Man 157

Vibrating Wire Push-In Pressure Cell

User Manual

What's this manual about?

This manual tells you about the Vibrating Wire Push-In Pressure Cell and how to use it to measure total earth pressures in soil.

Who does this apply to?

Installers, field engineers and technicians who need to acquire measurements of total earth pressures using a Vibrating Wire Push-In Pressure Cell.

Welcome!

Thank you for choosing the Vibrating Wire Push-In Pressure Cell.

This manual has been written to provide you with relevant information and to guide you in best practice when using a Vibrating Wire Push-In Pressure Cell in order for you to gain the most from our product.

Please read this manual thoroughly before use to help avoid any problems and keep it handy during installation.

Vibrating Wire Push-In Pressure Cell

The Vibrating Wire Push-In Pressure Cell measures total earth pressures in all soil types. A piezometer within the unit allows the measurement of pore water pressure and therefore the derivation of effective pressure.

The cell is formed from two sheets of steel welded around the periphery and the remaining narrow gap between the plates filled with oil.

A Vibrating Wire pressure transducer is connected by a short steel tube, forming a sealed hydraulic system.

A porous filter disc is incorporated in the cell and is connected to a second Vibrating Wire transducer, together forming an integral piezometer. The two Vibrating Wire transducers are mounted in tandem behind the spade-shaped cell and safeguarded within the protective pipe.

Each transducer is fitted with PVC sheathed, screened, electrical cable which extends beyond the top of the borehole to enable future termination or extensions.

Contents

OVERVIEW & INTRODUCTION

Important information

The following symbols are used throughout this manual

IMPORTANT INFORMATION

QUESTION

WARNING

TIP

! Important: Failure to adhere to the warnings in this manual may result in network disruption and possible data loss.

Failure to observe the warning may result in injury, product malfunction, unexpected readings or damage to the product that may invalidate its warranty.

Tips give additional information that may be helpful when using a Vibrating Wire Push-In Pressure Cell.

PRODUCT CHANGES

Soil Instruments Limited has an on-going policy of design review and reserves the right to amend the design of their product and this instruction manual without notice.

WARRANTY

Please refer to Soil Instruments Limited terms and conditions of sale for warranty information. Batteries are a consumable item and are excluded from any warranty.

DISPOSAL

Products marked with the symbol are subject to the following disposal rules in European countries:

- This product is designated for separate collection at an appropriate collection point
- Do not dispose of as household waste
- For more information, contact Soil Instruments Limited or the local authority in charge of waste management.

System Description
Things You Need to Know

FEATURES

- Uses proven Vibrating Wire technology
- Designed to be pushed into all soil types
- Recoverable push-in casing
- Additional, integral pore pressure sensor allows derivation of effective pressure
- Measures total earth pressures in all soil types
- Fast response to low volume pressure changes
- Fitted with thermistor for temperature monitoring
- Strong, screened and flexible connecting cables

BENEFITS

- Push-in design facilitates perfect contact with the soil
- Accurate, repeatable readings over long cable lengths
- Long working life, long-term stability and reliability
- Over-voltage surge arrestor protects against electrical damage
- Design prevents case stresses from affecting readings
- Suitable for manual or remote monitoring

Vibrating Wire Push-In Pressure Cell System Components

OVERVIEW

The Vibrating Wire Push-In Pressure Cell is suitable for measuring total earth pressures in clay soils up to shear strength of 300kN/m.

The integrated Vibrating Wire Piezometer enables pore water pressure to be measured; therefore the effective stress can be determined.

