

USERS MANUAL

GEOTECH PVT DIRECT PUSH PIEZOMETER

for pore pressure measuring



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DOCUMENT HISTORY

Date	Comment	Sign
2015-02-25	Change of design and content.	mcn
2015-09-15	Revised information on Lithium Metal Battery	mcn
2015-10-26	Editorial changes. Added items to Trouble Shooting.	mcn
2015-11-09	New handheld computer. Added items to 2.4; added Fig. 7	mcn
2015-11-11	Changes in "Preparations"	mcn

1 General Information

1.1 Foreword

This manual contains important information for the proper use and safe operation of the GEOTECH PVT DIRECT PUSH PIEZOMETERS.

Read the manual carefully before you start operating the system. Also read the maintenance instructions before performing any maintenance work. The warranty from Ingenjörfirman Geotech AB is valid only if the instructions in this manual are followed.

Always keep the manual by the equipment and replace it immediately if it should become wholly or partially unusable. A new copy can always be ordered from Ingenjörfirman Geotech AB.

1.1.1 Content

The information in this publication is on the basis of information that was available at the time that the publication was written.

The information can change at any time. Ingenjörfirman Geotech AB reserves the right to change or update the content of the manual without prior notice.

1.2 Safety

The operator must be alert to potential hazards. The operator should also have the necessary training, skills and tools to perform these functions properly.

The important safety messages in this manual are presented as follows:



Indicates a hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



This warning identifies important messages in this manual, e.g. information on risk for costly damage. Carefully read the message and inform your colleagues.

2 Product Information

2.1 General Description

The GEOTECH PVT DIRECT PUSH PIEZOMETER is very accurate and cost efficient precision gauge. It can be used for permanent installation or pulled up for recalibration and reuse. The piezometer has a ceramic pressure sensor, which is very stable over time, making it the perfect choice for long-time projects and permanent installations. The output from the piezometer is digital and is not affected by cable length. Each piezometer is supplied with a calibration certificate.



Fig. 1 – The piezometer is available in several versions – with or without logging function. Pressure transducer, A/D converter, processor with optional log memory and battery are integrated in the probe. Only the cable is visible on the surface.

The piezometer is delivered mounted on a one meter 1" pipe. For installation, you normally use 1" pipes. In some cases a release adapter could be used together with your normal sounding rods. When a release adapter is used, the sounding rods can be pulled back up after installation, leaving only the piezometer and cable in the ground. This makes it possible to save material by using the same rods for several piezometers.

There are several options for programming and data collection:

1. Use your own standard windows computer with PVTLog software and USB interface with two crocodile clips.
2. The rugged turn-key readout kit comprises a handheld computer with accessories, mPVT software, interface with two crocodile clips and a barometer. All in a sturdy transport case.
3. Remote reading using a permanently installed local cell phone based gateway. Data are available from your computer and alarms could optionally be sent as text messages to your mobile phone.

2.2 Logging direct push piezometer with memory

The logging piezometer operates without the need of additional battery, logging box or any kind of permanently installed external equipment – just two wires are visible on the surface.

A similar device "Logging Air Pressure Meter" can be installed above the surface, recording barometric pressure for compensation at each time.

The active component is a ceramic piezoresistive pressure sensor. Small movements of the sensor membrane result in changes of electrical bridge parameters that are detected, amplified and passed through an A/D converter. The data are processed in a micro-controller and saved in the on-board memory. The use of a ceramic diaphragm gives excellent stability over time, ensures high linearity across the entire range of measurement and reduces effects of hysteresis to a minimum. In addition the sensor has built in temperature compensation.

