the local time of operation of the equipment are defined.

Figure 5: First use screens







To set the time, you will need to obtain a GPS signal. If a message with no GPS signal is displayed, look for an open area. If this operation is not possible, it will be possible to set the time at another time, in the equipment's settings. To start using without setting a time, turn penetroLOG off and on again, this will cause the message of no GPS signal to be no longer displayed.

3.2 Basic Operation

Figure 6: User interface



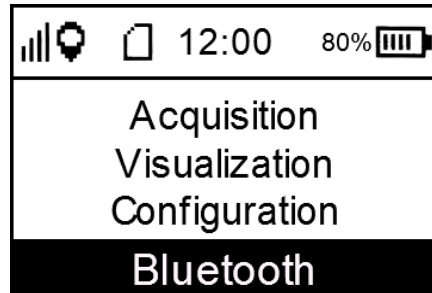
The equipment is operated using the keys     and the graphical screen, where measured values are shown, as well as warnings and information to the user, such as the battery charge status, memory occupation indicator and GPS signal.

When turning on the equipment, after a startup screen, the main screen is displayed. The following information is displayed on this screen: battery level, free memory, GPS position indication and time indication (only with GPS receiving data), at the top of the screen.

The memory occupation is shown by the icon (memory card) represented by the filling steps, which indicate the memory occupation.

The icon with the 4 vertical bars indicates the strength of the embedded GPS signal. If it has a signal, the main screen also indicates the time, using data from the GPS itself.





Figure 7: Main Screen



In the main menu, there are 4 options:

- **Acquisition:** menu used to make new data acquisitions.
- **Visualization:** menu that allows viewing the acquired data on the equipment itself.
- **Configuration:** menu where equipment settings are changed.
- **Bluetooth:** menu that allows you to enable or disable Bluetooth and check its status.

Each of the menus has internal options.

Navigation between the menu options is done using the  and  keys. The  key selects the chosen option. The  key returns to the previous menu.

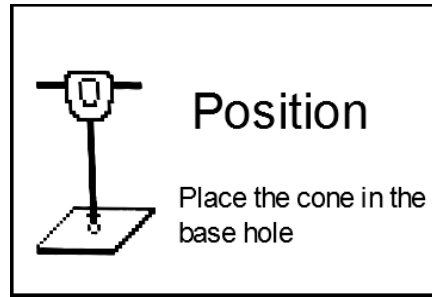
3.3 Data Acquisition

Place the reflecting base on the ground. It serves as a reference for depth measurement. The base can be placed on the straw, however, the distance between the ground and the base will be considered at the measured depth.

Use the “Acquisition” menu to perform measurements.

At first, the following screen will appear:

Figure 8: Position Screen

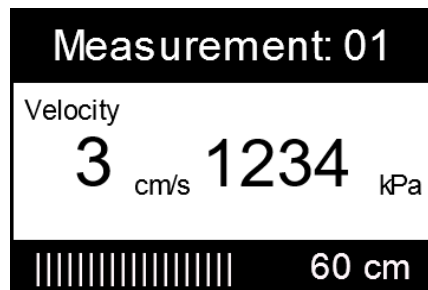


At this moment, the equipment position must be kept stable, with the tip of the rod just touching the ground, through the central hole of the reflecting base. The equipment automatically recognizes the starting depth and goes into measurement mode. The measurement starts automatically when the depth is kept stable for a few seconds, with a minimum of 0.1 cm and a maximum of 4.5 cm. The start of the measurement is indicated by an audible alert. On the positioning screen, do not rest the equipment on the reflecting base.

Note:

Do not start penetrating the soil before the audible alert. On this screen, measurements are not performed. Wait for the audible alert and the measurement screen to start the measurement.

Figure 9: Measurement Screen



In the screen, in the central part on the left, the penetration speed in cm/s is reported. Still in the central part of the screen, on the right side, the values of resistance to penetration in kPa are informed. Finally, the depth is represented by a horizontal bar that is gradually filled in, indicating the progress in the measurement depth, represented in cm, in the lower part of the display.