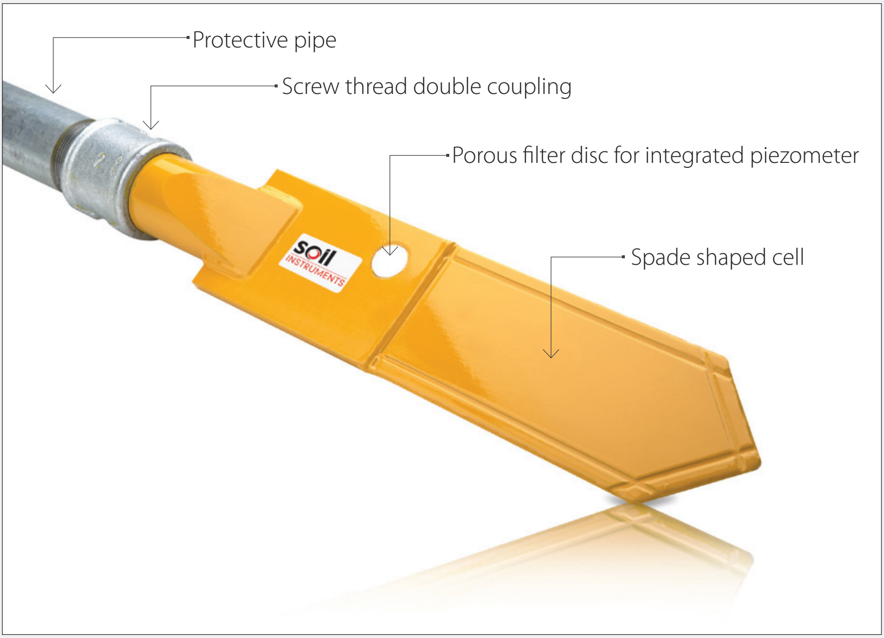
The cells may be installed permanently and used to monitor changes in earth pressure associated with construction of an excavation.

When installed in vertical boreholes, total horizontal stresses are measured by the pressure cell. They are often installed in stiff clay behind and in front of retaining walls, in soft puddle clay cores of old embankment dams and glacial till adjacent to sea cliffs.

The cells may also be used in horizontally drilled boreholes in tunnels and cliff faces. In these situations both horizontal and vertical stresses can be measured by the appropriate orientation of a number of cells.

The cells may be used as a site investigation tool to measure the in-situ stresses in the ground prior to any disturbance.

Vibrating Wire Push-In Pressure Cell Components



PUSH-IN PRESSURE CELL PREPERATION GUIDE

Preperation of Equipment Prior to Installation

Follow the precautions outlined in this manual at all times to ensure the correct working order of your instrument.

It is essential that the equipment covered by this manual is handled, operated and maintained by competent and suitably qualified personnel.

To guide you in the competence required for installing each instrument in our product range, Soil Instruments provides you with a recommended skill level in all of our manuals and datasheets.

Soil Instruments recommend an **advanced** skill level for installing a Vibrating Wire Push-In Pressure Cell.

All our equipment is rigorously tested and calibrated to the highest standards before leaving our factory, however it is good practice to perform a function test on all of the equipment to ensure that no damage has occurred whilst in transit or during unloading.

FUNCTION TEST

As soon as the equipment arrives, check that all the necessary parts are in correct working order, even if the installation is not going to be carried out immediately.

Prior to installation, the following tasks are necessary:

STEP	ACTION
1	Connect the wires from the Pressure Cell to a Vibrating Wire readout, such as **VWnote** or **VWread**
2	Take a set of readings using $F^2/1000$ units
3	Check that the readings are stable

Please refer to Datasheets '*RO-1-VW-NOTE Vibrating Wire Note*' and '*RO-1-VW-READ Vibrating Wire Readout*' for details on Soil Instruments Vibrating Wire handheld readouts.

