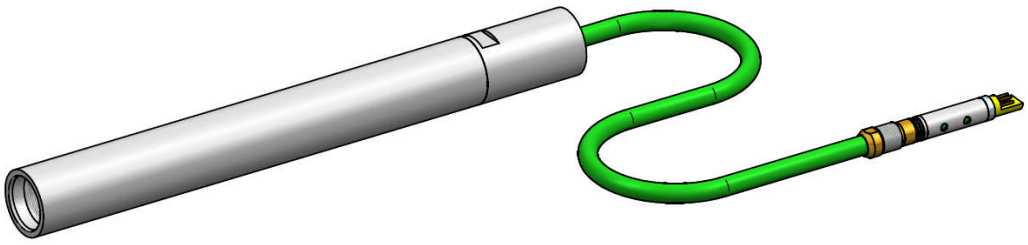
USERS MANUAL

GEOTECH SCPT

(Seismic Cone Penetration Testing)



Ingenjörsfirman Geotech AB
Datavägen 53
SE-436 32 ASKIM (Göteborg)
Sweden
Ph: +46 - 31 28 99 20
Fax:+46 -31 68 16 39

E-mail: info@geotech.se
www.geotech.eu

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DOCUMENT HISTORY

Date	Comment	Sign
2009	Revised content	
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2014-11-21	Editorial corrections. Added actions to Trouble Shooting.	mcn

1 General Information

1.1 Foreword

This manual contains important information for the proper use and safe operation of seismic add-on equipment to GEOTECH CPT System.

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

Always keep the manual at the equipment and replace it immediately if it should become wholly or partially unusable. A new copy can always be ordered from Ingenjörsfirman 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. Ingenjörsfirman 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:

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ NOTICE

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

Seismic tests are carried out to measure shear (S wave) and compression wave (P wave) velocities in soils. The SCPT method combines the seismic test with results from the CPTU probe, and will give you a good basis for evaluation of a number of critical soil properties, e.g. the risk for liquefaction.

Please refer to separate literature for detailed information on scientific background and evaluation methods.

GEOTECH CPT NOVA is a modularly designed product family for user-friendly, robust and accurate CPT, CPTU, Seismic CPT (SCPT) and Electric Conductivity CPT soil investigations. This manual concentrates on seismic features. Please refer to separate documents for descriptions of CPT/CPTU and Electronic Conductivity CPT.

The CPTU probe is designed for use on land as well as off shore, and give accurate measurements of cone resistance (Qc), sleeve friction (fs) and pore pressure (u). Options for sintered pore pressure filters in u1 and u2 positions as well as slot filters are available.

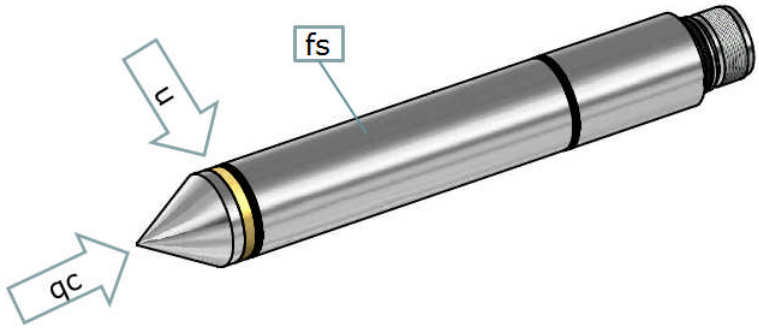


Fig. 1 – The CPT NOVA probes are designed for use on land as well as off shore, and give accurate measurements of cone resistance (Qc), sleeve friction (fs) and pore pressure (u) (figure shows pore pressure filter in standard position "u2"). In addition there is a built-in inclinometer.

The wave is normally generated at the ground surface or at subsea applications on the seabed. A modified sledgehammer and a metallic plate form a simple and reliable wave source for use on land:

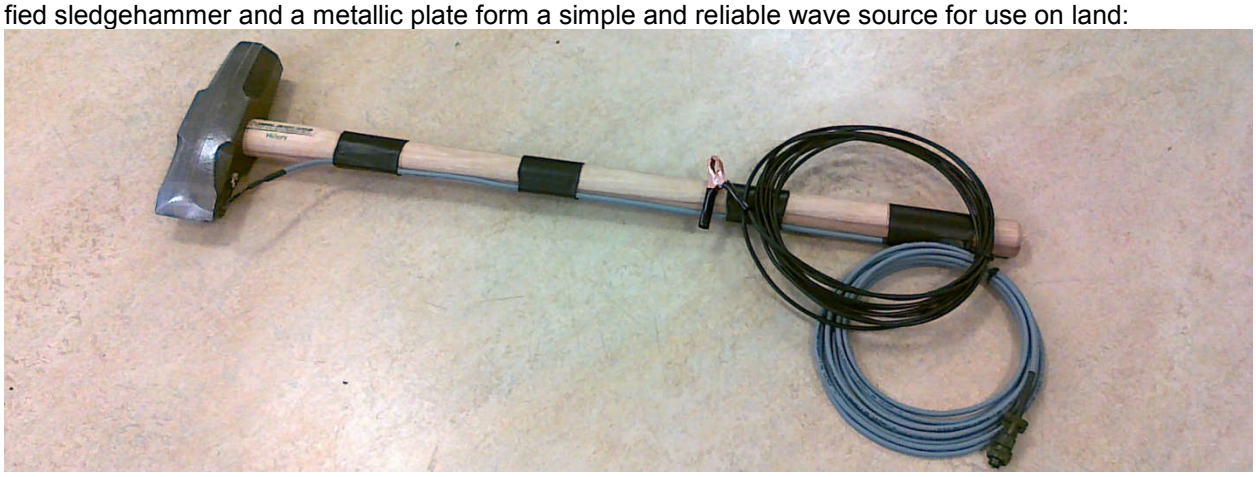


Fig. 2 – Wave source for use on land based on a modified sledgehammer.