The speed must be kept as constant as possible. International standards recommend penetrating at 3 cm/s. The equipment allows measurements to be made at up to 5 cm/s. Higher speeds can cause loss of points and are indicated with audible alerts during the measurement.

CAUTION:

For your own safety, do not rest your body (chest and abdomen) on the equipment during measurements. Stand beside the equipment, with your feet on the floor, using your arms only.

The equipment was designed to withstand force in the direction of the rod. If excessive forces are applied in other directions, the rod may break.

Depth measurement is done by ultrasound. Any obstacle between the equipment and the reflecting base can compromise the measurement. During measurement, keep your feet off the reflecting base. Take care that your knees are not between the equipment and the base. The feet must be placed outside the reflecting base. Remove all leaves and plants on the reflecting base. Preferably, move plants away from the base. If measurements are made in the presence of strong wind, it is recommended that the operator keep his back to the wind, protecting the equipment.

Note:

Audible alerts during measurement indicate speeding. Measurements under these conditions may contain invalid data. For measurements where speed alert occurs, review the information before using it.

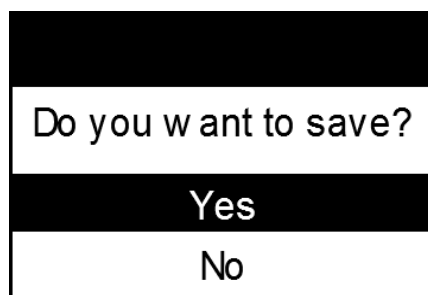
During the measurement, the blue LED on the top right of the panel will flash with each acquisition, according to the configured resolution.


Note:


If during the measurement, the penetration is interrupted for more than 8 s the measurement will be interrupted. Stops are not recommended during measurement.


At the end of the measurement, when the configured depth is reached, the user will be asked to confirm the measurement recording.

Figure 10: Save measurement screen



To confirm saving use the  key.

If during the measurement, before reaching the determined depth, the  key is pressed after more than 10 cm penetrated, the user can choose to interrupt the measurement. Even with an interrupted measurement, you can

choose to save it. If the key  is pressed before 10 cm, the measurement will be canceled without saving.

The equipment supports up to 100 kgf. The force should be applied as evenly as possible between the two handles of the equipment. The rod must be driven perpendicular to the ground. With the thinner optional type 3 removable rod, the maximum force is limited to 75 kgf.

After the end of the measurement, remove the equipment from the ground.

Note:

Before each measurement, remove soil deposits from the stem. This accumulation of soil can interfere with the measurement. Soil remnants on the stem cause little interference, negligible for the vast majority of applications.

For scientific measurements that wish to reduce any external interference, it is recommended to clean the rod and apply lubricant spray before each measurement.

CAUTION:

Do not apply force beyond that specified on the equipment. If there is an indication of excessive force, immediately relieve the stress on the handles so as not to cause damage or to de-calibrate the penetroLOG.

CAUTION:

The thinner optional type 3 rod has less resistance. Take care to apply force only in the direction of the rod. Forces applied in other directions, even if below the maximum force it can withstand in the direction of use, may lead to its breaking.

Also be careful when removing the rod after measurement.

CAUTION:

To conserve the equipment, avoid impacts, falls and exposure to rain.


3.4 Data Visualization

PenetroLOG has basic features for visualizing data on the equipment itself, without the need for data transfer.

In the “Visualization” menu, in the “View Jobs”, it is possible to see the measurements already made in each job. An index is shown, with all measurements, indicated by the measurement number. The time and date of the measurement are also shown.

Figure 11: Measurement display screens

View last	See measurement	00 cm-	00Kpa
View measurements	Attributes	01 cm-	00Kpa
Delete last	Def. Reference	02 cm-	00Kpa
Delete all		03 cm-	00Kpa

In the index, to select a measurement, use the  key.

In each measurement it is possible to see the data and its attributes. The data is shown in two columns. The first shows the depth in cm and the second the pressure in kPa.