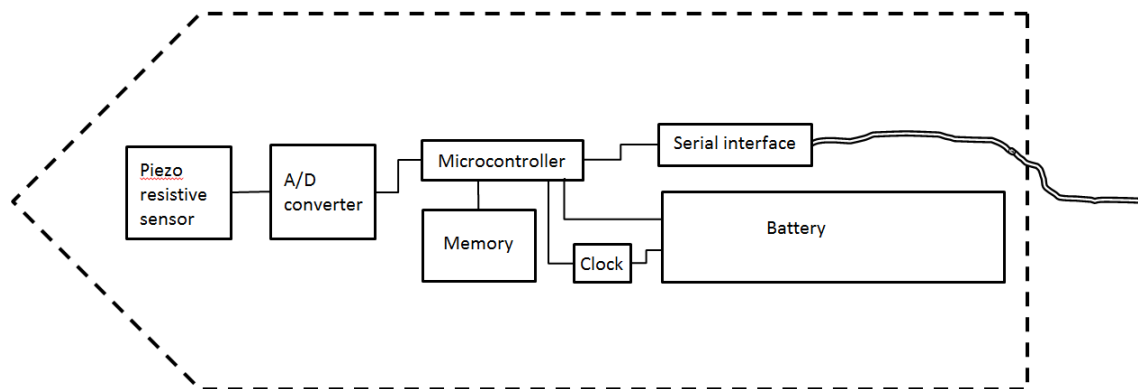


Fig. 2 – Logging direct push piezometer with memory: Small movements of the sensor membrane result in changes of electrical parameters that are detected, amplified and passed through an A/D converter. The data are processed in the microcontroller and saved in the on-board memory.

Modern electronics and power saving technology enables permanent installation of the equipment for several years without any need for battery change or charging. Logging intervals are programmed from your computer with interface and two crocodile clip wires. The same setup is used for uploading log files and for viewing the real-time value of pressure and temperature.

2.3 Direct push piezometer without memory

Connect your computer with crocodile clip interface to the piezometer for real-time reading of temperature and pressure.

The piezometers can alternatively be connected to a local network with a telematics unit for remote monitoring and/or instant alarms upon critical values.