The seismic add-on adapter is to be connected immediately behind the CPT probe. It is available with uniaxial or three-axial sensor. The standard adapter is intended for use together with “NOVA Probe”. Versions for “Classic probe” are available on request.

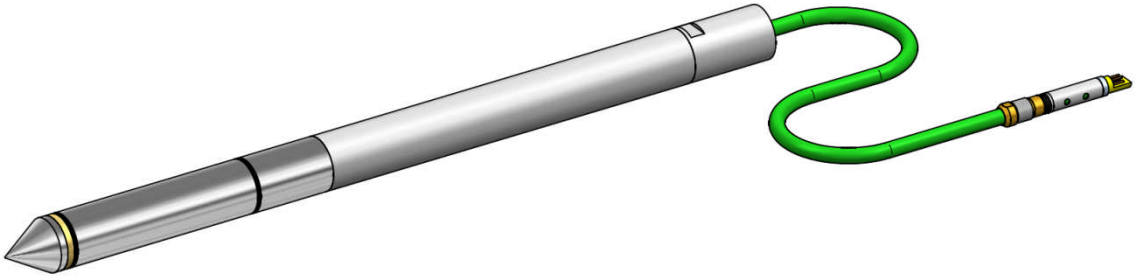


Fig. 3 – The SCPT adapter is available in uniaxial and three-axial versions for connection to a CPT NOVA probe. Versions for connection to the previous “Classic probe” are still available on request.

The trigger signal is generated when the hammer is hit against the steel plate. The seismic signal is captured by the SCPT box and transferred to the SCPT-LOG software in the logging computer.
After processing in the probe, CPTU data are passed on to the interface, which also receives depth information, from a depth encoder. The CPT-LOG software in the logging computer communicates directly with the interface via a separate cable. Data are presented simultaneously on the computer screen as curves and digits.

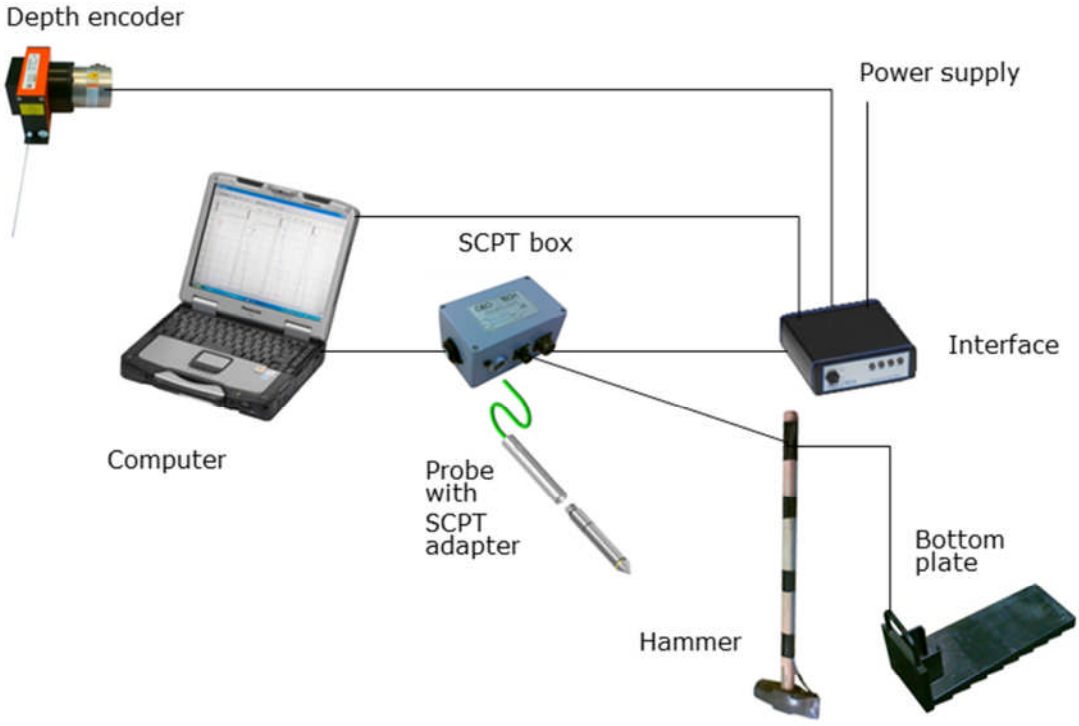


Fig. 4 – Typical system design for a GEOTECH SCPT system. The seismic signal is captured in the SCPT box that communicates directly with the computer via a USB cable. CPTU data from the probe and the depth encoder input are combined in the interface that communicates with the CPT-LOG software in your computer via a separate cable.

The seismic system can be delivered as add- on equipment to your existing CPT system or together with CPTU equipment as a complete turn-key plug-and-play package.

