FALKER
Automação Agrícola

Manual

Automated Compaction Measurement System

SoloStar

PLG5500

Review C

08/2024

MAN_PLG5500_ C

Code 41-0001.5500

To make things easier to understand and highlight important aspects, some information has been given special formatting, as shown below.

Note:
They provide some detail or explain a point in the text better.

ATTENTION:
They indicate points to be observed by the user for correct use and maintenance of the equipment.

CAUTION:
They warn of situations that could permanently damage the equipment or cause other serious damage.

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Contents

1. Introduction

The SoloStar system makes it possible to take compaction measurements over large areas quickly and automatically. The automatic system ensures ease of continuous and prolonged operation.

SoloStar has been designed so that it can be installed in a wide variety of vehicles that are used in the field, and can be used by precision agriculture service providers or farmers.

The equipment detects areas of compacted soil by electronically measuring the penetration resistance (Cone Index) together with the depth measurement. A GPS receiver can be connected to the equipment to record the geographical location of each measurement. The data can be transferred to a computer for visualization and analysis.

Measuring compaction is the next step for those who already work in precision agriculture and know that not all yield restrictions can be explained by soil fertility alone.

Thank you for choosing Falker!

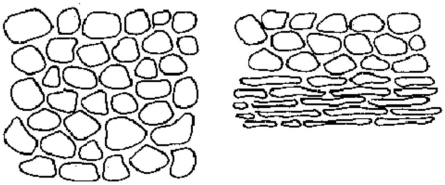
2. Soil compaction

This chapter presents some basic concepts so that the user of the equipment can correctly collect data and interpret the results obtained with the SoloStar, since determining soil compaction is an essential factor for the success of the final productivity of crops.

2.1. What is soil compaction?

Soil compaction is nothing more than an increase in soil density and a reduction in soil porosity.

Figure 1: Schematic representation of a well-structured soil (left) and a soil with a compacted subsurface layer (right).



2.2. Causes of soil compaction

Soil compacts in the subsurface due to external pressures exerted on it, especially when it is in a high state of humidity, usually called plasticity. The main agents causing these external forces include:

- Traffic of machinery and implements.
- Cattle trampling at high stocking rates.
- Soil preparation in inadequate humidity conditions.

- Geomorphological predisposition of some soil types to become compacted.

2.3. Consequences of soil compaction

The main consequences of soil compaction in agricultural areas include:

- Greater soil resistance to root penetration.
- Lower aeration capacity.
- Increased sensitivity of plants to diseases.
- During periods of heavy rainfall, it causes erosion due to reduced infiltration capacity, carrying chemical sediments and soil particles into water sources, generating economic losses and environmental damage.
- By impeding root growth and in periods of drought, less water and nutrients are used by the plant.

All these factors will reduce the productivity potential of agricultural crops, putting at risk all the investment made to plant the crop and, consequently, the financial health of the agricultural production unit.

2.4. Analysis of compaction data

There are several ways of working with penetration resistance data, in terms of collecting and analyzing data in the field. The following are examples of some of the methods.

2.4.1 Compaction measurements at humidity close to field capacity

An ideal moisture window is recommended for measuring penetration resistance (PR) at homogeneous moisture in the area. This period, in practical terms, is located between 24 hours and 48 hours after a rainfall, when the soil is at field capacity. This period lasts until approximately 2 weeks after the rainfall (the time will basically depend on the evapotranspirative demand of the plant and soil and the porous characteristics of the soil in question), i.e. until a water limit point,

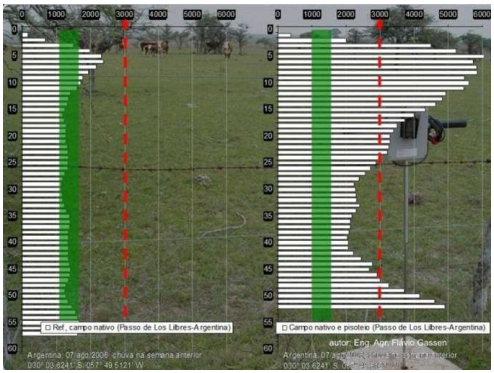
when the soil starts to become too resistant to obtain a representative PR value.

Taking soil moisture values during measurements is important for analyzing penetration resistance values in different years. Soil moisture is also part of the analysis, along with other factors, in order to decide on the critical RP for determining whether or not the soil is compacted and, with this, to define the corrective or preventive management that will be given to this area.

2.4.2 Use reference areas to make comparative measurements

An alternative line of work when the critical PR value for a given soil type is not known, at a given moisture content, is to establish a reference soil resistance profile on the same property or in a nearby area, provided it has the same soil type. This reference area can be soil under native forest or under a fence (in short, soil that has not been subjected to mechanical or anthropogenic action for a long time). Likewise, it is feasible to use a region of the field that is known in advance to produce well (compared to the rest of the field), even in years of water deficit, i.e. that does not suffer from suspected soil compaction.

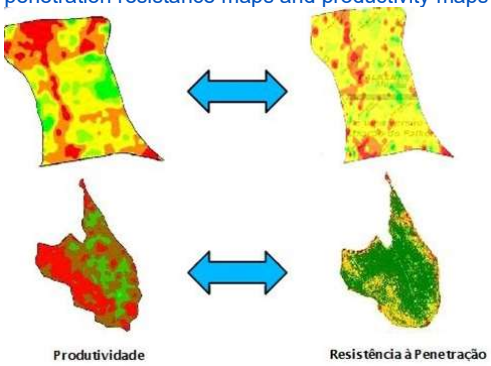
Figure 2: Example of a reference profile (left figure) and a profile of the same soil in the field. Gassen, F. (2008)



2.4.3 Compaction maps vs. productivity maps

An effective way of analyzing soil compaction maps is to compare them with yield maps and other physical and chemical soil attributes. In this way, it is possible to correlate and identify areas that need greater attention, the so-called critical areas, where compaction is clearly indicated as a limiting factor for productivity, because the chemical attributes in these places are not shown to be limiting.