Figure 12: Measurement attributes screen



Measurement:	0000
Time:	00:00
Date:	00/00/00
Lat:	00.000000
Long:	00.000000
Alt:	0000m
Cone type:	2
Max. depth:	60cm
Resolution:	1cm
Task:	01
Max. PR:	00Kpa
Max. depth PR:	00cm
Veloc.:	No excess
Measurement complete	


With a measurement selected, it is possible to define that it corresponds to a reference point, through the option “Def. reference”. Only one measurement can be a reference in each job. The last measurement defined as a reference will prevail, the previous reference being then defined as a normal measurement.

In the visualization menu, it is also possible to delete the last measurement taken or all measurements from the device's memory.

3.5 Configurations

In the configurations menu, it is possible to determine the measurement parameters, such as maximum depth, resolution, type of cone used and the measurement mode. The standard cone is the type 2 cone.

In the parameter editing screens, use the  key to start editing the parameter and also to confirm the edition. The  key cancels the edition,


keeping the previous parameter. After editing is confirmed, the  key returns to the menu.

In the settings menu, it is also possible to organize the 10 jobs in the memory. It is possible to define the name of each one and choose which one will be used in the next measurements. New measurements are stored in the job in use.

In the settings menu, there is the option to restore the default values. This option returns all settings to the factory default values. The measurements on the equipment are not deleted.

3.6 Internal GPS

PenetroLOG model PLG2040 already has an internal GPS, which allows georeferencing all measurements, and even record the date and time when they were taken. This model does not require an external antenna or cables and accessories for this.

 An icon identifies whether the device was able to calculate the current position. For this, it is necessary to have at least 3 satellites visible by the equipment, since the GPS signal depends on the triangulation between satellites so that there is record of the current position. The accuracy of the position will depend on the quality of the signal.

 The other icon identifies the signal strength.

The 4 levels indicate the accuracy of the data acquired by the GPS. For better accuracy, it is always indicated to wait for the signal to stay with the 4 bars, aiming at greater precision in the acquired coordinate. Depending on climatic or environmental conditions, such as clouds and trees, it may not be possible to obtain the 4 bars.

3.7 Screens

The chaining of the screens takes place mainly through the keys. Following the navigation scheme of the screens presented below, in addition to carrying out the compaction measurements, we can also view these measurements and define the equipment settings.