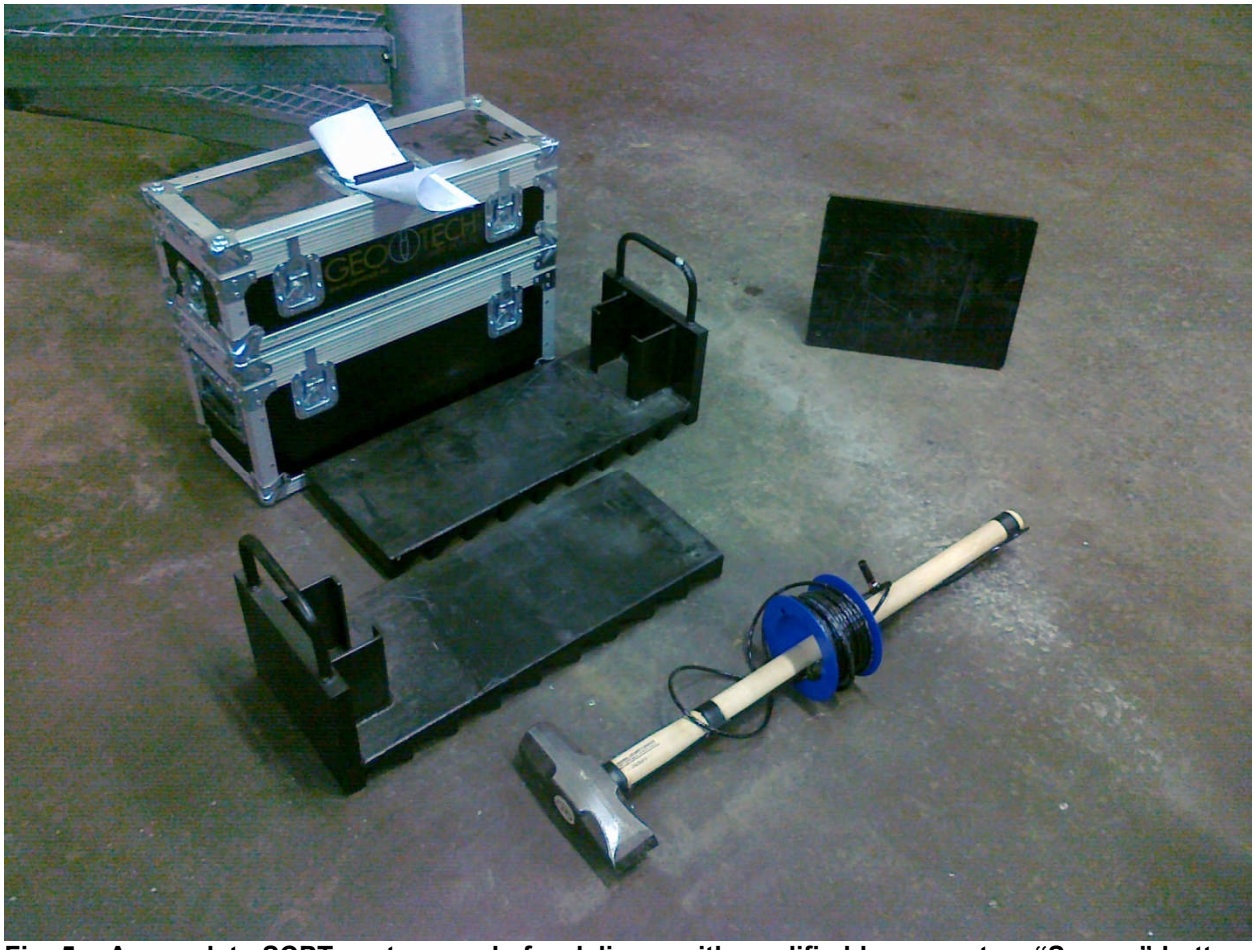
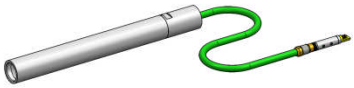
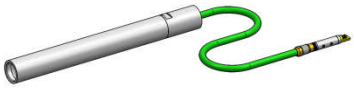
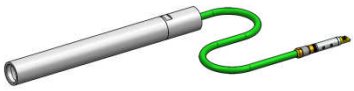


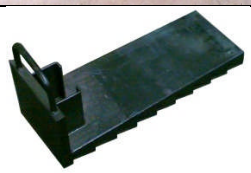
Fig. 5 – A complete SCPT system ready for delivery with modified hammer, two "S wave" bottom plates and one plate for P wave generation.

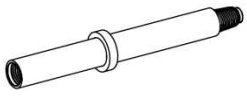
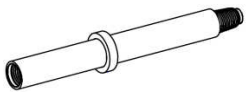
2.2 Intended use

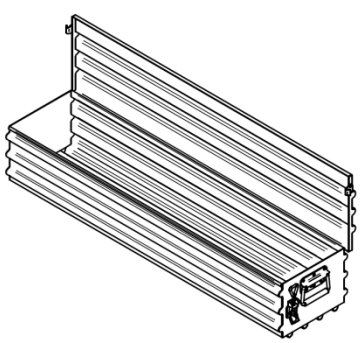
GEOTECH CPT and SCPT equipment is designed for geotechnical site investigations, and may only be used for this purpose. All other use is prohibited.

2.3 System components overview

Item No.	Item	Illustration	Description
		In the hole equipment:	
See separate manual	Probe NOVA		Electronic probe for testing soil properties according to the CPT and CPTU methods. Measures soil data while being pushed through the ground, e.g. point resistance (qc), sleeve friction (fs) and pore water pressure (u). Diameter 36 mm.
10692	SCPT adapter 3-axial Nova		Seismic three-axial adapter to be connected to "probe NOVA". Power supply and data transmission through the cable. Diameter 36 mm. Conical standard thread.
10508	SCPT adapter 3-axial Classic		Seismic three-axial adapter to be connected to "Classic probe". Power supply and data transmission through the cable. Diameter 36 mm. Conical standard thread. Available on request.
10691	SCPT adapter 1-axial Nova		Seismic uniaxial adapter to be connected to "probe NOVA". Power supply and data transmission through the cable. Diameter 36 mm. Conical standard thread.
10500	SCPT adapter 1-axial Classic		Seismic uniaxial adapter to be connected to "Classic probe". Power supply and data transmission through the cable. Diameter 36 mm. Conical standard thread. Available on request.
10758	Cable, from probe adapter		Cable, from probe adapter. Green, diameter 10,5 mm. 0.093kg/m. CE conformity according to Low Voltage Directive LVD 2006/95/EC. RoHS. (Connectors 10502 below are mounted on cable pictured).
10502	Set of connectors, probe-cable		Normally mounted on cable at delivery.