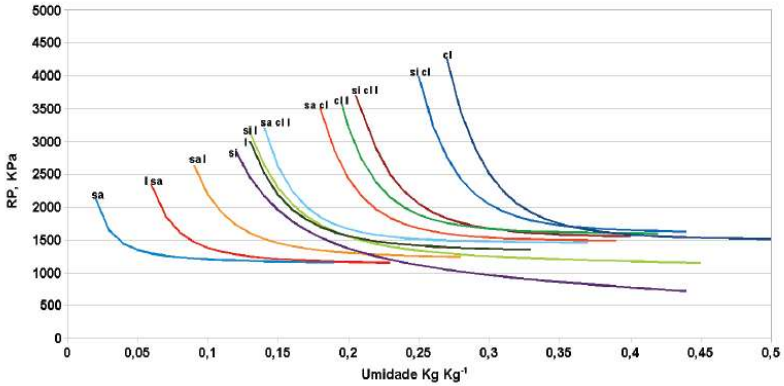
Figure 3: Example of penetration resistance maps and productivity maps of the same area



2.4.4 Compensation of penetration resistance according to soil moisture value

There is a line of work stating that, due to the natural characteristics of each type of soil, including issues of texture and structure, it is possible to obtain a mathematical model of how the PR will behave according to the variation in humidity. From there, for each type of soil, you can have the RP values corrected from the humidity at the time of collection to a standard humidity, i.e. as if the data had been measured at field capacity. There are several bibliographical references available showing these equations.

Figure 4: Penetration resistance as a function of gravimetric moisture in 12 American soil classes, calculated using the equation of Dexter A.R. (2007).



2.5. Differences between manual and automated compaction measurement systems

In technological terms, there is no difference in the quality of the measurements or the accuracy of the data collected with the manual soil compaction measurement system, penetroLOG, when compared to the automated systems, SoloStar and SoloTrack. In all three models, the technology used to obtain the data is identical. Therefore, everything will depend on how well you handle the manual equipment. The main thing to watch out for is the speed at which the cone is inserted into the soil (which should not exceed 35 mm or 3.5 cm per second) and the angle at which the rod is inserted - it should be as perpendicular to the ground as possible. Data collected in accordance with the recommendations for using penetroLOG is just as good quality as data collected with automated systems.

The main advantage of the automated system is the practicality of obtaining the data. In this equipment, the force applied to insert the rod into the soil is constant, supplied by an electric motor and not based on the weight of the person using the manual system. The speed will logically vary minimally depending on the resistance the soil offers to penetration, which will never be uniform along the soil profile.

But it will not exceed the maximum speed recommended by the ASABE EP542 standard.

2.6 Generating compaction maps

One of the most interesting ways of visualizing the physical situation of the soil is to spatialize the data by generating maps. These maps are usually stratified, with one for each average 10 cm layer of the soil profile. The sample grids used usually range from 0.3 to 5 ha. The minimum number of sub-samples recommended is 3 for each grid. Remember that the greater the number of samples and sub-samples for a given area, the better the information collected.

2.7 Possible recommendations for solving compacted layers

There are several ways to improve the physical health of the soil. Of course, the best option is to prevent the soil from being physically degraded by carrying out preventive management. Here are some examples:

- Mechanical intervention (scarification or subsoiling).
- Crop rotation (winter crops or green manures).
- Controlled machine traffic in the field.
- Planning the timing of mechanized operations.
- Controlling soil moisture for traffic.
- Adjusting the width, type of wheelset and tire pressure.

The most suitable solution for a given situation will depend on an analysis of a number of factors. It is always recommended to consult an agronomist before making any intervention decisions.

3. The System

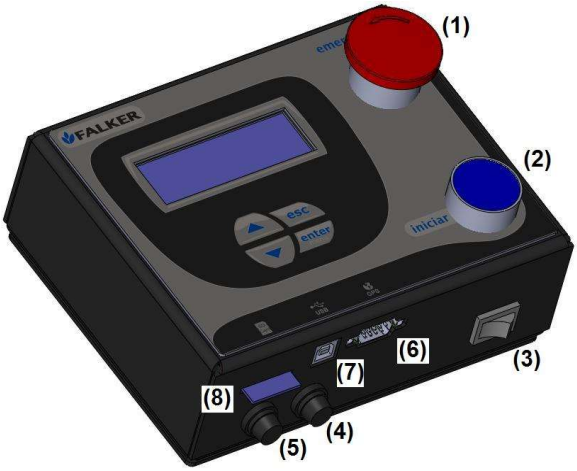
The SoloStar System is an Automated Soil Compaction Meter and the following items are supplied with it:

- Measuring tower
- Control panel
- General Start Guide
- Spare fuses
- Self-locking M8 nut (spare)
- USB cable
- Cone template
- SD Card memory card
- SD card reader (for USB)

Figure 5: Measuring Tower and Control Panel

4. Operation

4.1. Basic Operation



(1) Emergency button

(2) Start button

(3) On/Off switch

(4) Fuse (0.5 A)

(5) Fuse (20 A)

(6) Serial port

(7) USB port

(8) Memory card slot (SD)

To turn the equipment on, there is an on/off switch at the bottom of the Control Panel (3).