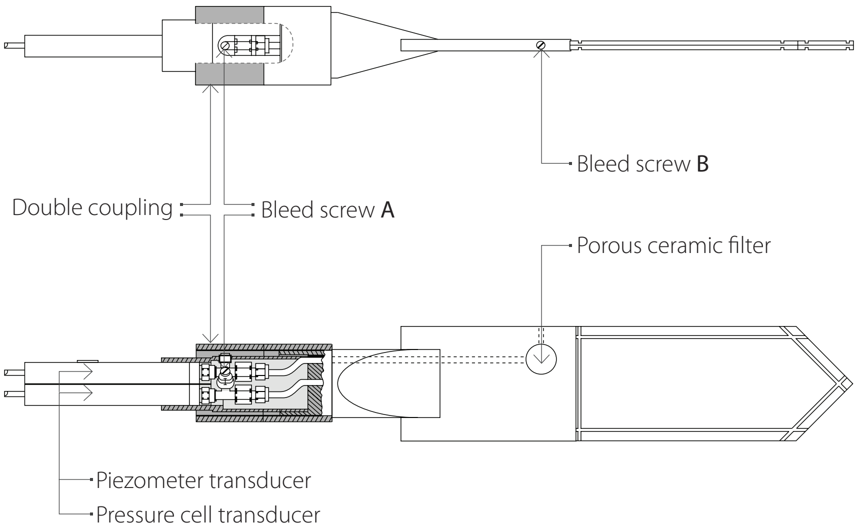
DE-AIRING THE PIEZOMETER

Please refer to '*Figure 1 - Schematic of the VW Push-In Pressure Cell*' on the opposite page in conjunction with the table below.

The filter of the pressure cell **MUST** be immersed in water for a **minimum** of 24 hours.

STEP	ACTION
1	Unscrew the double coupling to reveal bleed screw **A**
2	Remove bleed screws **A** and **B**
3	Place the pressure cell **vertically** with the point facing **downwards** in a water filled container to fully immerse the filter and leave for at least **24** hours
4	Incline the pressure cell at approximately **30°** from **horizontal** with the tip pointing **upwards**
5	Fill a dosing syringe with de-aired water and attach it to bleed screw **A**
6	Inject water until it trickles out of bleed point **B**
7	Turn the pressure cell **vertically** with the point facing **upwards** and shake vigorously to displace any air which may be trapped near the diaphragm of the piezometer transducer
8	Check that the O-ring is still fitted to bleed screw **B**
9	Inject water to displace any trapped air, insert and tighten bleed screw **B**
10	Lay the pressure cell **horizontally** and the disconnect dosing syringe
11	Insert and tighten bleed screw **A**

Figure 1 - Schematic of the VW Push-In Pressure Cell



Once the Piezometer has been prepared, store the pressure cell under water to keep the ceramic filter fully saturated until time of installation.

ZERO CHECK & CALIBRATION

Calibration values for the pressure cell and piezometer transducers are supplied with the instrument.

The base value is derived from the fluid pressure in the oil within the pressure cell. The base value may be affected by ambient temperature and barometric pressure which needs to be considered when checking the base value of the instrument.

Prior to installation of the cells it is vital to record the base (zero) reading since this will be the value to which all others will be compared.

You MUST ensure you record the base (zero) reading prior to installation.

Place the cell in an area where there is a constant temperature.

Placing the pressure cell in a drum of water that is close to the ground temperature is a good way to ensure that the temperature remains constant for recording the base (zero) reading.

The constant temperature should be as close to the ground temperature as possible as the oil filled cell will be affected by thermal expansion. Leave the cell for 3 to 4 hours to remove the existing temperature gradients within the cell and allow adjustment to the constant temperature. After this time has elapsed, record the reading on both transducers in $F^2/1000$ format using a Vibrating Wire readout, such as VWnote or VWread.

Please refer to Datasheets '***RO-1-VW-NOTE Vibrating Wire Note***' and '***RO-1-VW-READ Vibrating Wire Readout***' for details on Soil Instruments Vibrating Wire handheld readouts.

The readings should then be recorded and kept with the instruments calibration sheet.

PUSH-IN PRESSURE CELL INSTALLATION GUIDE
Vibrating Wire Push-In Pressure Cell

Follow the precautions outlined in this manual at all times to ensure the correct working order of your instrument.

It is essential that the equipment covered by this manual is handled, operated and maintained by competent and suitably qualified personnel.

To guide you in the competence required for installing each instrument in our product range, Soil Instruments provides you with a recommended skill level in all of our manuals and datasheets.

Soil Instruments recommend an **advanced** skill level for installing a Vibrating Wire Push-In Pressure Cell.