		Seismic wave generation:	
10504	Hammer with electric trigger contact.		Hammer with electric trigger contact. Connector for trigger signal to Seismic box. Clamp for earth connection of bottom plate.
10503	Bottom plate, S		Bottom plate for generation of share wave (S wave).
11679	Bottom plate, P		Bottom plate for generation of compress wave (P wave).
		SCPT surface equipment:	
19665	Seismic box 3-axial USB		Seismic box with capacity for three-axial seismic adapter. Connections for trigger pulse, cable from probe/adapter, and for CPTU data to CPT Interface. USB cable for connection to computer included.
10850	Cable, acquisition box – interface		Cable for connection of the Seismic box to the CPT-interface.
		SCPT data acquisition and analysis software	***Medium for software delivery may change without notice***
10558	SCPT-LOG		SCPT logging software. Right to use on one computer, licensed by owner of all rights Geotech AB.
10559	SCPT-Analysis		SCPT analysis software. Right to use on one computer, licensed by owner of all rights Geotech AB

		Spares and tools	
	Spare HASP key		USB key for hardware lock (Spare part, not additional license).
		CPT rods etc.	
07629	CPT sounding rod 36 STD		CPT sounding rod for soil investigation. For cable or acoustic data transfer. Properties of each part: Diameter: 36 mm, conical STD “Standard” thread. Active length: 1000mm Total length:1546 mm incl. winding Approx. weight: 6.75 kg
01826	CPT sounding rod 36 “Speedlock” (SPL)		CPT sounding rod for soil investigation. For cable or acoustic data transfer. Properties of each part: Diameter: 36 mm, conical SPL thread. “Speedlock”. Active length: 1000mm Total length:1546 mm incl. winding Approx. weight: 6.75 kg
12418	Friction reducer STD/STD ring		To be mounted before the first rod. Reduces the friction between soil and rod. 36mm STD/STD threads.
12418	Friction reducer STD/SPL ring		To be mounted before the first rod. Reduces the friction between soil and rod. 36mm STD/SPL threads.
02846	Scraper rubber		Cleans the rod while pulling it up.

24835	Transport case for rods		Transport case for 1 m rods. Dimensions: 113 x 27 x 22 cm. Weight 19.3 kg

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

2.4 SCPT adapter

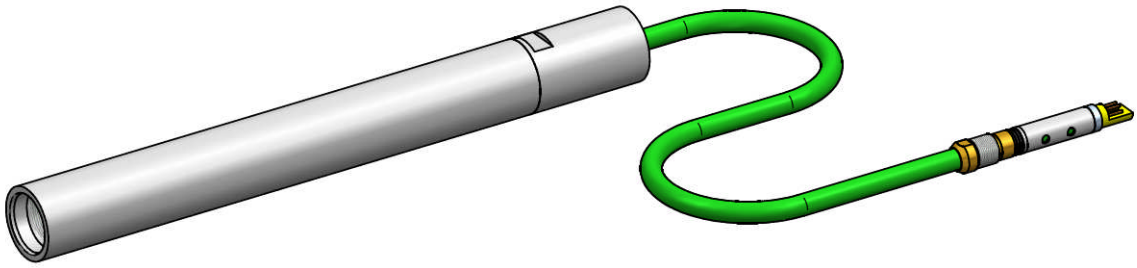


Fig. 6 –The SCPT adapter is to be mounted between the probe and the pushing rod.

The SCPT adapter is to be mounted between the CPTU probe and the pushing rod. The sensor is mounted centrally in the adapter and is available in uniaxial and three-axial versions. Note that NOVA and Classic probes will require different SCPT adapters.

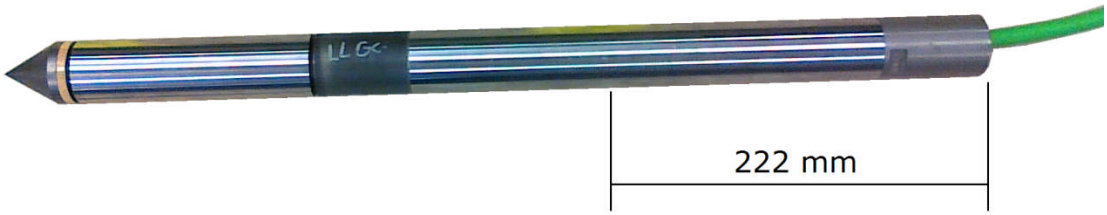


Fig. 7 –SCPT NOVA probe assembly. The seismic sensor is mounted centrally in the SCPT adapter.

2.5 Cable from probe/ seismic adapter

The connection between the adapter and cable demands caution. Make sure that connectors fit to each other properly before tightening the bolts. Before the other end of the cable is connected to the SCPT box, the LEMO adapter should be mounted on the connector.



Fig. 8 – The connection between the SCPT cable and the seismic adapter: Make sure that connectors fit to each other properly before tightening the bolts.



Fig. 9 – Before the cable is connected to the SCPT box in the other end, the LEMO adapter should be mounted on the connector.