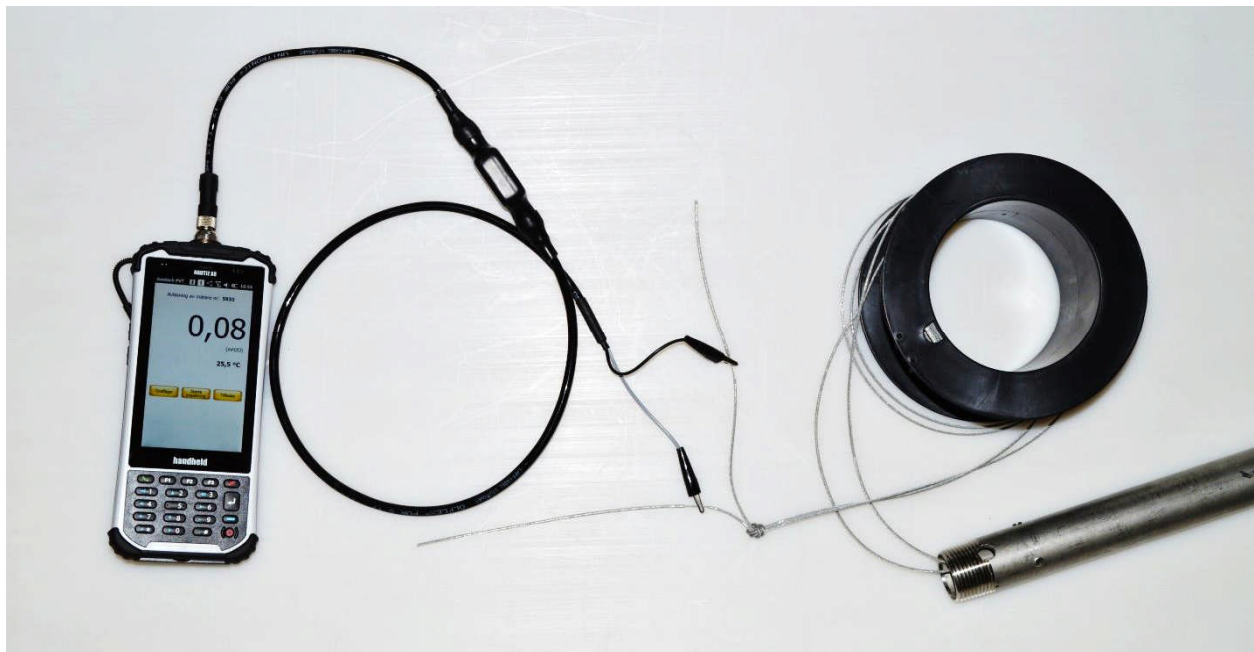


Fig. 3 – Pressure and temperature real-time values are instantly available when connecting the piezometer to the crocodile clips of the handheld reading kit. Have the similar functionality with you own standard computer – just install the PVTLog software and connect the USB/crocodile clip interface (read-out kit for PC).

2.4 Read-out kit for PC

Install the PVTLog software on your own computer and connect it to the piezometer via the USB/crocodile clip interface. Do real-time readings of pressure and temperature. When used with the piezometer with logging memory, you can program logging intervals and collect log files. Data is stored on a format facilitating further processing in MS Excel.

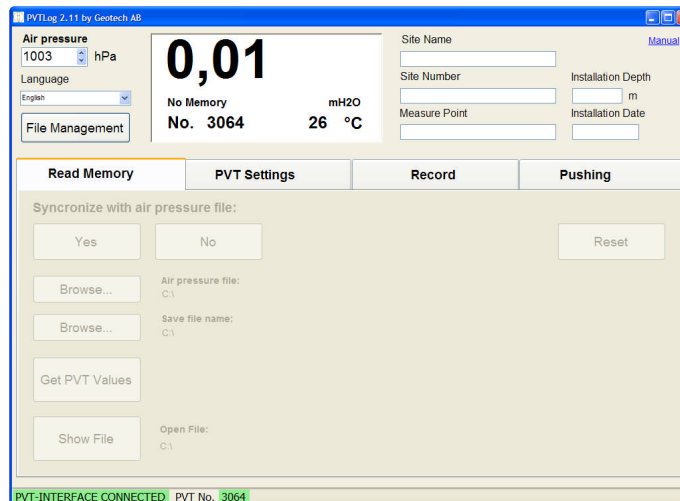


Fig. 4 – Install the PVTLog software on your own computer and connect it to the piezometer via the USB/crocodile clip interface.

The delivery comprises software, interface and user manual. Standard Windows computer (XP, 7 or later) is to be sourced locally by the customer.

Please refer to separate manual for information on installation and use!

2.5 Rugged read-out kit with handheld computer



Fig. 5 – The rugged read-out kit comprises a hand-held computer with mPVT software, interface with crocodile clip wires and a barometer. All packed in a sturdy transport case. Computer and barometer models are subject to change without notice.

The delivery comprises hand-held computer with accessories and mPVT software, interface with crocodile clip wires, a barometer and a sturdy transport case.

When used together with the Geotech PVT piezometer, you can use the equipment for setting logging intervals and collecting stored log files. Data is stored on a format that facilitates further processing in MS Excel and similar programs.

Please refer to separate manuals for detailed information on mPVT software and handheld computer!

2.6 Remote read-out solutions

Remote data collection is possible with the Geotech PVT Gateway with built-in 3G “cellular phone”. Do settings and collect data via the Internet. Set thresholds and get alarms as e-mail or text messages to your phone.

Please refer to separate documents for information on equipment and systems for remote control.



Fig. 6 – Remote read-out solution example: Monitoring of the seabed close to a sea-port building site. A telematics gateway is installed on buoy for communication via the mobile phone network. Set thresholds and get alarms as e-mail or text messages to your phone.



Fig. 7 – Remote read-out solution example: Monitoring of pore pressure in clay at different depths under a road. The gateway receives settings and sends logged data via the mobile phone network.