When the SoloStar is switched on, the message "Falker SoloStar PLG 5500" and the software version appear on the screen. At this point the motor is started, moving the rod to its initial position. After a few seconds, the SoloStar will enter measurement mode, displaying the message "Ready to measure" on the screen.

On this screen there is an indication of the folder in which the measurements are being saved, the number of the next measurement to be taken, the battery voltage, an indication of the GPS connection and an indication of the system status.

The letter "G" in the top right-hand corner of the screen indicates that the GPS is properly connected. An asterisk " * " indicates that the GPS is operating with a signal.

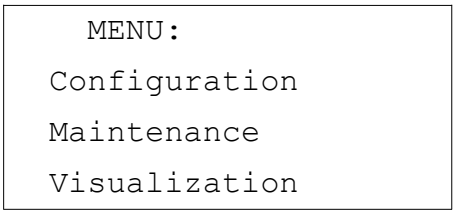
The enter key gives access to the main menu, where there are three options:

Visualization: menu that allows you to visualize the acquired data on the device itself and export data to a memory card.

Configuration: menu where you change the device's settings.

Maintenance: menu containing information on the status of the system.

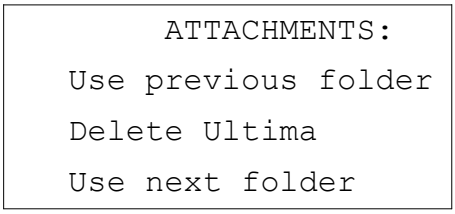
The appearance of the menu screen is shown below:



Each of the menus has internal options.

Navigation between the menu options is carried out using the and keys. The enter key selects the chosen option. The esc key returns to the previous menu.

On the home screen, pressing esc opens the shortcut menu, showing some of the most commonly used functions.



In this menu you can delete the last measurement taken and change the folder in which the measurements are being saved. To make it even easier to use in certain field applications, you can switch between two adjacent folders just by pressing two buttons: esc and enter, in sequence.

4.2. Start button (2)

It is used to start the measurement. When pressed, it starts the rod moving downwards.

To indicate that the motor is running, the display starts flashing.

4.3. Emergency button (1)

When pressed, it stops any movement of the measuring tower, aborting the entire operation. It is the general switch for the drive circuit and is used to switch off the electric motor in an emergency. Once the button has been released (by turning clockwise), the SoloStar automatically returns to its initial position.

4.4. On/off switch (3)

Used to turn the equipment on and off. It is located at the bottom of the control panel.

4.5. Data Acquisition

To take a measurement, simply press the "**start**" button on the control panel and SoloStar begins its operation. When the cone touches the ground, a simple beep sounds and the device starts acquiring data. When the rod reaches the depth that has been set, the measurement is saved, a double beep occurs and the SoloStar automatically returns to the starting position, keeping the screen flashing, indicating that the rod is moving.

During the measurement, the depth in cm, the pressure in kPa and the battery voltage in V are displayed on the screen.

Note:

In the event of excessive force, SoloStar returns to the starting position automatically, regardless of the user's command.

Note:

The emergency button is used to protect the motor in the event of a short circuit or excess current due to the shaft locking. It is the circuit's general switch and is used to turn off the equipment in an emergency.

Note:
Before each measurement, remove accumulations of soil from the rod and cone. This build-up can interfere with the measurement. Remnants of earth on the rod cause minor interference, negligible for the vast majority of applications.
For scientific measurements where you want to reduce any external interference, we recommend cleaning the rod and applying a *spray* lubricant before each measurement.

4.6. Equipment settings

In the settings menu you can determine the measurement parameters, such as maximum depth, depth resolution, type of cone used and the measurement mode. The default cone is cone type 2.

On the parameter editing screens, use the 

key to start editing the parameter and also to confirm the edit. The 

key cancels the edit, keeping the previous parameter. After confirming the edit, the 

key returns to the menu.

In the settings menu, you can also organize your work with the 20 existing folders. You can define the name of each folder and determine the folder in use. New acquisitions are stored in the folder in use.

In the **Settings/Excessive** force menu, you can configure the device to save measurements in which an excessive force error has occurred, if you wish to record the information. The factory default is NO.

If the GPS is connected, you can adjust the local time zone ('Time Adjustment' menu) and the date is automatically set using the data received from the GPS. The clock is dependent on the GPS connection.

In the settings menu, there is the option of restoring the configuration parameters to factory default values. Existing measurements and folder names are not deleted.