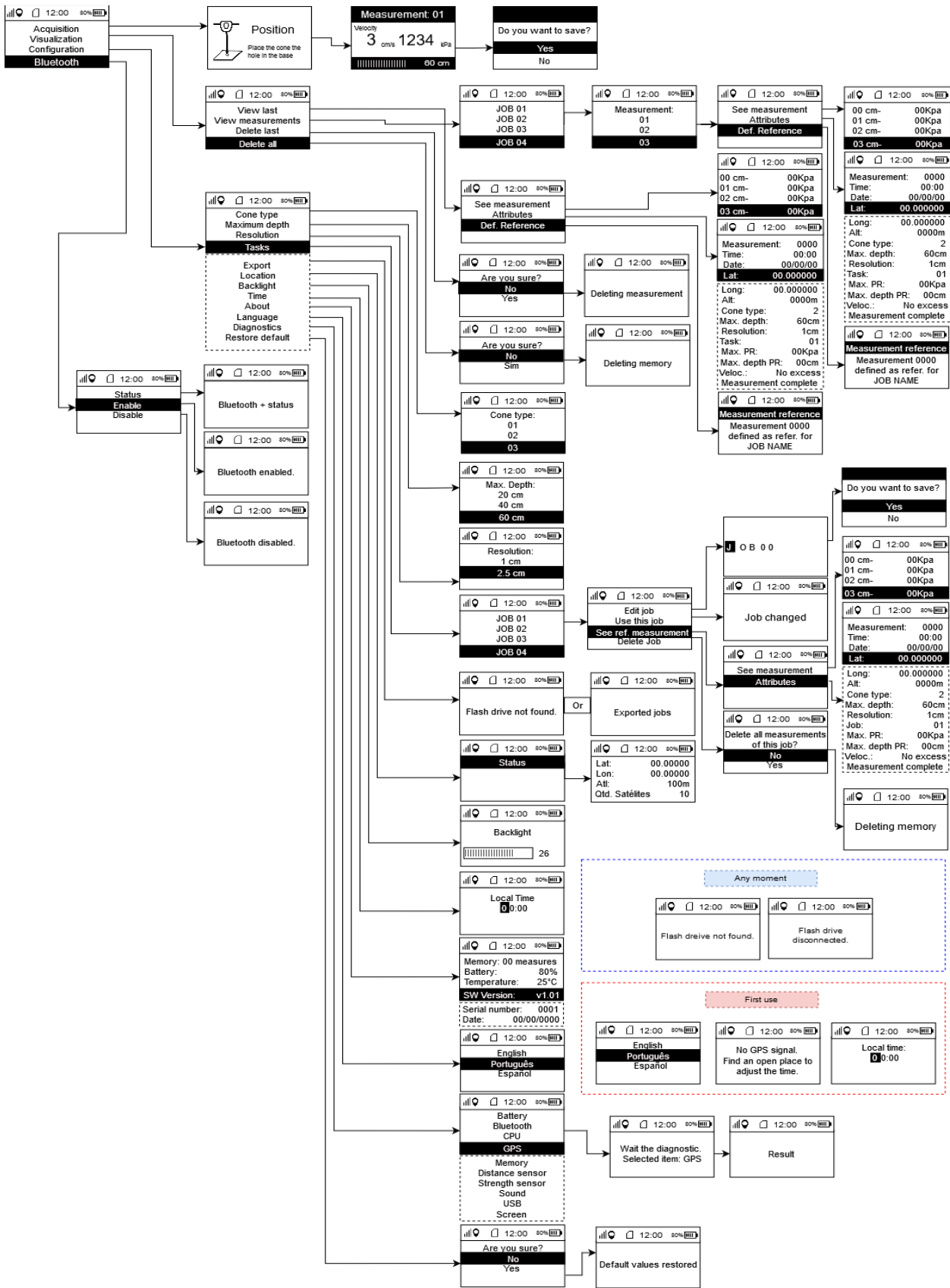
Navigation between the different screens of the equipment takes place in a simple and intuitive way, using the  and  keys to change the settings, view the measurements, etc., and the  and  keys to enter and exit a screen, respectively.

Figure 13: Navigation of equipment screens



3.8 Falker Compact - Data Visualization and Analysis



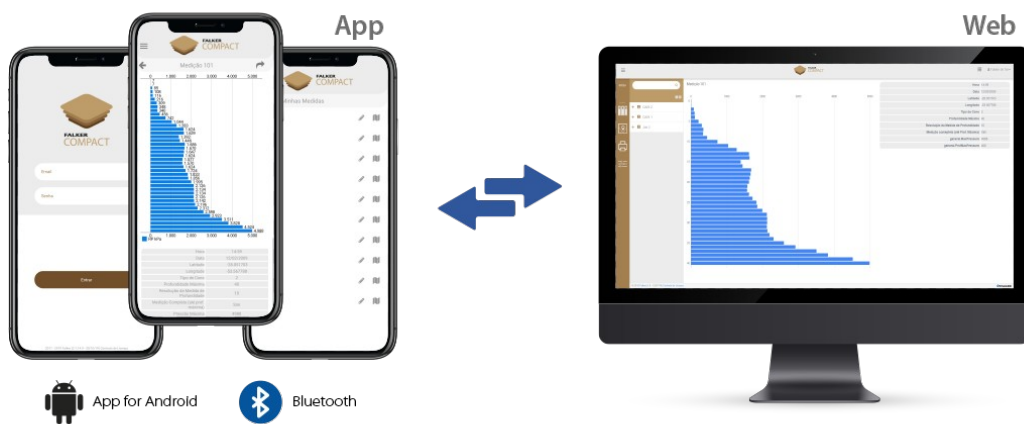
The Web Application can be accessed at:

compact.falker.com.br

And the App is available for Android devices on the Google Play Store. Search for "Falker Compact"

penetroLOG has a specific Web Application and App for viewing and analyzing the collected data.