2.7 Additional product information

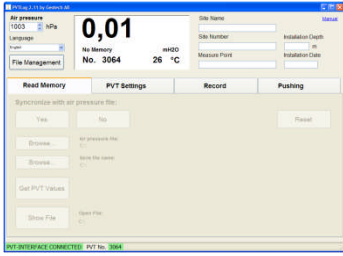
Please refer to separate documents for description of additional and special equipment.

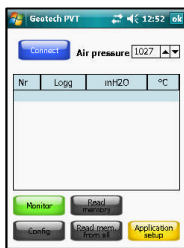
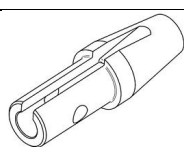
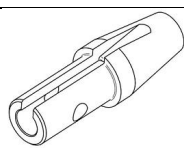
2.8 Intended use

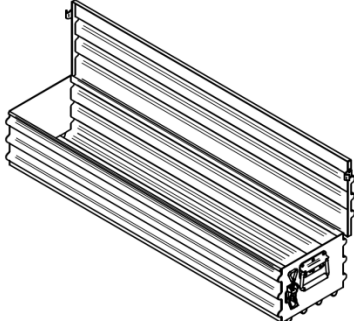
The system is designed for geotechnical and hydrological monitoring, and may only be used for this purpose. All other use is prohibited.

2.9 System components overview

Item No.	Item	Illustration	Description
		Direct push piezometers	
10591	Piezometer with memory. 25 m wire.		Logging direct push piezometer with memory. Range 40 mH ₂ O (approx. 400kPa).
10590	Piezometer without memory. 25 m wire.		Direct push piezometer without memory. Range 40 mH ₂ O (approx. 400kPa).
13186	Piezometer with memory. 50 m wire.		Logging direct push piezometer with memory. Range 40 mH ₂ O (approx. 400kPa).
13185	Piezometer without memory. 50 m wire.		Direct push piezometer without memory. Range 40 mH ₂ O (approx. 400kPa).
27928	Piezometer with memory 2MPa.		Logging direct push piezometer with memory. Range 2MPa. Note: Cable length and type to be specified separately.
29029	Piezometer without memory 2MPa.		Direct push piezometer without memory. Range 2MPa. Note: Cable length and type to be specified separately.
19653	Piezometer cable		Standard cable for piezometer. Permanently mounted on piezometer from factory. Specify length upon ordering.
10663	Special cable PVT		Double insulated copper cable. Permanently mounted on piezometer from factory. Specify length upon ordering.
On request	Piezometers with special characteristics are available on request.		Direct push piezometer with special characteristics available on request. E.g. different range, cable type or cable length. Please refer to separate documents for detailed information. Note that some of the information in this manual might not be applicable for these items.

Item No.	Item	Illustration	Description
10592	Logging air pressure meter		Logging air pressure meter for capture of barometric reference file.
Included in 10592	Holder air pressure meter		
		Interface and software for Laptop computer	
19656	Reading kit El. Piezom. for PC	 	Reading and programming kit for standard windows computer comprising: PVTLog software and USB/crocodile clip interface. Computer not included. Connect the interface to the USB outlet of your computer and the crocodile clips to the piezometer. The program makes it possible to collect data and to change settings.
Included in 19656 above	PVTLog	 	PVTLog read-out and programming software. Right to use on one computer, licensed by owner of all rights Ingenjörfirman Geotech AB. The program makes it possible to collect data and to change settings. <i>Medium for delivery may be changed without notice.</i>
Included in 19656 above	PVT Interface USB		USB/crocodile clip interface. Connect the interface to the USB outlet of your computer and the crocodile clips to the piezometer.