DRILLING THE BOREHOLE

The diameter of the borehole should ideally be 150mm diameter and no less than a100mm and should be drilled to within 0.5m to 1m of the desired location of the installation.

Make sure that the diameter of the borehole is no less than 100mm as an absolute minimum.

Ensure that the borehole remains open, casing may be required to prevent the borehole collapsing in poor ground.

Installation Procedure

RECOVERABLE CELL; VERTICAL HOLE WITH PERMANENT INSTALLATION PIPES

Having drilled the borehole and prepared the instrument as specified in the '*Push-In Pressure Cell Preparation Guide*', installation can now take place.

Remove the 500mm long protective pipe and feed the cables through the first length of installation pipe.

Screw the pipe onto the double coupling at the end of the pressure cell as shown in the photograph below.

Ensure that the installation pipe is correctly aligned and securely threaded to the double coupling of the pressure cell.

Once the pipe is securely threaded to the pressure cell, a thread sealing compound such as 'Boss White' or 'PTFE' tape should be placed onto the coupling to prevent any water ingress.

Bentonite pellets and water may be placed inside the first 0.5m of the protective pipe to act as a seal.

Sealing the protective pipe prevents it from acting as a drain and ensures a fast response of the piezometer to changes in the pore water pressure in the soil.

Make a clear and distinct mark on the upper end of the first installation pipe to indicate the orientation of the pressure cell, and repeat for all subsequent lengths of installation pipes.

It is essential to mark the subsequent installation pipes to ensure the correct orientation of the pressure cell is maintained.

Make sure you record a base (zero) reading immediately before the pressure cell is lowered into water or placed in the ground.

Immediately before you lower the pressure cell into water or install fully within the borehole, ensure you record a base (zero) reading on both the pressure cell and the piezometer. This reading is essential as the pressure cell is temperature sensitive and the temperature at the surface may well be different to that in the ground. This reading then becomes the zero reading which is used in all subsequent calculations.

When installing pressure cells to depths greater than 6m, the weight of the installation pipes necessitates the use of a pipe clamp to support the lower pipes whilst attaching the next one. An overhead pulley system or similar system is also required.

After the base (zero) reading has been recorded, lower the pressure cell and the first length of installation pipe down the borehole and support it. Connect the subsequent lengths of installation pipe making sure that the orientation is maintained. Attach the push-in adapter and cap to the upper end of the top installation pipe to allow the cables to protrude from the pipes and to allow pushing load to be applied.

The force required to install the pressure cell to a depth of 0.5 to 1m beyond the end of the borehole in clay with shear strength of approximately 150mN/m, is between 1.5 and 2 tonnes. Most of the reaction required is to push the boss of the cell and the installation pipes into the ground.

The cell needs to be pushed in steadily. Often the drill rig used to bore the hole can be used to apply the necessary pushing force. If the drilling rig is not suitable, a shell and auger rig for example, or if the borehole was hand augured, a cross beam anchored to ground pickets via two pull lifts may be used.

PERMANENT CELL; VERTICAL HOLE WITH RECOVERABLE INSTALLATION PIPES

To enable recovery of the installation pipes, the pressure cell is supplied with a 500mm long protective pipe with a left-handed thread at its upper end. A reusable threaded left-hand and right-hand adaptor connects the protective pipe to the installing pipes.

The threaded left-hand and right-hand adaptor is a separate item and must be specified when ordering.

The pressure cell is installed in the same manner as described in the '*Permanent Installation Pipes & Recoverable Cell*' section.

After the pressure cell has been pushed in to the required depth, the installing pipes are turned in a clockwise direction until the adaptor disconnects at the protective pipe. The installation pipes can then be removed.

HORIZONTAL HOLE

The installation procedure for horizontal holes is the same as for vertical holes although the problem of supporting the weight of the installation pipes is eliminated.