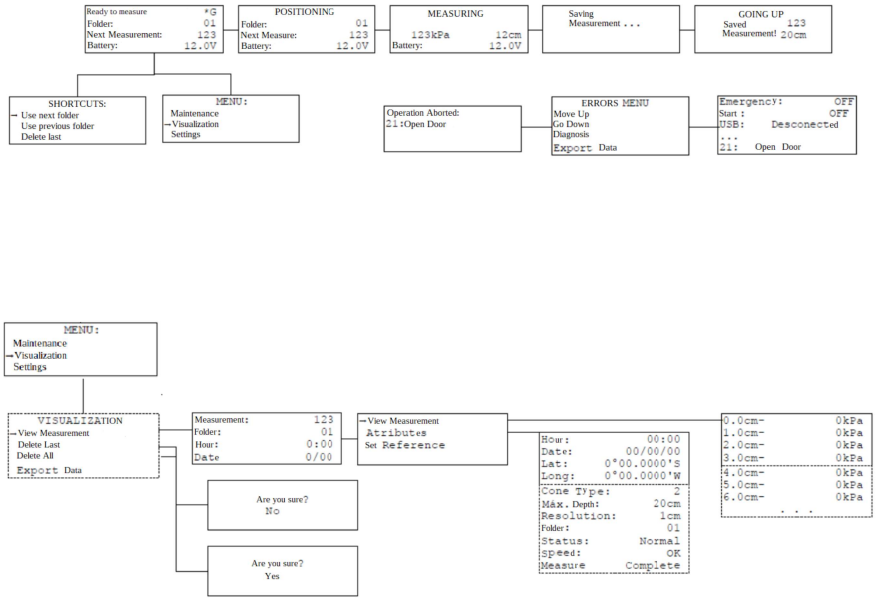
4.7. Screens

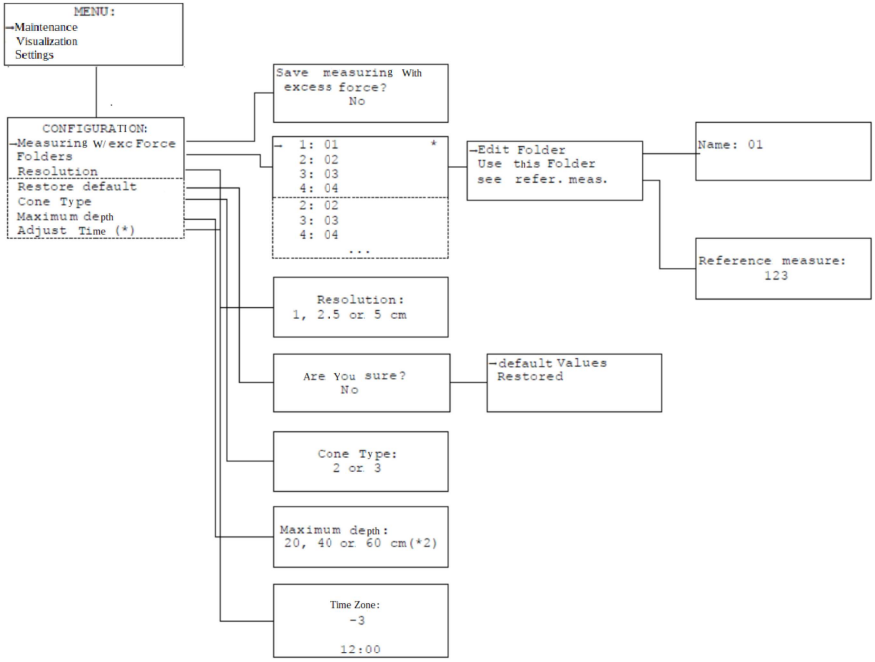
The screens are linked mainly by keys. Following the screen navigation diagram below, you can not only take compaction measurements, but also view these measurements and define the equipment's settings.

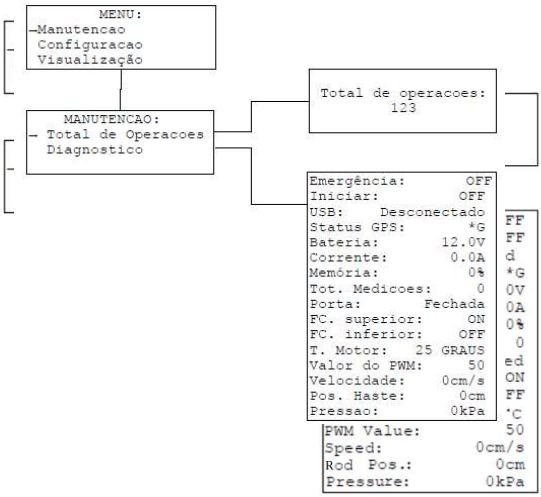
Navigation between the equipment's different screens is simple and intuitive, using the  and  keys to change settings, view measurements, etc., and

the keys enter and esc to enter and exit a screen, respectively.

Figure 6: Navigating the device's screens




MENU:
Maintenance
Visualization
Settings
CONFIGURATION:
Measuring w/exc Force
Folders
Resolution
Restore default
Cone Type
Maximum depth
Adjust Time (*)
Save measuring With excess force?
No
1: 01 *
2: 02
3: 03
4: 04
2: 02
3: 03
4: 04
...
Edit Folder
Use this Folder
see refer. meas.
Name: 01
Reference measure:
123
Resolution:
1, 2.5 or 5 cm
Are You sure?
No
default Values
Restored
Cone Type:
2 or 3
Maximum depth:
20, 40 or 60 cm(*2)
Time Zone:
-3
12:00



4.8. Fault Detection System

SoloStar is equipped with a fault detection system that protects the equipment and warns the operator if anything abnormal occurs during operation.

In the event of faults, the equipment indicates to the operator what type of anomaly is occurring.

Problems can be detected such as overheating, a low battery, problems with the rod positioning system, excessive force applied to the pressure sensor, among others.

Below is a list of possible errors that can be detected.

