

VW PIEZOMETERS AND PRESSURE TRANSDUCERS

Vibrating wire piezometers are absolute pressure transducers aimed to measure soil pore pressure.

Applications include control of over-pressure in silt and clay soils, measurement of permeability and hydraulic gradients in dams and water pressure evaluation for landslide safe-rates.

Output signals, suitable for transmission over long distances, are easily read and automated.

Multipoint piezometers allow pore pressure monitoring in several point of the same borehole with only one electrical cable.

Hi-Tech sensor component
for reliability and fast
response

High accuracy
and resolution

Entirely stainless steel
construction
and hermetically sealed

Different filter porosity
match installation
in both sand or clay

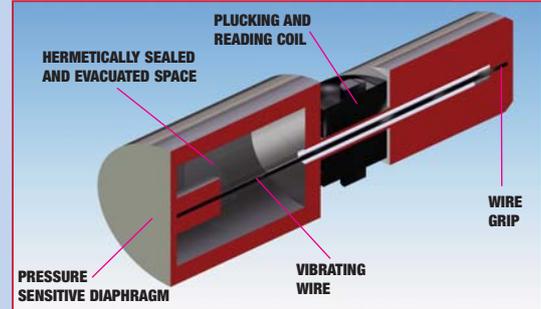
Readily automated
and suitable for long term
monitoring



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VIBRATING WIRE TECHNOLOGY

This sensor has a stainless steel pressure sensitive diaphragm with a tensioned steel wire. The vibrating wire is tensioned inside an hermetically sealed and evacuated space. The water pressure causes a deflection of the diaphragm with a corresponding variation in the tension of the steel wire. The change in tension is measured as a change in the resonant frequency of the wire. The square of the resonant frequency of the gauge wire is directly proportional to the pressure applied to the diaphragm. Two coils, one with a magnet, another with a pole piece, are located close to the wire. In use, a pulse of varying frequency is applied to the coils and this causes the wire to vibrate primarily at its resonant frequency. When excitation ends, the wire continues to vibrate and a sinusoidal signal, at the resonant frequency, is induced in the coils and transmitted to the readout unit where it is conditioned and displayed.



TECHNICAL SPECIFICATIONS

MODEL	PK45S	PK45A	PK20S	PK20A	PK45C	PK45I	PK45H	PK45M
Measure	pore pressure		pore pressure		pore pressure	pore pressure	water pressure	pore pressure
Application	embedded into the soil		embedded into the soil		removable inside Casagrande tip	direct drive-in	3-port assembly, pressure cells	multipoint piezometers
Measuring range	from 170 kPa to 3.5 MPa		from 170 kPa to 3.5 MPa		350, 700 kPa	350, 700 kPa 2 MPa	from 350 kPa to 30 MPa	from 700 kPa to 3.5 MPa
Overload	100% FS		100% FS		100% FS	100% FS	100% FS	100% FS
Sensitivity	0.025% FS		0.025% FS		0.025 % FS	0.025% FS	0.025% FS	0.025% FS
Linearity (*)	<0.4% FS		<0.4% FS		<0.4% FS	<0.4% FS	<0.4% FS	<0.4% FS
Total Accuracy (**)	<0.25% FS		<0.25% FS		<0.25% FS	<0.25% FS	<0.25% FS	<0.25% FS
Thermic zero shift	0.01±0.03 % FS /°C		0.01±0.03 % FS /°C		0.01±0.03 % FS /°C	0.01±0.03 % FS /°C	0.01±0.03 % FS /°C	0.01±0.03 % FS /°C
Thermic sensitivity shift	<0.05% FS /°C		<0.05% FS /°C		<0.05% FS /°C	<0.05% FS /°C	<0.05% FS /°C	<0.05% FS /°C
Electric supply	5 ÷ 12 V DC		5 ÷ 12 V DC		5 ÷ 12 V DC	5 ÷ 12 V DC	5 ÷ 12 V DC	5 ÷ 12 V DC
Electric insulation	4KV		4 KV		4 KV	4 KV	4 KV	4 KV
Temp. operating range	-20 to +100 °C		-20 to +100 °C		-20 to +100 °C	-20 to +100 °C	-20 to +100 °C	-20 to +100 °C
Temp. sensor	thermistor		thermistor		thermistor	thermistor	thermistor	thermistor
Material	stainless steel		stainless steel		stainless steel	stainless steel	stainless steel	stainless steel
Diameter	28 mm		20 mm		28/30 mm	28/35 mm	28 mm	48.3 mm
Length	200 mm		180 mm		230 mm	260 mm	180 mm	250 mm
Weight	0.5 Kg		0.4 Kg		0.8 Kg	1.0 Kg	0.5 Kg	2 kg
Filter Unit								
Material	s/steel vjon	ceramic HAE	s/steel vjon	ceramic HAE	s/steel vjon	ceramic HAE value	-	s/steel vjon
Diameter (mm)	disc 18mm	disc 15mm	disc 18mm	disc 15mm	stone 4 mm	disc 15mm	-	disc 18mm
Pore size	40/50 µm	0.25µm	40/50 µm	0.25µm	40/50 µm	0.25 µm	-	40/50 µm
Cables								
Model	WE104K00ZH WE104X20ZH(**)		WE104K00ZH WE104X20ZH(**)		WE104K00ZH WE104X20ZH(**)	WE104K00ZH WE104X20ZH(**)	WE104K00ZH WE104X20ZH(**)	WE1160LSZH WE1320LSZH
N° of conductors	2 pairs (4 wires)		2 pairs (4 wires)		2 pairs (4 wires)	2 pairs (4 wires)	2 pairs (4 wires)	8 or 16 pairs
Remarks:	(*) including hysteresis, calculated as span		(**) with polynomial factors, including hysteresis		(***) armoured with stainless steel sheath			