In an online system, with data saved in the cloud and automatic synchronization between Web and App, you can access information from anywhere for analysis or sharing. It also allows the generation of reports of measurements for presentation.



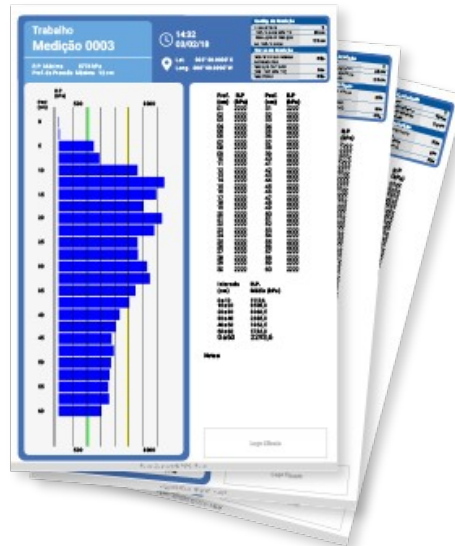
Note:

Falker Compact System for transferring and analyzing data on the computer is constantly evolving.

Follow the guidelines directly on the system.

Reports

Ease of presenting
the collected data



The system also allows you to customize and export reports to present the measurement results, including graphs, parameters and attributes of the data collected

3.9 Data Transfer

The transfer can be done in two ways:

- **USB:** connect a pendrive to the equipment and use the "Export" option, within the "Configuration" menu. Follow the guidelines below.

- Use a flash drive formatted in FAT32;
- Do not remove the flash drive during data transfer;
- Do not charge the battery simultaneously;

The data must then be sent to the Falker Compact web system via a computer. Inside the flash drive, a folder named "PLG" will be created where the exported files can be found. The file format will always be ".fpl2".

- **Bluetooth:** pair the equipment with a smartphone and transfer the measurements from the equipment to the App via Bluetooth. The first time the smartphone receives an internet signal with the app open, it will automatically synchronize data in the cloud, on the Falker Compact system.

4 Basic Maintenance

4.1 Battery Charging

PenetroLOG has an internal battery that must be charged with the original cable, connected to a plug charger with a safe USB port or to a USB device. Avoid using chargers that are not approved by the responsible bodies.

The connector compartment is protected by a magnetic cover on the front of the equipment. Access is by lifting the lower part of the cover, as shown in the image below:

Figure 14: Connectors access



During charging, the red LED is on. When charging is complete, the LED turns off.

Measurements cannot be performed with a connected power source.

4.2 Cleaning the Equipment

After use, before storing the equipment, remove the soil. The removable rod should preferably be washed with water. Dry before storing.

CAUTION:
Do not get the equipment wet.

4.3 Parts Wear

The mechanical parts of the penetroLOG are made of quality materials, which combine the best compromise between resistance to mechanical efforts, weight and wear resistance. Some parts, however, have natural wear and tear.

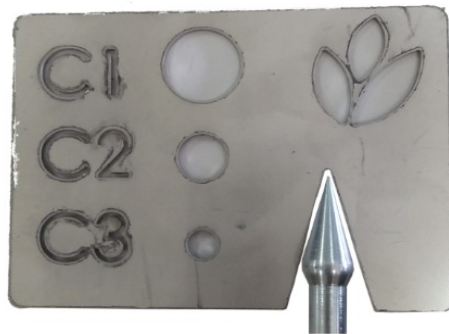
The removable rod cone is one of the parts that wears out due to friction with the ground. The material in this part may present oxidation, which, however, does not compromise the performance and use of the equipment.

ATTENTION:

Keep the equipment clean when stored so as not to accelerate the process of wearing parts. Storing the equipment with soil, especially damp, can reduce the life of the parts.