Item No.	Item	Illustration	Description
		Handheld read-out and programming kit	
19600	Reading kit El. Piezom.		Portable read-out and programming kit. Transport case comprising: - Rugged hand-held computer - Charger and cables - Interface with cables - Software mPVP - Barometer <i>Computer and barometer models are subject to change without notice.</i>
Included in 19600 above	mPVP software		mPVP read-out and programming software. Right to use on one handheld computer, licensed by owner of all rights Ingenjörfirman Geotech AB. <i>Normally delivered pre-installed from Geotech.</i>
		De-airing tools	
19651	Syringe PVT		Syringe for saturation of the piezometer.
20351	Funnel PVT		Funnel for saturation of the piezometer.
		Tools (optional)	
15123	Release adapter PVT, CPT stand		Release adapter for permanent installation of the piezometer using standard 36 mm CPT rods.
On request	Release adapter PVT, for other rod type		Release adapter for permanent installation of the piezometer using other type of rod. Please revert with requirements!

Item No.	Item	Illustration	Description
		Pipes for installation	
		Note: galvanized pipes should not be used!	
01727	Pipe 1" 1m		Steel pipe 1", length: 1000mm. Weight approx. 3 kg
07509	Pipe 1" 2m		Steel pipe 1", length: 2000mm. Weight approx. 6 kg.
28545	Pipe 1" 1m stainless		Stainless steel pipe 1", length: 1000 mm.
28500	Pipe 1" 2m stainless		Stainless steel pipe 1", length: 2000 mm.
24835	Transport case for rods		Transport case for 1 m rods and pipes. Dimensions: 113 x 27 x 22 cm. Weight 19.3 kg

The GEOTECH PVT product family is being continuously developed and improved. We therefore reserve the right to changes of the information above.

3 Preparations

3.1 Saturation of the piezometer



Fig. 7 – Keep the filter of the de-aired probe under water.

Secure the piezometer in a vice (or another sort of device which can hold the piezometer in a steady grip).

Put the funnel over the tip and remove the screw from its tip. Use a syringe to fill the tip as many times as it requires in order to saturate the filter. Use distilled water. No air bubbles should be visible.

When ready, put the screw back and tighten it up. Remove the funnel. If possible, the piezometer should be kept under water until use. You might apply a plastic or rubber membrane while the filter is held under water. That makes it easier to handle the piezometer above ground, still keeping the filter saturated until the piezometer can be pushed down.

Store the saturated piezometer at a temperature above 3°C – the water inside the piezometer expands as temperatures get close to freezing temperatures, with cracked sensor membrane as result.

! NOTICE

Store the saturated piezometer at a temperature above 3°C. The sensor membrane might crack if the water inside the piezometer starts freezing.

3.2 Using pipes

If pipes or hollow rods are used for installation without release adapter, the cable must be rolled out and threaded through the rods. Make sure that there are no sharp edges that could damage the cable. A damaged cable could make the piezometer unusable. You may use a stick or plastic pipe attached to the cable end when pulling the cable through the pipe segments.

Do not use the equipment together with galvanized rod /pipes. A chemical reaction may occur with the stainless steel of the piezometer body, resulting in generation of gas and unreliable measurements.