CE electromagnetic compatibility according to EN 61326-1 and EN 61326-A1 directives for EMC emission and immunity

FILTER UNITS AND SATURATION DEVICE

The filters are available with different porosity and air entry value to suit the specific conditions of use. The filter porosity and the fluid used determines the air entry value. Filters are usually saturated in boiled water.

For the saturation of ceramic PK45 HAE value filter, SIGGEO provides a device consisting of a stainless steel pump with manometer and a threaded port for the connection with the filter unit. Ceramic filter of PK20 piezometers could not be saturated with the pump.

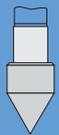
- OPF01SAT000** Saturation device for HAE filter
- OPF01D16000** HAE ceramic filter for PK45 model, 0.25µm porosity
- OPF40D20000** LAE synerized filter for PK45 model, 40/50 µm porosity
- OPF20D16000** HAE ceramic filter for PK20 model, 0.25µm porosity
- OPF20D20000** LAE synerized filter for PK20 model, 40/50 µm porosity

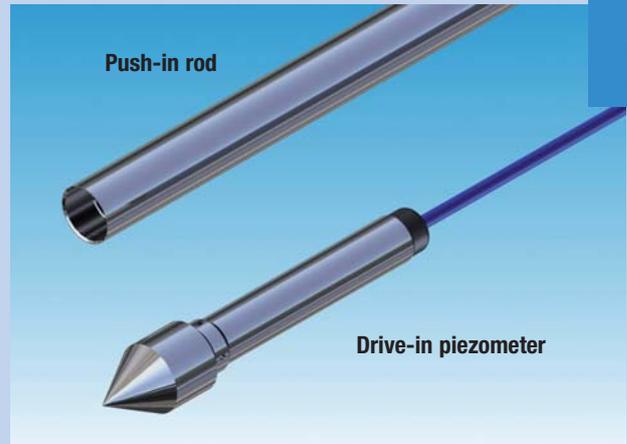


DRIVE - IN PIEZOMETERS

Vibrating-wire drive-in piezometers, are special versions intended to be pushed directly into soft soil.

If the equipment used to drive the piezometer into the ground can grip and lock on the extension pipe, the piezometer can be pressed directly into the ground. However, if the piezometer is installed by applying a vertical force at the top of the extension pipes, then a slotted adapter is required to prevent damage to the cable.

PK45I	Description	Applications
	Drive-in piezometer Special version for pushing directly in soft soil	Pore pressure monitoring in soft soil



Over pressure during push-in into soft soil

Sisgeo drive-in piezometer has been designed with conical end tip (40 mm OD) having larger diameter than piezometer body (28 mm OD). For the above the sensor does not have any overpressure problem during the push-in into soft soil.