Excessive wear of the cone compromises the quality of the measurements. As an indication of wear, the tip diameter and shape can be used. For this, the gauging template has holes and a tapered cut. The holes indicate the minimum size of the tip tips of types 1, 2 and 3. The tapered cut indicates the recommended tip shape. If the rod **passes** through the hole, it must be replaced as it has more wear than that allowed by international standards. The triangular cutout serves to check the shape of the tip, if it presents deformation of the tip, not fitting the cutout, the rod must also be changed.




Figure 15: Wear verification holes and tip shape



The use of rods with wear above the recommended interferes with the measurements. The results obtained with these rods will contain measurement errors.

4.4 Software Update

The equipment's embedded software, which controls its operation, can be updated by the user himself with files provided by Falker.

To do this, you must enter the mode called "Bootloader". With the equipment turned off, keep the  and  keys pressed. Keeping both keys pressed, switch on the equipment using the  key. The equipment will remain with the display off or with the indication of "Bootloader" and the

blue LED will flash continuously. Now the equipment has entered Bootloader mode.

After that, connect the equipment to the computer, using the same charging cable.

The computer will recognize PenetroLOG as a removable media, which can be found by clicking on “My Computer” on Windows computers.

Select the file provided by Falker (revxxx.fs2), click on the file and drag it to the PenetroLOG folder under “My Computer”. The update process will take place automatically, and takes only a few seconds.

CAUTION:

Do not attempt to update using files that you are not sure are provided by Falker and are suitable for your version of equipment. Attempting to update with unspecified files may lead to the need for maintenance by Falker.

Updating the equipment's software is an existing feature to allow updating the equipment and possibly adding new functions without the need to return the equipment to Falker.

4.5 Other Questions

If you need other maintenance or have questions not covered in this manual, contact Falker.

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5 Troubleshooting

Problem	Possible Solution
Equipment beeps during measurement	If it is in motion, during measurement, it is speeding. If it is stopped and still beeps, it is an interference problem in the depth measurement (wind, foot or knee, etc.) - see Interference.
It is always on the 'Position' screen and does not mark strength or speed.	Measurement has not started. It is necessary to position the equipment (0 to 4.5 cm) and wait for the screen to change to the Measurement screen
Interference	Wind: keep your back to the wind. Sheets, feet, legs, knees: ensure that there are no obstacles between the ultrasound sensors at the bottom of the penetroLOG and the reflecting base during the measurement.
During the measurement it returns to the initial screen	If, after the measurement start, a depth greater than 10 cm is not reached within 8 seconds, the equipment returns to the initial screen for new acquisition.

In case the above instructions are not sufficient and the problem persists, contact Falker.

6 Technical Specifications

The following table presents the main technical information for the equipment.

Table 2: Technical Specifications

Maximum Penetration Depth	Type 1 and 2	60 cm
	Type 3	40 cm
	Type 1 cone	3100 kPa
Maximum Cone Index	Type 2 cone	7700 kPa
	Type 3 cone	15100 kPa
	Depth Measurement Resolution	1 or 2.5 cm, configurable
Cone Index Measurement Resolution	Type 1 cone	3.1 kPa
	Type 2 cone	7.7 kPa
	Type 3 cone	20.1 kPa
Maximum Insertion Speed	5 cm/s	
Memory Capacity	3000 measures	
Power Supply	Internal rechargeable battery Autonomy > 12 hours of use	
Battery Charging Port	USB-C Connector	
User Interface	Graphic LCD display with backlight 1 multifunction LED, audible indication	
Keys	4 operation keys and 1 on / off key	
Equipment Weight	3 kg	
Briefcase weight with equipment and accessories	6 kg	
Cones Diameter (according to ASAE standard S.313.3)	Type 1 cone	20.27 mm
	Type 2 cone	12.83 mm
	Type 3 cone	7.94 mm
Maximum Supported Force on the Rod	Type 1 and 2	100 kgf
	Type 3	75 kgf
GPS receiver	Integrated	
Data Transfer	Bluetooth to smartphone app or flash drive to web app	

* Rods with Type 1 and Type 3 cones are optional and must be purchased separately.