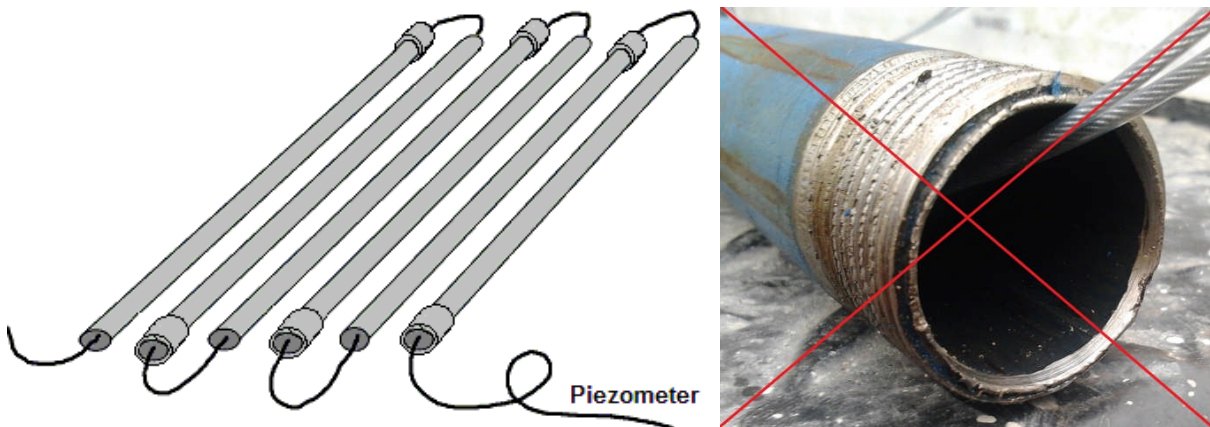


Fig. 8 – Thread the cable through rods/pipes – do not forget the joints. Only use high-quality pipes free from sharp edges and burr.

! NOTICE

Make sure that there are no sharp edges that could damage the cable.

! NOTICE

Do not use galvanized rods/pipes. A chemical reaction may occur with the stainless steel of the piezometer body, resulting in generation of gas and unreliable measurements.

3.3 Using a release adapter

For installation in soft soils, at limited depths a release adapter could be used together with your normal sounding rods. When a release adapter is used, the sounding rods can be pulled back up after installation, leaving only the piezometer and cable in the ground. This makes it possible to save material by using the same rods for several piezometers.

The release adapter is to be screwed on the pushing rod and slipped into the one-inch pipe end of the piezometer. The cable comes out of the slit and should run freely on the outside of the pushing rods during installation. Make sure that there are no sharp edges or dirt in the cable slit of the adapter. Also make sure that the cable is not squeezed between the adapter and the piezometer pipe.

We recommend you to pull the cable inside the rod string if you should be using rods that are thicker than 32 mm, e.g. standard 36 mm CPT rods.

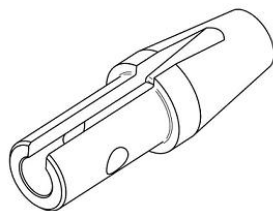


Fig. 9 – Release adapters are available for most common rod types.

! NOTICE

Make sure that there are no sharp edges or dirt in the cable slit of the adapter. Also make sure that the cable is not squeezed between the adapter and the piezometer pipe. Pull the cable inside the rod string if rod diameter should be larger than 32 mm in order to avoid damages to the cable.

3.4 Pre-drilling

If the first meters consist of dry crust with clay or silt, pre-drilling is recommended. Depending on soil conditions and local quality requirements for pore pressure measurements, pre-drilling may need to be carried out all the way down to the ground water table. If possible, keep the hole filled with water.

If the first meters consist of fillings, pre-drilling is recommendable through the whole filling. If the soil seems to collapse into the hole it should be stabilized with a casing pipe or a fluid, e.g. bentonite. If casing is being used, it should be filled with water.

Should the ground be frozen, pre-drilling is always to be carried out. If the piezometer is pressed through frozen soil, a negative pressure might occur, sucking the water out of the filter. In worst case the water inside the piezometer could freeze and crack the sensor membrane.

NOTICE

Pre-drilling should always be carried out through frozen ground. Negative pore pressure could affect de-airing. The sensor membrane might crack if the water inside the piezometer freezes.

4 Installation of the piezometer

4.1 Pushing down

The piezometer should be pushed down through the soil with a constant speed of max. 2 cm/sec – in some soils you have to push even slower. To prevent overloading of the sensor membrane, it is recommended to connect the read-out instrument and check the pressure regularly during the installation. The pressure may never exceed the pressure range with more than 75% (valid for standard equipment). Lower limits may apply for piezometers with special range.

Protect the cable from tangling and from high pull forces. Make sure that there are no sharp edges that may damage the cable. A damaged cable could make the piezometer unusable.

NOTICE

Push down the piezometer slowly and monitor the pressure during installation – the pressure may never exceed the pressure range with more than 75% (valid for standard equipment). Lower limits may apply for piezometers with special range.