Push-in rod

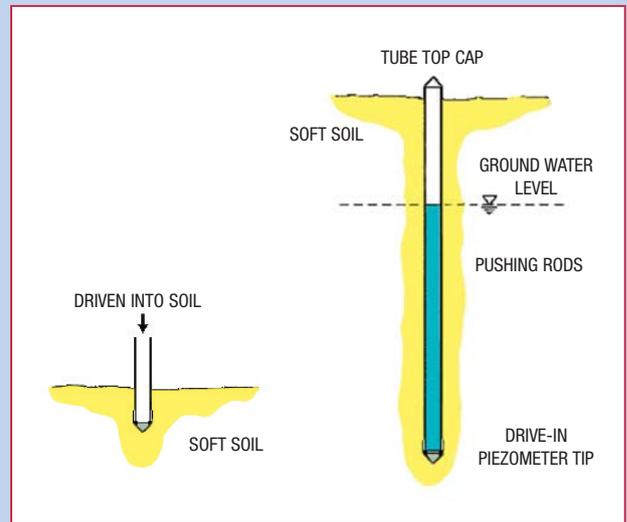
It is a stainless steel 430 mm long tube having 29.1 mm ID and 33.7 mm OD which allow the junction with standard CPT rods. The push-in rod shall be threaded at job site and it must be reused.

Material

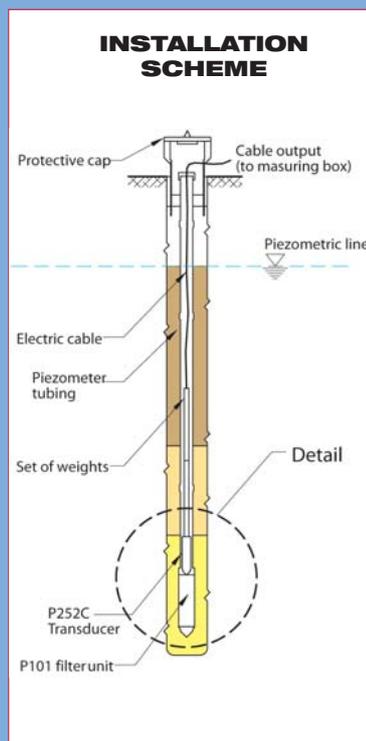
Entirely stainless steel body with conical end tip of 35 mm OD.

Filter unit

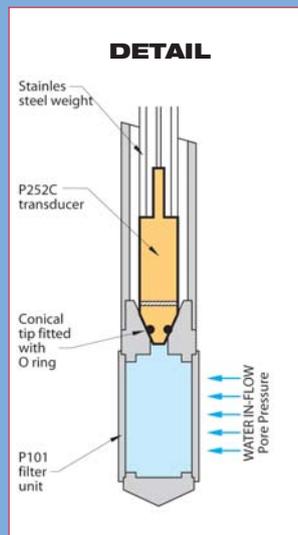
Ceramic high air entry value filter (1 bar and 3 bar available). Filter on request should be saturated at factory or at site by means of saturation device model OPF01SAT000.



REMOVABLE PORE PRESSURE TRANSDUCER



PK45C are removable pressure transducers for pore pressure monitoring. They are suitable for long term monitoring as the instrument can be removed for calibration checks, and maintenance or re-used in further boreholes. The sensor is housed in a stainless steel sealed body with a conical tip. The tip, fitted with an 'O' ring, is designed to mate the conical port of the porous filter. Sealing is maintained by ballasting weights inserted into the electric cable. A small orifice at the conical tip allows pore pressure to act on the diaphragm sensor. P101 porous filter unit is normally installed and the transducer is then lowered into the access tube suspended by its own electro-mechanical cable until the piezometer assembly rest on the piezometer. All the transducers can be removed from the borehole by lifting out by means of the electro-mechanical cable.