N°	Error	Description	Cause	Solution
3	Memory full	Memory full	1. The memory must be full.	1. Save the data according to item 4.12 of the manual and then delete the memory.
17	Corrupted internal memory	Internal memory problem.	1. There may be problems with the internal memory device.	1. If this erropleasecontact Falker.
19	SD card File creation	Error when trying to write to the card	1. Card file system format error	1. Save the existing data on the card and format according to item 4.12 of this manual.
21	Open door	Maintenance door open	1. Open door 2. Door sensor wiring problem. 3. Problem with the door sensor.	1. Close the door 2. Check the cabling and connections of the COM2 connector. 3. Check the door sensor for a bent or broken rod.
22	Obstructed course	Obstruction was detected in the mechanical system	1. Wear of mechanical parts 2. Object obstructing the mechanical system. 3. Possible problem with the position sensor	1.Check for looseness or wear of bushes or nuts 2. Check for anything obstructing the movement of mechanical parts 3. Check the position sensor
23	Top limit switch	Top microswitch pressed at the wrong time	1.There may be poor contact or a break in the key cables. 2. The upper microswitch may be jammed.	1.Check the wiring and connections of the COM3 connector and replace the key if necessary. 2. Check that the upper micro-key is locked.
24	Temperature	Operating temperature above the equipment's limit.	1.Natural overheating of the engine. 2. Overheating due to equipment defects.	1. Wait until the motor has cooled down before continuing to use the equipment. 2. Check the cause of the problem.
25	Overcurrent	Operating current above specified limits	1. May occur in cases of very hard ground and low battery operation. 2. there may be a problem with the positioning system, making operation difficult.	1. Recharge the battery. 2. Check the mechanical positioning system for play or wear.
26	Undervoltage	Operating voltage below specified values	1. Problem with the power supply connections 2. Discharged battery	1. Check the power supply connections 2. Recharge the battery

N°	Error	Description	Cause	Solution
27	Overvoltage	Operating voltage above specified values	1. Battery with inadequate voltage.	1. Check the power supply (battery, alternator). Caution! Values above those specified may damage the equipment.
28	Positioning 1	Lower microswitch actuated at the wrong time	1. defective microswitch 2. problem with the microswitch connections. 3. the lower microswitch may be jammed.	1.Check and/or replace the microswitch 2. Check the connections on the COM4 connector 3. Check that the lower micro-key is locked.
29	Load cell	Pressure value read incompatible with that expected by the system.	1.Problem with the load cell. 2. Problemwith theload cell cabling. 3. may be an obstruction problem.	1. Check that the load cell is working correctly (Diagnostics menu). 2. Check the conveyor cables inside the measuring tower and the COM2 connector. 3. see error 22.
30	Positioning 2	Does not respond to measurement start command.	1. Cable problem. 2. Faulty motor. 3. faulty position sensor.	1.Check the COM1, COM3 connector and the internal connector near the motor. 2. Replace the motor. 3. see error 31.
31	Sensor Position 1	Position sensor fault detected	1. bad contact in the cables. 2. position sensor away from the sprocket. 3. damaged sensor.	1. Check the cabling and connections of the COM3 connector. 2. Move the sensor closer to the sprocket by 2mm and retighten the nuts. 3. Replace the position sensor.
32	Engine	No connection to the motor was detected.	1. Cable problem. 2. Defective engine.	1.Check the COM1 connector and the internal connector near the motor. 2. Replace the motor.
33	Sensor Position 2	Position sensor fault detected	1.Problem with the position sensor cables. 2. Problem with the position sensor.	1.Check COM3 connector. 2. Replace the position sensor.
34	Excessive force	Excessive force	1. Measurement taken on very compacted soil 2. Rod hit obstacle when penetrating the ground (stone, hard root, etc.).	1. This may be a valid value where the ground is very compacted 2. In this case, look for a suitable place to take the measurements

*If the error persists, contact Falker.

4.9. Operation aborted

The operation can be aborted by events foreseen by the equipment, by the operator or automatically by the protection system.

The operator can abort a measurement in progress by pressing the emergency button in the top right-hand corner of the control panel. Pressing this button will stop the device. When the button is released and turned clockwise, the device returns to its initial position.

The protection system can also abort the measurement if it detects anormal equipment behavior. It can trip in the event of excessive force on the rod (very hard ground), an open maintenance door, faults in the rod positioning system (limit switch and position sensor), battery voltage outside the specified limits or overcurrent in the electric motor.

In the event of an aborted operation, the movement of the rod will be immediately interrupted, indicating the cause of the interruption until the system starts moving again. If a critical event has occurred, in addition to the interruption, the system triggers an intermittent beep informing the user that something unusual has occurred.

On the OPERATION ABORTED screen, pressing 

will bring up the error menu, where you can export the measurements to a memory card, enter diagnostics mode and raise or lower the positioning system if necessary to solve the problem.

Access to the diagnostics menu is used to help solve a possible problem.

Note:
In the event of excessive force, an audible warning sounds and the SoloStar aborts the operation, returning to the starting position. The measurement will be saved if so configured in the settings menu.

Note:
If the emergency button is pressed during data acquisition, the operation is aborted and the measurements will **NOT** be saved.

Note:
If the maintenance door is opened during measurement, the operation is aborted and the measurements will **NOT** be saved. The SoloStar will return to the starting position as soon as the door is closed.

4.10. Equipment diagnostics

In the **Maintenance/Total operations** menu you can see the total number of operations carried out on the equipment.

In the **Maintenance/Diagnostics** menu you can monitor various important data for the correct functioning of the equipment, such as operating voltage, current consumed by the equipment, free memory for storing measurements, door switch status, upper and lower limit switches, motor housing temperature, among others.

This data is useful for diagnosing system malfunctions.

4.11. GPS connection

The GPS should be connected directly to the serial port at the bottom of the Control Panel. The same cable used to connect the GPS to computers should be used.