2.6 Seismic acquisition box

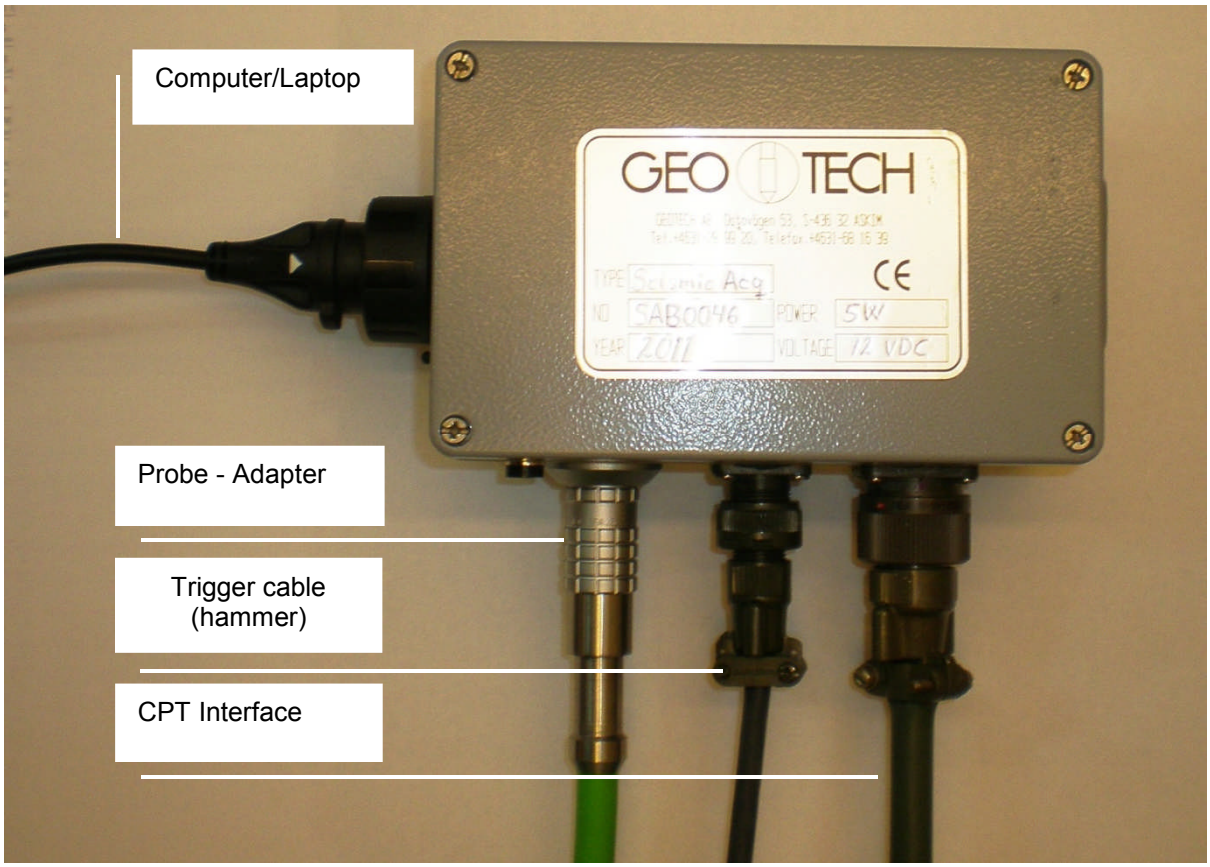


Fig. 10 – Connection of cables to the Seismic box.

2.6.1 CPT Interface cable

Note that the cable between the Seismic Box and the CPT Interface must have internal connection to all pins (some “Microphone cables” might not be fully connected). The signals from the CPTU probe are passed on to the CPT interface without processing in the Seismic box. Old interfaces might need to be upgraded.

CPT Interface connector pins	Function
A	Power +12V
B	Signal
C	-
D	Ground
E	Reserved
F	-

2.6.2 Trigger cable (hammer)

The trigger input is normally open. A trigger pulse (closing) from the hammer will initiate the SCPT test.

Trigger connector pins	Function
A	Trigger upon grounding
B	Ground

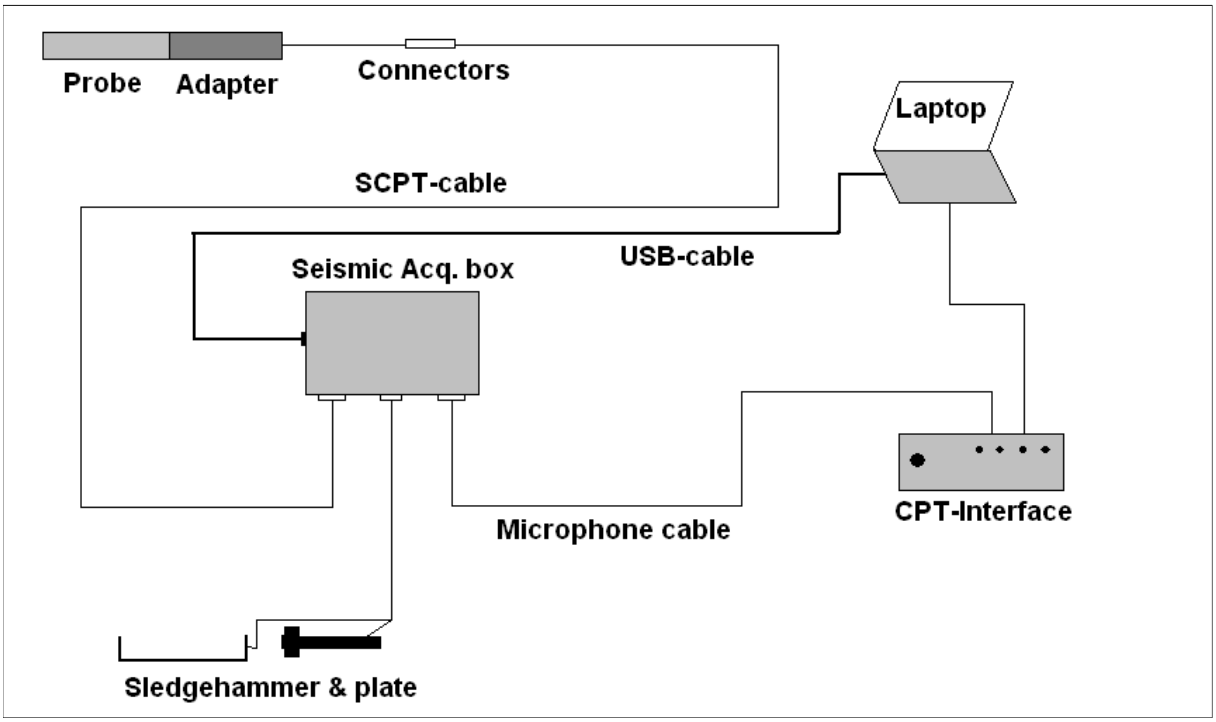


Fig. 11 – Block diagram for connection of a complete SCPT system.