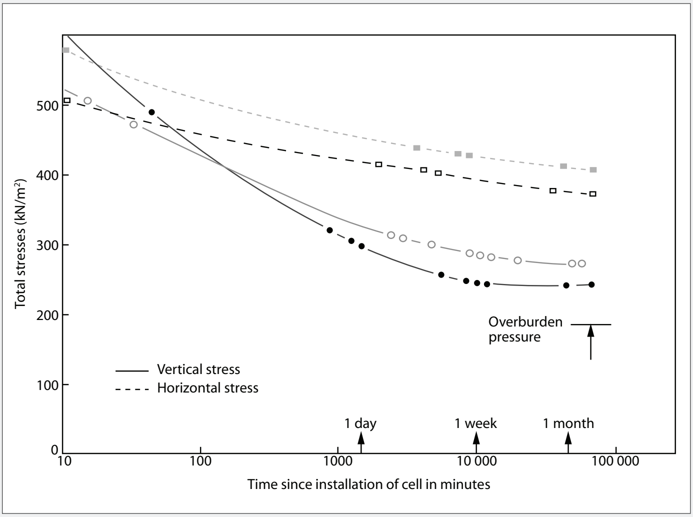
The arrangement necessary for pushing the pressure cell into position will depend upon the installation conditions. The cell may be pushed into position using a double acting hydraulic jack fixed to an Acrow prop in certain circumstances.

TAKING READINGS, MONITORING & DATA INTERPRETATION

Taking Readings & Moitoring

READING FREQUENCY

Readings on the pressure cell should be taken immediately after installation before grouting has been carried out. Several readings should be taken during the first day and a reading every day for the subsequent 3 to 4 days. A reasonable number of readings during the first 10 days after installation will ensure the pressure cell is functioning properly in the short term and provide a typical pressure/time dissipation curve, as shown in the example below.



MONITORING

The frequency of monitoring in the long-term will depend on the reason for the installation. If only knowledge of the in-situ stresses are required and no changes are expected, then weekly readings for a month after the first 10 days should be sufficient.

The cell can be removed after this time and installed elsewhere. When removing the cell it is important to check that the initial pre-set base (zero) reading is the same as the reading at the time of the initial installation.

Where pressure cells have been installed permanently to monitor changes in earth pressure, such as adjacent to a retaining wall, the frequency of readings will depend on the construction operations.

Data Interpretation

Pressure Measurements

ORIGINAL IN-SITU PRESSURES

The action of pushing the pressure cell into the ground initially generates high pressures locally around the cell. In a clay soil these excess pressures dissipate rapidly at first, but it is usually up to 10 days after the installation before the cell registers a stable equilibrium value. Due to the method of installation, this value is likely to be larger than the original in-situ pressures in the undisturbed ground.

It is suggested that where the pressure cell is pushed into soft and very soft clays, the magnitude of the over read is very small and may be ignored. In firm and stiff clays, it appears that the cell may over read by a small but significant amount. Based on work by Tedd and Charles (1983), it is suggested that the over read should be taken as half the un-drained shear strength of the clay.

PRESSURE CHANGES

Measured changes of pressure should be regarded as actual changes without any correction needed to be applied.

PORE PRESSURE

Measurements from the piezometer may take up to a week to fully stabilise before reliable results can be obtained.

DATA REDUCTION

The mathematical relationship between the frequency of vibration of a tensioned wire and the force applying the tension is an approximate straight line relationship between the square of the measured frequency and the applied force.

Engineering units of measurement maybe derived from the frequency based units measured by vibrating wire readouts in 3 traditional ways;

From '**period**' units and from '**linear**' ($f^2/1000$) units using two methods; a simple linear equation or a polynomial equation.

CALCULATING ENGINEERING UNITS FROM FREQUENCY BASED UNITS

The mathematical relationship between the frequency of vibration of a tensioned wire and the force applying the tension is an approximate straight line relationship between the square of the measured frequency and the applied force.

'**Engineering**' units of measurement maybe derived from the frequency based units measured by Vibrating Wire readouts in three traditional ways;

From '**period**' units ($t \times 10^7$) and from '**linear**' ($f^2/1000$) units using two methods, a simple '**linear**' equation or a '**polynomial**' equation.