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FULLY-GROUTED METHOD

The fully-grouted installation method permits to easy install multipoint piezometers for pore pressure measurement in different soil levels, erasing the problem of forming sand filters. The working principle is based on the idea that a diaphragm piezometer embedded directly in a large mass of low permeability cement-bentonite grout should respond instantly to a pore water pressure change. Grout mixes (water-cement-bentonite) should be controlled by weight and proportioned to give the desired strength of the set grout. According to Mikkelsen paper (Piezometers in Fully Grouted Boreholes - FMGM 2003), the grout shall rest for a curing time of minimum 28 days. Fully grouted method could be used also for Casagrande piezometer installation (see Field performance of fully grouted piezometers - Simeoni, De Polo, Caloni, Pezzetti - FMGM 2011) or for multiple-instrument columns (i.e. inclinometer tube + piezometers).

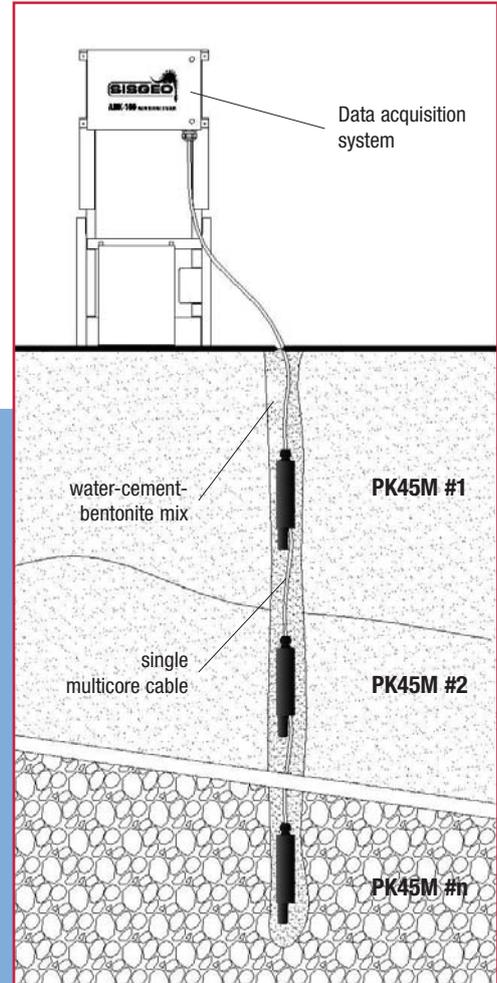
MULTIPOINT PIEZOMETERS

Multipoint Piezometer (product code OPK45M00000) is a string of Vibrating Wire pressure transducers connected through a single multicore cable that allow to have until No.8 measuring point into one borehole. They are available with several full scale and with both HAE and LAE filters.

Vibrating Wire pressure transducers provide excellent long-term accuracy, stability of readings and reliability under demanding geotechnical conditions. Each measuring point have a built-in thermistor that permit to monitor also the temperature variation during grout curing and temperature curve Vs depth.

With the common installation method (sand filter + bentonite sealing), multiple piezometer installations in a borehole were slow, complex and subject to unexpected communication between piezometers. Fully Grouted installation method with multipoint piezometers permits quick and easy installation, excellent strata sealing and rapid response to pore pressure changes.

- OWE1160LSZH** 8 pairs (16 conductors) LSZH multicore cable, allow to have a multipoint piezometer with untill No.4 measuring point.
- OWE1160LSZH** 16 pairs (32 conductors) LSZH multicore cable, allow to have a multipoint piezometer with untill No.8 measuring point.



3-PORT PIPE UNION

From the drainage gallery in the dam body, the up-lift water pressures are usually monitored installing a 3-ports assembly on the top of stand pipe. The 3-ports assembly consists of a 3-ports pipe brass union (2,0 MPa) equipped with stainless steel Bourdon gauge manometer, no-vacuum valve brass made (2,1 MPa), 2 brass valves and, optionally, with electrical or vibrating wire pressure transducer.

- OP2RACT2000** 3-PORT BRASS PIPE UNION
- OP2RACV2100** NO-VACUUM VALVE, WORKING PRESSURE 2.1 MPA
- OPMAN100000** BOURDON MANOMETER
- OPK45H00000** VIBRATING WIRE PRESSURE TRANSDUCER
- OP252A00000** ELECTRIC (RESISTIVE SG) PRESSURE TRANSDUCER