2.7 Wave generation

2.7.1 Sledge hammer

The hammer has one cable for connection to the seismic acquisition box and one cable with a clamp for grounding in the bottom plate.

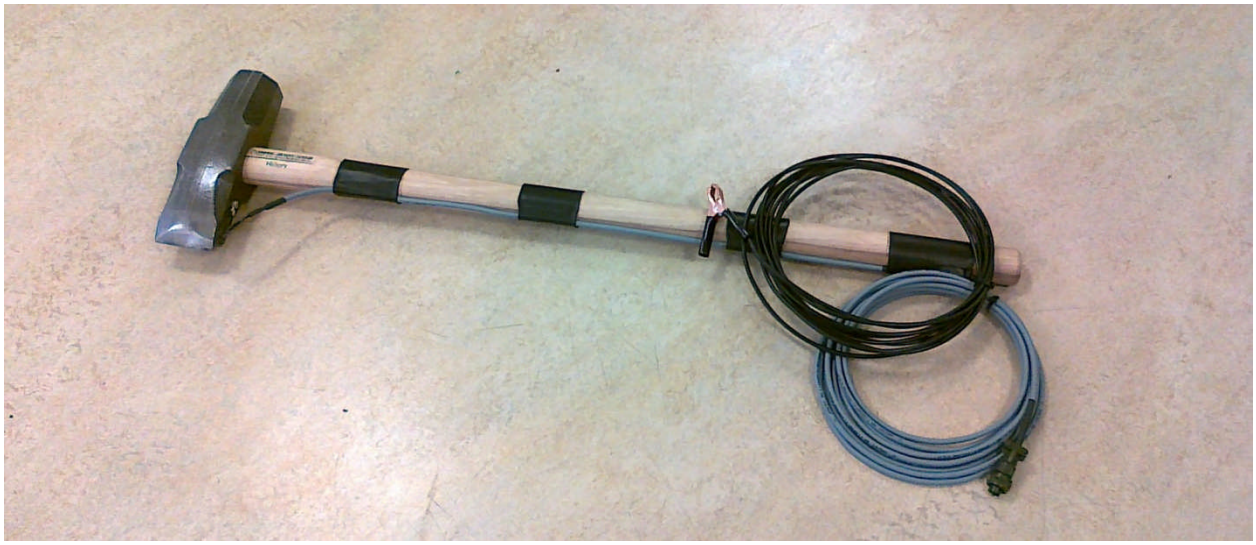


Fig. 12 – Wave source for use on land based on a modified sledgehammer. Connection to seismic box and for grounding in bottom plate.

2.7.2 Bottom plate “S wave”

Target and grounding clamp surfaces should be cleaned from possible paint, rust and dirt.

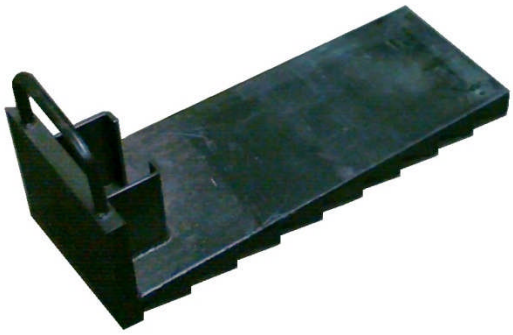


Fig. 13 – Bottom plate for S wave.

2.7.3 Bottom plate “P wave”

Target and grounding clamp surfaces should be cleaned from possible paint, rust and dirt.

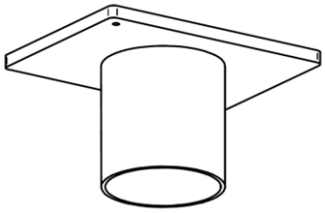


Fig. 14 – Bottom plate for P wave.

2.7.4 Remote controlled wave generator

Remotely controlled wave generators and insulated trigger solutions are available on request, e.g. for sub-sea use. Refer to separate documents for details.

2.8 SCPT-LOG logging software



Fig. 15 – SCPT-LOG logging software with HASP key. Medium for software delivery is subject to change without notice.

The Seismic Box interacts with the CPT-LOG software, installed on the logging computer. The software has functions for setting up system, performing tests and presenting test results.

The HASP key that comes with the system is required for running the software. Please refer to separate software manual for details.

2.9 SCPT-Analysis software

The SCPT-Analysis will help you analysing the test results. Please refer to separate software manual for details.

3 Preparations

Please refer to the “Installation” chapter below and separate software manual for information about setting up the equipment. Note that details may change depending on soil conditions, applicable standards and end customer demands. Refer to separate manual for setting up the CPTU functionality.

Prepare and saturate the CPT probe according to separate manual.

3.1 Preparations for shear wave testing (S wave)

Apply two “L” shaped bottom plates as indicated in the illustration below and press them firmly into the ground, e.g. under the wheels, tracks or foot of the site investigation rig or vehicle. The plates are equipped with transversal “teeth” to improve the contact with the ground. Do not to apply the plates too close to the rod string (recommended 1 to 3 m).

Sledge hammer blows parallel with the ground surface will give polarised shear waves. If you want to apply two oppositely polarised S waves, the sledge hammer blows should be directed towards the rod string from two opposite points, at the same distance from the rod. Typically, it would be from both sides of the drill mast.

Try to isolate the rod string from the parts of rig or vehicle affected by sledge hammer blows.

In order to provide a repeatable source for seismic attenuation analysis, you might like to use a hydraulic or pneumatic piston, or a sledge hammer swinging around a fixed point.