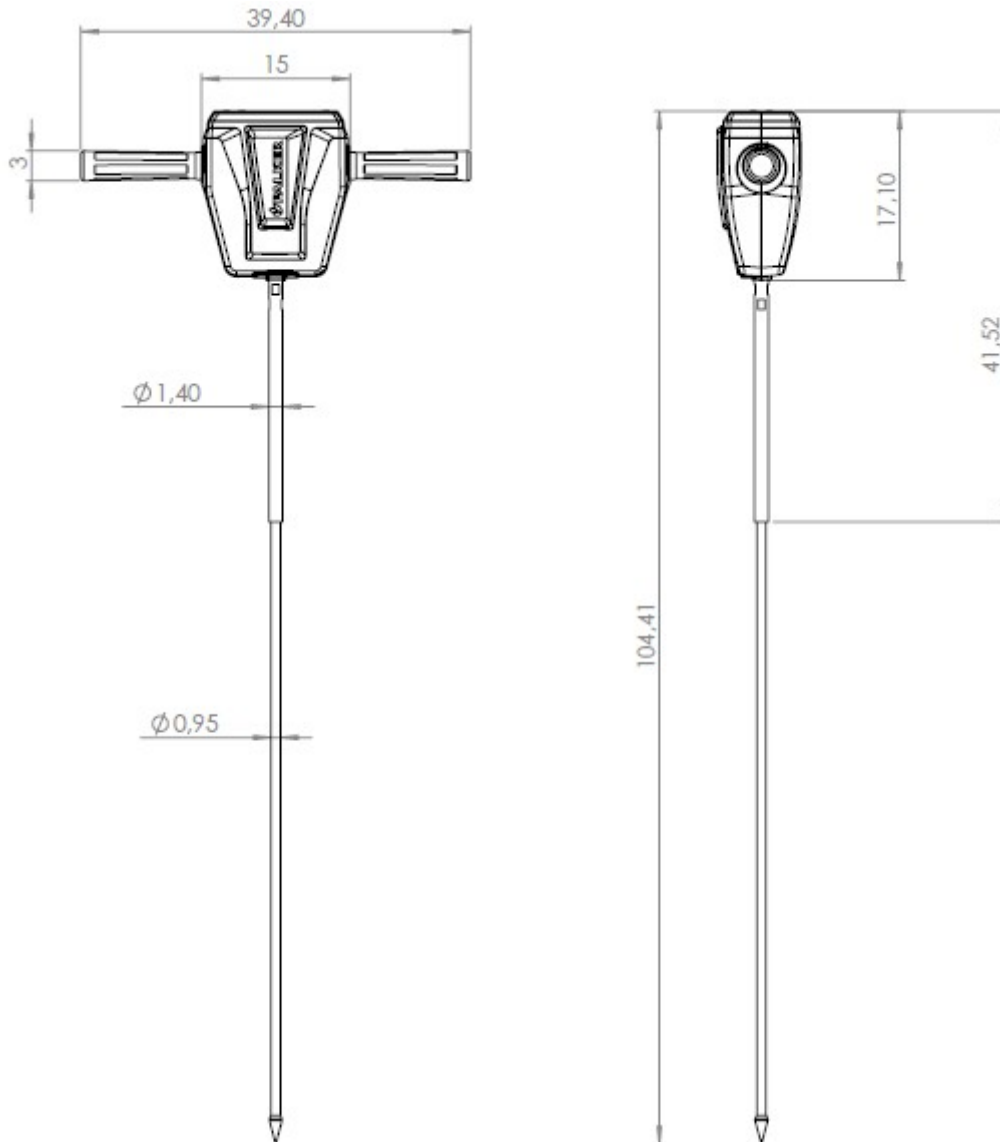
CAUTION:

Do not use force beyond the specified on the equipment. If there is an indication of excessive force, immediately relieve the stress on the cuffs, so as not to cause damage or de-calibrate the penetroLOG.

6.1 Dimensional Information

The dimensions of the equipment are shown in the figure.

Figure 16: Dimensions in cm



6.2 Anatel Homologation

This product contains the Bluetooth card approval code 05118-16-10070 .