CALCULATION USING PERIOD UNITS

The following formula is used for readings in '**period**' units.

$$E = K (10^7/P0^2 - 10^7/P1^2)$$

Where;

'**E**' is the Pressure in resultant '**engineering**' units,
'**K**' is the '**period gauge factor**' for units of calibration (taken from the calibration sheet)
'**P0**' is the installation '**period**' base or '**zero**' reading
'**P1**' is the current '**period**' reading.

This method of calculation is used by Soil Instruments Vibrating Wire Loggers (models RO-1-VW-1 or 2 and with serial numbers starting VL or TVL) internal processors, for calculating and displaying directly on the loggers LCD screen, the required '**engineering**' based units. The loggers require '**period**' base or zero reading units for entering into their channel tables to calculate and display the required '**engineering**' units correctly.

If an '**engineering**' based unit is required other than the units of calibration, then the correct '**K**' factor will have to be calculated using the standard relationship between '**engineering**' units. For example, if the units of '**engineering**' required were in inches and the calibration units were millimetres, we can find out that 1mm is equal to 0.03937", so we would derive the '**K**' factor for inches by multiplying the '**K**' factor for millimetres by 0.03937.

CALCULATION USING LINEAR UNITS

The following formula is used for readings in '**linear**' units.

$$E = G (R0 - R1)$$

Where;

'**E**' is the resultant '**engineering**' unit,
'**G**' the '**linear gauge factor**' for the units of calibration (taken from the calibration sheet)
'**R0**' is the installation '**linear**' base or '**zero**' reading
'**R1**' is the current '**linear**' reading.

Again the '**linear gauge factor**' for units other than the units of calibration would need to be calculated using the same principles as stated in the last paragraph of the '**period unit**' section.

LINEAR UNIT CALCULATION USING A POLYNOMIAL EQUATION

'**Linear**' units may be applied to the following '**polynomial**' equation, for calculation of '**engineering**' units to a higher order of accuracy.

$E = (AR1^2 + BR1 + C)$

Where;

'**E**' is the resultant '**engineering**' unit
'**A**', '**B**' and '**C**' the '**polynomial gauge factors**' 'A', 'B' and 'C',
(taken from the calibration sheet)
'**R1**' is the current '**linear**' reading.

The value '**C**' is an offset value and relates to the zero value experienced by the transducer at the time of calibration.

This value should be recalculated at the installation time as follows;

$C = - (AR0^2 + BR0)$

Where;

'**A**' and '**B**' are as above
'**R0**' is the installation '**linear**' base or '**zero**' reading.

Please note that the sign of the recalculated value of '**C**' should be the same as the original value of '**C**', so if the original is negative then the recalculated value should also be a negative.

Conversion to '**engineering**' units other than the units of calibration, would best be done after conversion, using a factor calculated using the same principles as stated in the last paragraph of the '**period unit**' section.

Appendix A - Conversion Table

Pressure, Stress & Modulus of Elasticity

MN/m2 or MPa	kN/m2 or kPa	kp or kgf/cm2	bar	atm	m H2O	ft H2O	mm Hg	tonf/ft2	psi or lbf/in2	lbf/ft2
1	1000	10.197	10.000	9.869	102.2	335.2	7500.6	9.320	145.04	20886
0.001	1	1.019 x 10-2	0.0100	9.87 x 10-3	0.1022	0.3352	7.5006	0.0093	0.14504	20.886
9.807 x 10-2	98.07	1	0.9807	0.9678	10.017	32.866	735.56	0.9139	14.223	2048.1
0.100	100.0	1.0197	1	0.9869	10.215	33.515	750.06	0.9320	14.504	2088.6
0.1013	101.33	1.0332	1.0132	1	10.351	33.959	760.02	0.9444	14.696	2116.2
9.788 x 10-3	9.7885	9.983 x 10-2	9.789 x 10-2	9.661 x 10-2	1	3.2808	73.424	9.124 x 10-2	1.4198	204.45
2.983 x 10-3	2.9835	3.043 x 10-2	2.984 x 10-2	2.945 x 10-2	0.3048	1	22.377	2.781 x 10-2	0.43275	62.316
1.333 x 10-4	0.1333	1.3595 x 10-3	1.333 x 10-3	1.315 x 10-3	1.362 x 10-2	4.469 x 10-2	1	1.243 x 10-3	1.934 x 10-2	2.7846
0.1073	107.3	1.0942	1.0730	1.0589	10.960	35.960	804.78	1	15.562	2240.0
6.895 x 10-3	6.895	7.031 x 10-2	6.895 x 10-2	6.805 x 10-2	0.7043	2.3108	51.714	6.426 x 10-2	1	144.00
4.788 x 10-5	4.788 x 10-2	4.883 x 10-4	4.788 x 10-4	4.725 x 10-4	4.891 x 10-3	1.605 x 10-2	0.3591	4.464 x 10-4	6.944 x 10-3	1