The protocol to be used is NMEA 0183, with a speed of 4,800 bps, 8 data bits, 1 stop bit, no parity.

The GPS connection is indicated by the letter "**G**" in the top right corner of the main screen. In addition, an asterisk " * " indicates whether there is a signal on the GPS device. If the " ***G** " does not appear on the main screen, even with the GPS connected via serial cable to the

equipment, it means that the signal received is invalid. Check the GPS signal.

4.12. Data transfer to the computer

Data can be transferred from the device in three ways: via USB cable, serial cable or SD Card.

In the case of cables, connect one end of the cable to the connector on the bottom of the control panel and the other end to the computer.

Use the software that comes with the SoloStar to transfer measurements.

Once the device is connected and switched on, you can configure the communication port. To do this, go to the **Communication/Configure Communication** menu and choose the correct port.

In the case of the SD Card, insert the card into the slot at the bottom of the control panel. Enter the visualization menu and then the export data menu. This will save a file in .FPL format, which can be opened by the Soil Compaction Data Visualization and Analysis Software.

ATTENTION:

If errors occur while exporting data to the card, you will need to format it. To do this, you need to use a computer. In Windows, go to "My Computer", right-click on the card icon and choose the "**Format**" option. Choose the file standard "**FAT32**" and the **allocation unit size 512 bytes** and click OK.

CAUTION:
Formatting erases all the files on the card!

CAUTION:
Do not turn off the equipment or connect any USB or SERIAL devices during a memory card transfer. This could damage the card.

4.13. Embedded Software Update

Connect the Control Panel to the computer, turn on the equipment and configure the communication port in the PC software.

To carry out this process, make sure that the Soil Compaction Data Visualization and Analysis Software is already installed on your computer.

In the Tools menu of the data visualization and analysis software, choose the update software option.

Click on 'Browse' and choose the software update file.

Click on the "Update" button and wait for the device to be updated.

ATTENTION:
It is recommended that you disconnect the GPS when updating the on-board software.

CAUTION:
Do not attempt to update using files that you are not sure have been supplied by Falker and are suitable for your version of equipment. Attempting to update with files that are not suitable may lead to the need for maintenance at Falker.

4.14. Electrical Installation

To power the electrical circuit, you can use the quad's own battery, located under the seat. The blue cable

must be connected to the positive pole and the **black** to the negative pole. Use a screwdriver to do this.

ATTENTION:

The power cables must pass between the fairing and the luggage rack of the quadricycle in places where there is no risk of crushing or breaking the cables, as well as excessive heating of the cables due to their proximity to the quadricycle's engine.

4.15. Choosing and changing Removable Stems and types of Cones

4.15.1 Types of Cones

Cone 3 (optional accessory) should be used when it is not possible to use cone 2 due to high compaction and, in these cases, it should be used over the entire area.

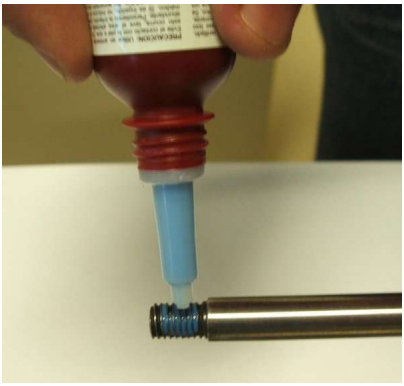
The correlation between values from measurements made with type 2 and 3 rods is neither direct nor fully normalized by the area compensation (already done internally to the equipment), even though the unit of measurement when using the two rods is the same and the mechanical parts have dimensions in accordance with the standard. This correlation depends on the characteristics of the soil. However, it is above 90%.

If it is of interest, for each type of soil it is possible to find an adjustment factor from cone 3 to cone 2, when necessary. However, as it is not constant, this type of adjustment cannot be incorporated into the equipment's software.

4.15.2 Removable stem replacement

To change the Removable Stem, due to vibration, it is necessary to apply a threadlocker to the thread of the Removable Stem and then screw it onto the Fixed Stem of the equipment.

Figure 7: Applying threadlocker to the stem



No tools are required for this assembly. The tightness between the parts does not need to be great. Just make sure that the threads are connected all the way.

4.15.3 Test template for Cone dimensions

The Cone, like any mechanical part, wears out with friction. The wear time can vary greatly, depending on the type of soil and the humidity of the soil at the time the measurement is taken. As this wear occurs, its dimensions are reduced, reaching a point that influences the measurement values.

To check that the Cone's measurements are up to standard, it is important to carry out a periodic test with the template that comes with the equipment. See figure below.

Figure 8: Test template for cone dimensions

If the cone passes through the hole intended for its size or does not match the angle, then the Removable Stem must be replaced.

5. Basic Maintenance

5.1. Necessary tools

The following tools may be required to carry out maintenance on the system:

- 1 x 10 mm socket wrench
- 1 x 13 mm socket wrench
- 1 x Allen key 4 mm
- 1 x Allen key 3 mm
- 1 x Fine-tip screwdriver
- 1 x Nozzle Pliers

5.2. Cleaning and lubricating equipment

After use, before storing the equipment for long periods, it is important to clean it. But you need to be careful when cleaning, as some parts of the equipment are vulnerable to water.

Cleaning the equipment from the outside can be done with a hose or water jet, making sure that the direction of the water jet is always from top to bottom, never the other way around, so as not to get the equipment's motor wet.

The removable stem can be washed with water. Dry before storing and use machine oil to prevent oxidation.