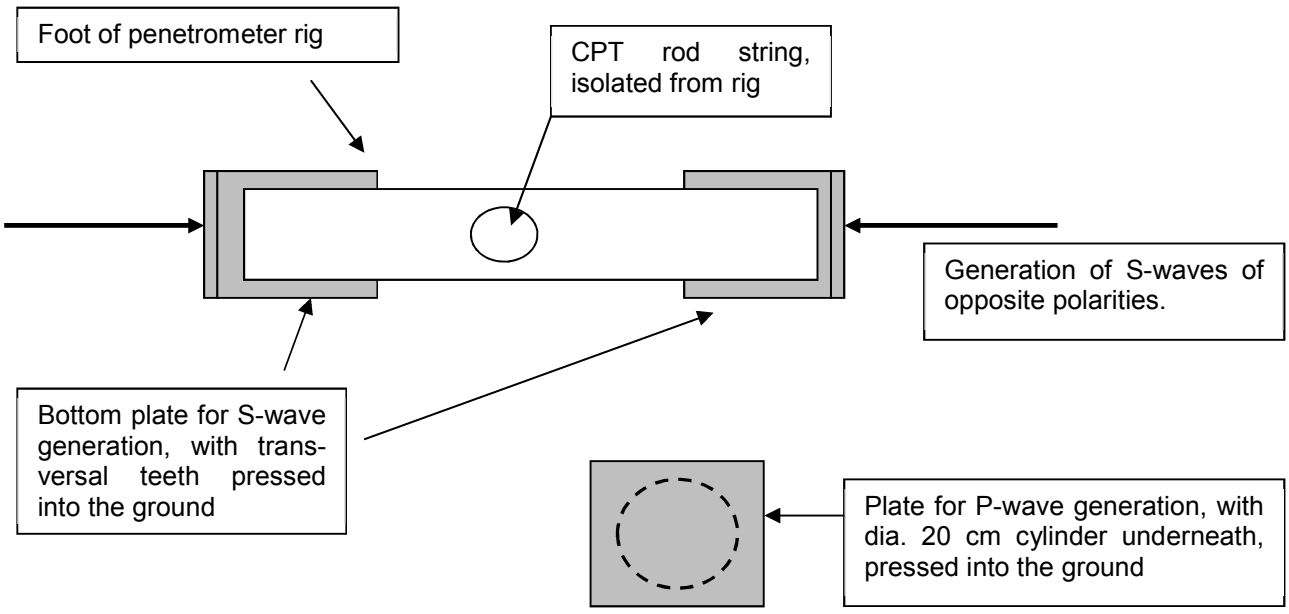


Fig. 16 – SCPT Acquisition Setup.

3.2 Preparations for compression wave testing (P wave)

Place the square plate with cylinder welded underneath, approximately 1 to 3 m from the rod string. Ideally there should not be any physical contact between the plate and rig or rod string.

Prepare for applying vertical sledge hammer blows on the plate. For a repeatable source of energy, a falling weight similar to SPT tests could be used.

4 Performing a test

Start the SCPT-LOG software and pre-set the acquisition parameters as described in the SCPT-LOG manual.

Start the CPT-LOG software. After having read the zeroes of the CPTU channels, start the CPTU test as described in separate manuals.

Stop the penetration at desired depth and perform dissipation test if required. Thereafter:
Go into PAUSE (see CPT-LOG manual). In order to reduce noise you might like to turn off the engine of the penetrometer or drill rig. In addition try to isolate the rod string from the drill rig or penetrometer.

In the “Sample Control” window of the SCPT-LOG software set the depth, gain and distance to the source. Set sensitivity to 100 m/s^2. Never change the sampling rate during a test. Analyses of traces with different sampling rates are not possible.

In the “SCPT Graph” window of the SCPT-LOG software set depth and wave type (S-Wave or P-Wave). For “S-Wave” select polarisation depending on wave source side and direction of stroke (left or right).

Press “Start” and the system is ready to collect data.

Hit bottom plate with the sledge hammer or activate the remote controlled wave source.

Directly after the acquisition is finished the graph is displayed in the graph window. Click
Save to save the data or Abort to delete it without storing. Press “Start” and repeat until you are satisfied with the graph. Don’t forget so save!

At the same level perform S-Wave test (horizontal strokes) from left and right and if required also P-test (vertical strokes or falling weight). Note that automatically generated file names carry important information about the test.

When you are satisfied with the graphs on one level, go back to the CPT-LOG software, press Start (F2) and resume the CPTU test.

Do the next SCPT test in the same way as described above. The interval shear velocity can be easily calculated in the field, for quality assessment, by running the seismic analysis software SCPT-Analysis.

At the end of the test, go into PAUSE mode with CPT-LOG, pull back the rods and read the zeroes of the channels of the CPTU probe.

For details on software handling, please refer to separate manuals for CPT-LOG, SCPT-LOG and SCPT-Analysis.

5 After test

5.1 Immediate actions

Wipe dry the equipment and store it in a controlled environment with low humidity between jobs.

⚠ WARNING

Deep-sea probe assemblies that have been exposed to high pressure should be opened with great care. Under certain conditions considerable energy in the form of overpressure could accumulate.

1. Clean and wipe dry the probe assembly directly after test and before disassembling.

2. Disassemble the probe from the adapter. Inspect the O-ring for damages and confirm that the internal parts of the joint are dry. If any water should be detected, the equipment must not be used until the root-cause has been identified and eliminated, all parts of the equipment are completely dry, and the functionality has been tested.

3. If necessary clean the internal threads of the adapter. Dirty or corroded threads might cause voltage drop affecting the functionality of the system. If necessary use a rotating wire brush to clean the thread of the transmitter.



Fig. 17 – Dirty or corroded threads might affect the functionality of the system. If necessary use a rotating wire brush to clean the thread of the adapter.

⚠ NOTICE

Make sure that the equipment is clean and dry after each shift.

6 Installation and system maintenance

6.1 Installation

6.1.1 Hardware installation

The standard system is delivered with dedicated cables for connection of the different system components. Hence the electrical installation is normally a simple plug-and-play operation. Please refer to product information above.