Appendix B – Troubleshooting Guide

Before any of the steps below are followed, a Vibrating Wire readout unit should be used to verify the stability of the reading.

The method used to verify the signal will be dependent on which type of VW readout is being used.

Please refer to the manufacturers' user manual for details on the method required for verifying signal strength.

Please refer to Datasheets ***RO-1-VW-NOTE Vibrating Wire Note*** and ***RO-1-VW-READ Vibrating Wire Readout*** for details on Soil Instruments Vibrating Wire handheld readouts.

Wildly fluctuating readings from the sensor (or an unsteady audio signal) are both indications of possible problems with the instrument or related electrical cables.

If the readout is giving faulty readings or audio signals from all of the sensors, a faulty readout unit and/or lead must be suspected. Another lead/readout unit should be used to check the readings.
If there is a fault with the readout unit,
please contact '***www.soilsupport.com***' for assistance.

STEP	ACTION
1	The resistance across the two conductors of the electrical cable should be tested using a multimeter. Check the resistance across the two conductors, either at the end of the cable if available, or at the corresponding terminals if wired into a Datalogger. The resistance across the two conductors should be approximately 120Ωto 180Ω. The majority of this resistance will come from the sensor, approximately 130Ω, with the remainder from the electrical cable connected to the transducer (for 22 gauge copper, resistance is approximately 1Ω /15m). Before proceeding, the continuity should be checked between conductors and the earthing screen of the electrical cable. **If continuity exists, a damaged cable is confirmed.**

STEP	ACTION
2	If the resistance across the two conductors is much higher than the values quoted in '**STEP 1**', or is infinite, **a severed cable must be suspected.** If the location of the cable damage is found, the cable can be spliced in accordance with recommended procedure.
3	If the resistance across the two conductors is much lower than the values quoted in '**STEP 1**', (less than 80 Ω) **it is likely that cable damage has occurred causing a 'short' in the circuit.** It is possible to calculate approximately how far from the cable end (or readout location) the suspected fault is. If the resistance of a known length of conducting cable is measured, a resistance/length unit can be found. This figure can be used to calculate the length of the conductor cable in between the readout location and the break in the circuit. If the location of the cable damage is found, the cable can be spliced in accordance with recommended procedure.

This method is only applicable if the '**short**' occurs between the two conductors of the electrical cable. Since cables are generally buried or hidden it is may not be possible to confirm a '**short**' is of this nature using this method.

STEP	ACTION
4	If the resistance is within the values quoted in '**STEP 1**' and no continuity exists between the conductor and the earth screen **AND** the reading from the sensor is unstable or wildly fluctuating, it must be assumed that the integrity of the circuit is good and the fault lies within the sensor. In this case please contact our support team at '*www.soilsupport.com*'.