On the inside of the equipment (to access the inside of the equipment, remove the front cover, following the instructions at the beginning of Chapter 5.4), if too much dirt has accumulated on the lower inside part, the excess must be removed. The guides and spindle must also be cleaned and then re-lubricated using spindle grease (pass the grease through the spindle).

grease and move the equipment up and down so that the grease is well spread), and machine oil on the guides to prevent them from oxidizing .

CAUTION:

Do not get wet inside the equipment, especially the part protected by the Top Cover (where the equipment's wires and motor are located).

5.3. Parts wear

The mechanical parts of the SoloStar system are made from noble materials that combine the best compromise between resistance to mechanical stress, weight and resistance to wear. Some parts, however, wear out naturally through use. For this reason, preventive maintenance is required according to the table below.

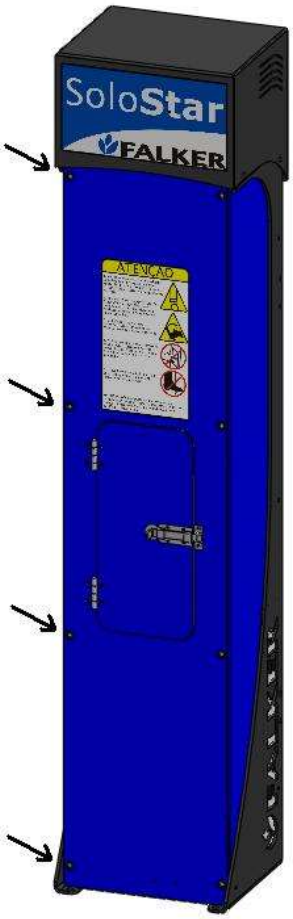
Parts	Preventive overhaul (number of operations)
Retightening screws	2.500
Changing the bushing refill	5.000
Changing the spindle nut	7.500
Removable stem replacement	Only if you don't pass the template test
Changing the HR guide	Only if wear is found

If the equipment starts to show a higher operating current, or if you notice a lack of power, it is important to lubricate the spindle using grease and clean the guides using machine oil.

5.4. Changing the Bushings

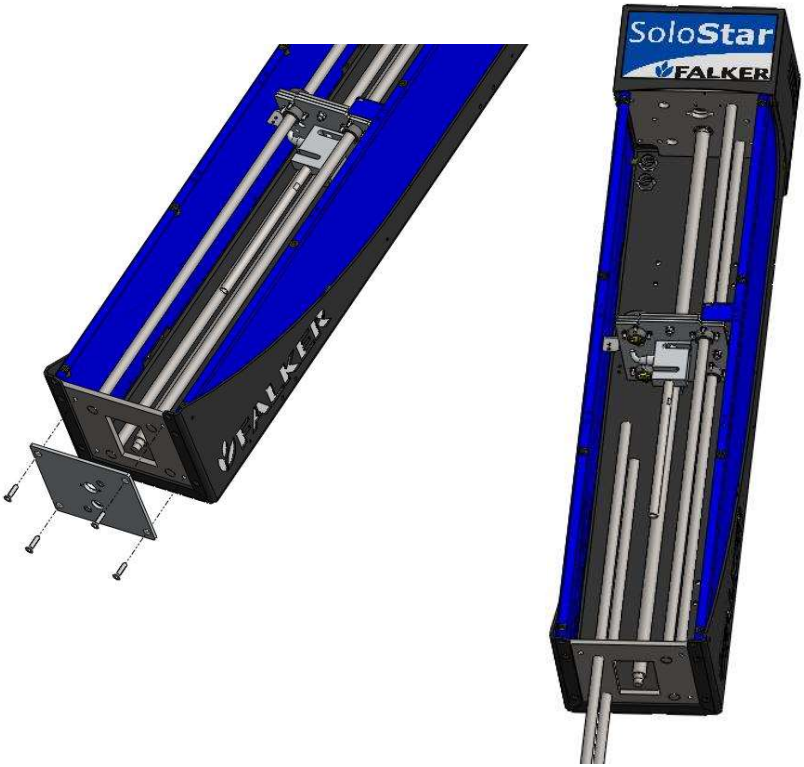
To change the bushing refills, put the unit down, enter the "Diagnostics" menu and press the start button when the Car. When you reach the halfway point, press the emergency button so that it stops - be careful with the Removable Stem (the Removable Stem, if desired, can also be removed before starting the procedure). Then remove the Front Cover by loosening the 8 screws securing it with the 4 Allen Key.

Figure 9: *Removing the Front Cover Screws*



Then remove the Lower Bearing Base and remove only two guides.

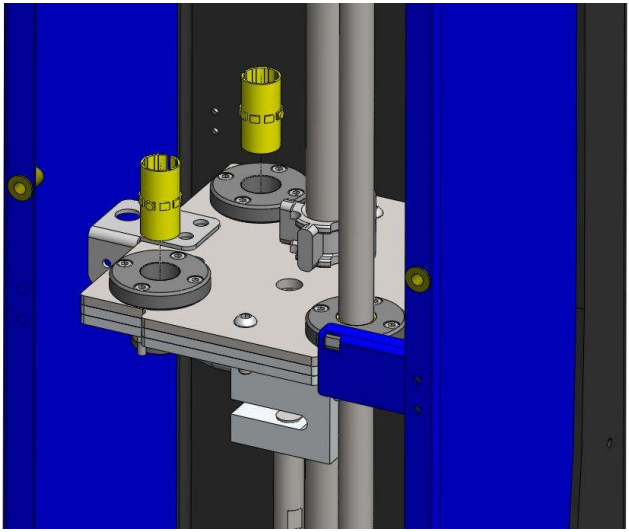
Figure 10: Removing the Lower Bearing Base and Guides



Carry out the replacement by removing the plastic parts from the inside of the two bushings, from which the guides have been removed, using a fine-tipped screwdriver to lift the plastic part and a pair of needle-nose pliers to remove it.