Cable between Seismic Box and CPT Interface
Note that the cable between the Seismic Box and the CPT Interface must have internal connection to all pins (some “Microphone cables” might not be fully connected).

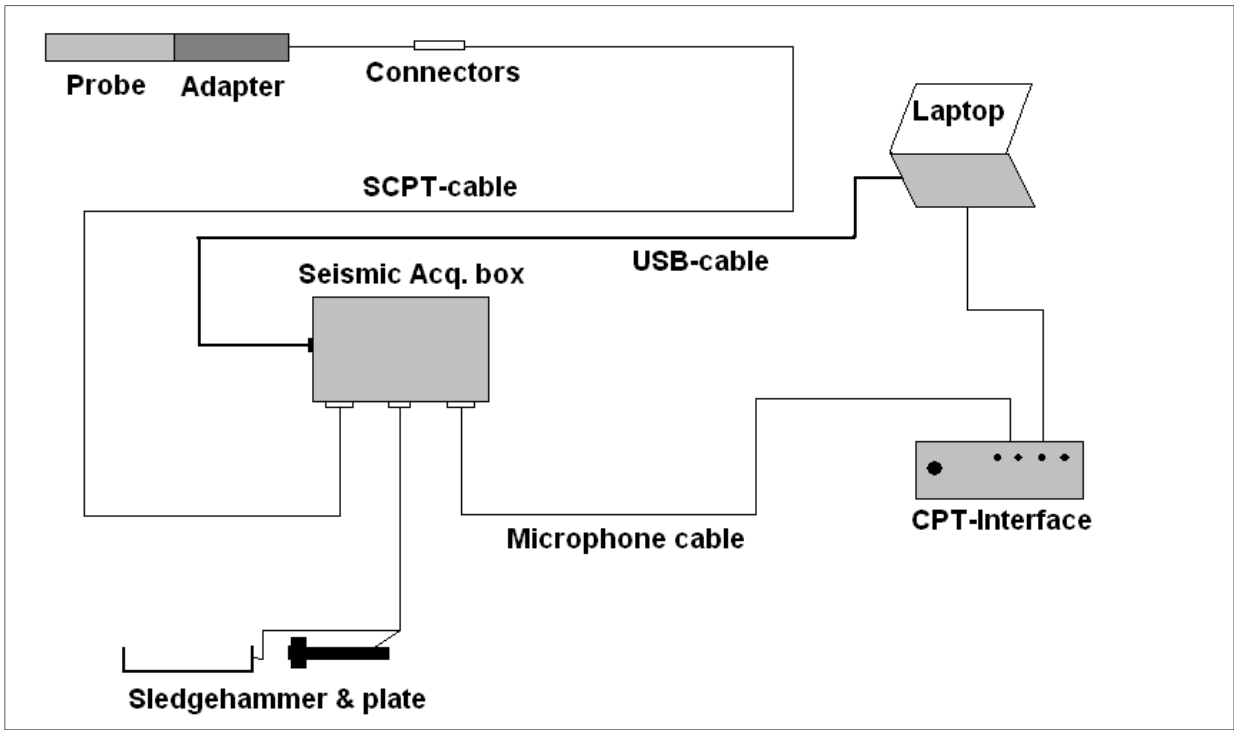


Fig. 18 – Block diagram for connection of a complete SCPT system.

Cable to SCPT adapter
Connect the cable to the SCPT adapter, thread the cable through the rod segments and connect it to the Seismic Box, using the cable adapter. Prepare the CPTU probe according to instructions in separate manual. Mount the SCPT adapter on the CPTU probe.

Trigger cable
Connect the sledge hammer cable to the Seismic Box and the free lead to a bottom plate, using the crocodile clamp. Make sure to remove paint and/or rust for best electrical contact between plate and clamp.

USB cable
Connect the USB cable to the Seismic Box and the computer.

Prepare interface, depth encoder and other CPTU parts as described in the Geotech CPTU manual.

6.1.2 Software installation

Normally the system is delivered without logging computer. Standard Windows PC is to be sourced locally by the customer. Please refer to separate software manual for installation instructions. Note that separate drivers might be required.

6.2 Authorized Workshops

For support, calibration and repair please contact:

Ingenjörsfirman 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:	**Possible causes/ Trouble shooting:**	**Actions:**
Error message "No USB BOARD installed. Restart!"	No contact computer - Seismic box.	Check cable computer - Seismic box
		Start "Instacal" software and check connection to Seismic box. Make sure that driver for seismic box is correctly installed. Refer to software manual for instructions.
No reaction upon hammer stroke.	Seismic box broken?	Disconnect the trigger cable from the Seismic box. Prepare a jumper wire and test by manually short circuiting pins A and B.
	No trigger signal received by Seismic box?	Check cable from sledge hammer and grounding to bottom plate. Make sure that polarity is correct, if repair should be necessary
No signal from SCPT adapter.	SCPT adapter or cable from probe assembly damaged?	Test by connecting SCPT adapter directly to the Seismic box.
Low amplitude of signal.	Weak signal / low gain setting	Increase gain setting in SCPT-LOG.
		Improve wave generation: increase stroke energy and/or contact between bottom plate and the soil.
No test results from CPT probe, e.g. q_c, f_s, u.	Cable mode not set in CPT-LOG software.	Select "Cable mode" in CPT-LOG Probe Characteristics.
	Poor connection between Seismic box and CPT Interface?	Make sure that you are using the right cable type (Item No. 10850), that it is undamaged and properly connected.
	Probe assembly or cable from probe assembly damaged?	Test by connecting SCPT adapter with CPT probe directly to the Seismic box.

Notes



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Datavägen 53 • 436 32 Askim • SWEDEN
Phone +4631289920 • Fax +4631681639
www.geotech.eu • info@geotech.se