NOTICE

Push down the piezometer with constant speed. Any kind of hammering will permanently damage the sensitive ceramic membrane of the pressure sensor.

NOTICE

Protect the cable from tangling and from high pull forces. Make sure that no sharp edges damage the cable. A damaged cable could make the piezometer unusable.

4.2 Cutting the cable

When the piezometer is installed at the right depth, the remaining part of the cable may be cut.

5 Programming and data collection

Connect the piezometer's two wires to the crocodile clips of your PVT Interface. Start up the software on your computer and connect the interface to one of the computer's USB ports. You can now read the serial number and real time value on the computer screen.

We recommend you to monitor the pressure in real time during installation.

If your piezometer is equipped with logging memory, you may use your computer for setting required logging intervals and collecting log files.

A log file from the installation will verify that the equipment has not been exposed to a pressure exceeding allowed maximum pressure while being pushed through the soil. In this case the logging interval should be set to the minimum.

Please refer to the separate software manual for your read-out and programming solution.

Please refer to separate documents for information on systems for remote management.

6 Maintenance

6.1 Damaged equipment

The piezometer is not designed for repair in the field. Disassembly requires special tools and special spare parts will be required. The piezometer requires calibration after having been disassembled.

Piezometers with logging memory are powered by Lithium Metal batteries that must be handled with care as a flammability hazard exists. Do not short-circuit, mishandle or disassemble the battery.

WARNING

Equipment containing Lithium Metal Batteries

The piezometer with logging memory is powered by a lithium metal battery that must be handled with care as a flammability hazard exists. Do not short-circuit, mishandle or disassemble the battery.

WARNING

Equipment containing Lithium Metal Batteries

When sending a piezometer with memory by air, the package must have a warning label and safety information. Please refer to appended transport instructions and rules issued by your forwarder. Never send damaged batteries by air.

6.2 Authorized Workshops

For support, calibration and repair please contact:

Ingenjörfirman Geotech AB
Datavägen 53
SE- 436 32 Askim
SWEDEN

info@geotech.se
+46 31 289920

For customs reasons, please declare **serial number** of probes etcetera when sending equipment for service.

6.3 Trouble Shooting

The trouble shooting table below is not complete, nor subject to any quality assurance, and thus published as indication only. Please feel free to revert with additional questions and suggestions.

Issue:	Finding possible causes:	Actions:
No communication with the piezometer.	Right COM port selected?	Select correct COM port.
	Are crocodile clips in contact with the wire?	Remove insulation from the wire and check that the clip is correctly attached.
	Is the piezometer or cable damaged?	Repair or replace.
	Is the contact damaged?	Consult with Geotech.
	Is the interface damaged?	Consult with Geotech.
Measured value reads 120 mH ₂ O constantly.	Has the sensor maximum pressure been exceeded?	The sensor membrane has been damaged. Install a new piezometer, pushing slower while monitoring the pressure real-time.
	Has the piezometer been exposed to hammering?	The sensor membrane has been damaged. The piezometer must not be hammered into the ground. Pre-drill of the ground is too hard.
	Has the saturated piezometer been exposed to temperatures below 3°C?	The sensor membrane has been damaged. The water inside the de-aired piezometer expands at it starts freezing.

Appendix

Transport instructions for “Piezometer with memory”

“Piezometer with memory” is powered by a Lithium-Metal battery with Li content not exceeding 2 g. The Li content for each cell does not exceed 1 g.

When sending by air, the package must have a warning label and safety information. Before sending the equipment, please check applicable rules with your forwarder. Never send damaged lithium batteries with air freight.

	Equipment containing Lithium Metal cells or batteries The package must be handled with care as a flammability hazard exists. The package should not be damaged or mishandled. If the package is damaged special procedures should be followed; this should include inspection and re-packaging if necessary. Do not load or transport package if damaged. For more information, call +46 31 289920.
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This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the entire width of the page. There are no margins, text, or other markings present.



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