After removing the plastic part of these two bushes, use the spare Bushings and fit them in place of the ones previously removed.

Figure 11: Changing the bushing refill



Once this is done, put the guides back as they were before and carry out the same procedure on the other two bushes.

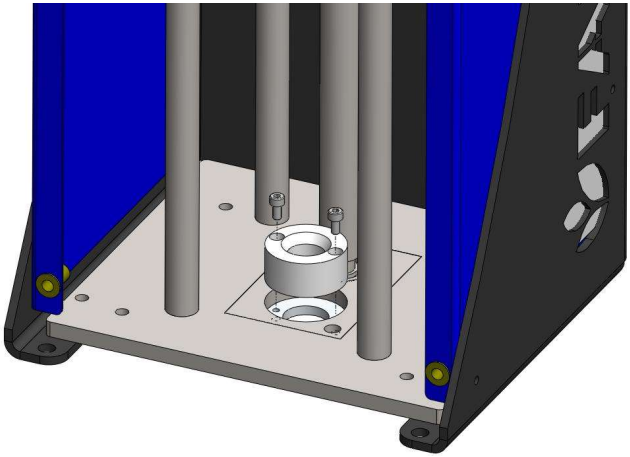
Once the bushings have been replaced, close the unit again following the steps in reverse order.

5.4. Changing the Removable Stem Guide

To change the Removable Stem Guide, you need to remove the Removable Stem and then remove the Front Cover.

Afterwards, loosen the two screws holding the Removable Stem Guide using the Allen Key 3 and then remove it.

Figure 12: Changing the Removable Stem Guide



Then replace the part by putting the new one in place and securing it with the two screws.

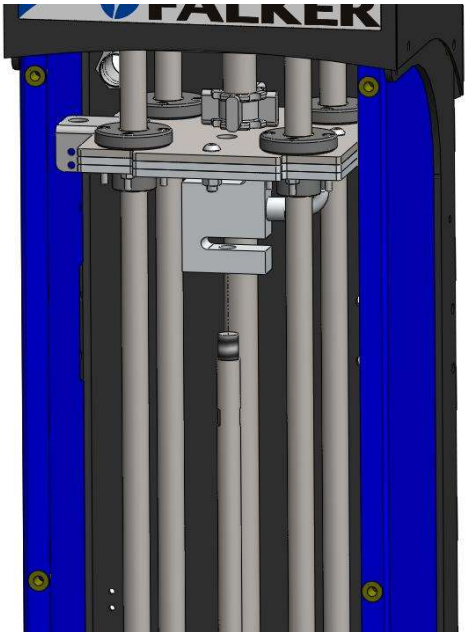
Once the change has been made, close the front cover of the unit and resume normal operation.

5.5. Changing the Fixed Rod

In the event of a problem that causes the Removable Stem to break, there is a risk that the thread connecting the Removable Stem to the Fixed Stem will break inside the Fixed Stem. If this happens, it will have to be replaced.

Then, using the 13 mm socket wrench, snap it into place and remove the fixed rod.

Figure 13: Changing the Fixed Rod



Take the new Fixed Rod, put a threadlocker on the thread and screw it into the Load Cell, then tighten it with the 13 mm Spanner, taking care not to overtighten it, as this could damage the Load Cell thread.

To finish, close the Front Cover.

CAUTION:

Never force the load cell. If the load cell is damaged, the equipment must be sent to Falker for maintenance.

5.6. Changing the Bearings and Spindle Nut

To carry out these maintenance tasks, contact Falker and arrange for your equipment to be serviced by the Falker team.

5.7. Other questions

If you require any other type of maintenance or have any questions not covered in this manual, please contact Falker.

www.falker.com.br

falker@falker.com.br

6. Technical Specifications

		PLG5500
Maximum Penetration Depth		20, 40 or 60cm, configurable
Maximum Cone Index	**Type 2 cone**	6,800 kPa
	Type 3 cone	15,100 kPa
Depth measurement resolution		1, 2.5 or 5 cm, configurable
Cone Index Measurement resolution	**Type 2 cone**	7.7 kPa
	Type 3 cone	20.1 kPa
Insertion Rated Speed		3 cm/s
Internal Memory Capacity	**Resolution: 10 mm**	910 measurements
	Resolution: 25 or 50 mm	2,000 measurements
Power Supply		12V battery (45Ah minimum capacity recommended)
Maximum Consumption		156 W at 13A
Indications to the User		Visual and audible signage Control display
Actuation		- Drive button - Emergency button - Automatic reversal in case of excessive force
Equipment diagnostic system		- Motor current monitoring - Engine temperature monitoring - Operating voltage monitoring
System Weight		60 Kgf
PC Interface		SD Card, USB and Serial RS232
Communication Protocol with GPS Receiver		NMEA 0183

		PLG5500
Total Equipment Height		110 cm
Maximum Strengh Supported	**Type 2 stem**	90 kgf
	Type 3 stem	75 kgf
Compatible Vehicles		Compatible with various models of Quadricycles and Trucks, and can be adapted to other vehicles upon prior consultation.

7. Dimensional Information

The dimensions of the assembled equipment are shown in the figure.

Figure 14 Dimensions in mm