Appendix C - Sample Calibration Certificate

soil INSTRUMENTS

Bell Lane, Uckfield, East Sussex
TN22 1QL United Kingdom t: +44 (0) 1825 765044 e: info@soilinstruments.com w: www.soilinstruments.com
Soil Instruments Limited. Registered in England. Number: 07960087. Registered Office: 3rd Floor, 1 Ashley Road, Altrincham, Cheshire, WA14 2DT, UK

VIBRATING WIRE INSTRUMENTS CALIBRATION CERTIFICATE

Instrument Type : Vibrating Wire Pressure Cell **Serial No.** : 025083

Instrument Range : 0.00 to 1000.0 kPa **Calibration Date** : 23/11/2006

Gauge Factors in kPa **Ambient Temperature** : 19°C

Period Gauge Factor (K): 4521.6290000 **Barometric Pressure** : 981 mbar

Linear Gauge Factor (G): (kPa/digit)0.4521600 **Calibration Technician** : David Manville

Polynomial Gauge Factor A: -0.000001984967000

Polynomial Gauge Factor B: -0.4311532000

Polynomial Gauge Factor C: 2839.456000**

Calibration Equipment:
Oil Deadweight Calibrator Serial No. 19462
Vibrating Wire Logger Serial No. 635

Regression Zero : 6400.5

Applied (kPa)	Reading (Period)	Reading F²/1000	Calculated (Linear)	Error %FS (Linear)	Linear Increment	Calculated (Polynomial)	Error %FS (Polynomial)
0.00	3955.0	6393.0	3.402	0.34	0.0	1.967	0.20
100.00	4021.9	6182.0	98.808	-0.12	-211.0	98.208	-0.18
200.00	4096.8	5958.0	200.093	0.01	-224.0	200.184	0.02
300.00	4173.9	5740.0	298.664	-0.13	-218.0	299.237	-0.08
400.00	4255.9	5521.0	397.688	-0.23	-219.0	398.555	-0.14
500.00	4345.0	5297.0	498.972	-0.10	-224.0	499.943	-0.01
600.00	4439.8	5073.0	600.257	0.03	-224.0	601.132	0.11
700.00	4539.8	4852.0	700.185	0.02	-221.0	700.771	0.08
800.00	4647.9	4629.0	801.017	0.10	-223.0	801.115	0.11
900.00	4763.0	4408.0	900.945	0.09	-221.0	900.364	0.04
1000.00	4885.9	4189.0	999.969	0.00	-219.0	998.524	-0.15

Formulae: Linear* $E = G(R0 - R1)$

Polynomial** $E = AR1^2 + BR1 + C$

* The zero reading should be established on site by the user on installation.
** The site value of C must be calculated using the formula $C = -(AR0^2 + BR0)$

The instrument detailed hereon has, as applicable, been tested and calibrated in accordance with procedures, which are part of our ISO9001:2008 Quality Management System, and unless otherwise indicated, performs within +/- 0.05% as specified. Thus, the in

Certified By ______________________ Line Manager

EC Declaration of Conformity

Soil Instruments Ltd., located at 34 Bell Lane, Uckfield, East Sussex, TN22, 1QL, United Kingdom.

We hereby declare that the devices described below are in conformity with the directives listed. In the event of unauthorised modification of any devices listed below, this declaration becomes invalid.

Type: STANDARD VIBRATING WIRE PUSH-IN PRESSURE CELL

Product Model: P9 VW Push-In Pressure Cell

Relevant EC Directives and Harmonized Standards:

2004/108/EC Electromagnetic Compatibility directive, as amended by **EN61326-1, ed3**

The product(s) to which this declaration relates is in conformity with the essential protection requirements of 2004/108/EC Electromagnetic Compatibility directive, as amended by EN61326-1, ed3. The products are in conformity with the following standards and/or other normative documents:

EMC: Harmonized Standards: EN 61326-1:2006 Lab Equipment, EMC

IEC61000-6-3:2007 Emission standard for residential, commercial and light-industrial environments
IEC61000-4-2:2008 Electrostatic discharge immunity test
IEC61000-4-3:2006 Radiated, radio-frequency, electromagnetic field immunity test
IEC61000-4-4:2012 Electrical fast transient/burst immunity test
IEC61000-4-5:2005 Surge immunity test
IEC61000-4-6: 2008 Immunity to conducted disturbances, induced by radio-frequency fields
IEC61000-4-11:2004 Voltage dips, short interruptions and voltage variations immunity tests

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The items comply with all applicable Essential Requirements of the Directives.

Philip Day

Date: 3/2/2016

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