

Vibrating Wire Piezometers

Applications

VW piezometers are used to monitor pore-water pressure. They can also be used to monitor water levels.

Typical applications include:

- Monitoring pore water pressures to determine safe rates of fill or excavation.
- Monitoring pore water pressures to determine slope stability.
- Monitoring the effects of dewatering systems used for excavations.
- Monitoring the effects of ground improvement systems such as vertical drains and sand drains.
- Monitoring pore pressures to check the performance of earth fill dams and embankments.
- Monitoring pore pressures to check containment systems at land fills and tailings dams.
- Monitoring water levels in stilling basins and weirs.

Operation

The VW piezometer converts water pressure to a frequency signal via a diaphragm, a tensioned steel wire, and an electromagnetic coil.

The piezometer is designed so that a change in pressure on the diaphragm causes a change in tension of the wire. An electro-magnetic coil is used to excite the wire, which then vibrates at its natural frequency. The vibration of the wire in the proximity of the coil generates a frequency signal that is transmitted to the readout device.

The readout or data logger stores the reading in Hz. Calibration factors are then applied to the reading to arrive at a pressure in engineering units.



VW Piezometers: Standard, Low-Pressure, and Push-In (bottom)

Installation Overview

Grout-In Method: The piezometer is lowered to the specified depth, and then the borehole is backfilled with a bentonite-cement grout.

Sand Zone Method: The piezometer is lowered to the specified depth. A sand filter zone is formed around the piezometer. A bentonite plug is placed at the top of the zone, and the remainder of the borehole is grouted.

Embankment Method: The piezometer is embedded in sand or grout and covered with hand-compacted fill. Signal cables are routed through trenches with bentonite water stops.

Push-In Method: The push-in piezometer can be pushed a short distance into soft soil at the bottom of a borehole. The piezometer must be monitored to ensure that it is not overpressured as it is pushed in.

Weirs: The piezometer is fixed to the wall of the weir. In this application, barometric pressure should also be monitored.

Advantages

Groutable: The VW piezometer can be installed without a sand filter zone. This greatly simplifies the installation of multiple piezometers in the same borehole. It also provides a way to install piezometers with inclinometer casing.

High Resolution: VW piezometers provide a resolution of 0.025% of full scale.

High Accuracy: Slope Indicator's automated, precision calibration system ensures that these sensors meet or exceed specifications.

Rapid Response: VW piezometers respond very quickly to small changes in pore-water pressure, whether they are grouted in, pushed into cohesive soils, or embedded in a sand filter zone.

Reliable Signal Transmission: With properly shielded cable, signals from the VW piezometer can be transmitted long distances.



VW PIEZOMETERS

0.7 bar (10 psi) piezometer52611610
 1.8 bar (25 psi) piezometer52611625
 3.5 bar (50 psi) piezometer52611020
 7 bar (100 psi) piezometer52611030
 17 bar (250 psi) piezometer52611040
 35 bar (500 psi) piezometer52611050

Does not include signal cable. Cable must be ordered at same time as the piezometer.

Sensor Type: Pluck-type vibrating wire sensor with built-in thermistor or RTD.

Range: 3.5, 7, 17, 35 bar (50, 100, 250, 500 psi).
 Low-pressure: 0.7, 1.8 bar (10, 25 psi).

Resolution: 0.025%FS.

Accuracy: $\pm 0.1\%$ FS for 0.7, 1.8, 3.5 and 7 bar ranges, $\pm 0.3\%$ FS for 17 and 35 bar ranges.

Maximum Pressure: 1.5 x rated range.

Filter: 50-micron sintered stainless steel.

Temperature Coefficient: $< 0.04\%$ FS per $^{\circ}\text{C}$.

Materials: Stainless steel.

Dimensions: 19 x 195 mm (0.75 x 7.75"),
 Low pressure: 29 x 191 mm (1.125 x 7.5").

Weight: 0.16 kg (0.3 lb).

Low-pressure model: 0.45 kg (1 lb).

SIGNAL CABLE

Polyurethane Jacket50613524
 Shielded cable with four 22-gauge tinned-copper conductors and polyurethane jacket.

Universal Connector57705001
 10-pin connector. Not required for terminal box, loggers, or if readings are taken with bare wires.

VW PIEZOMETERS WITH CABLE

3.5 bar (50 psi) piezometers
 with 15 m (50') cable52611028
 with 30 m (100') cable52611024
 with 45 m (150') cable52611027
 with 60 m (200') cable52611026

7 bar (100 psi) piezometers
 with 30 m (100') cable52611033
 with 45 m (150') cable52611034
 with 60 m (200') cable52611035
 with 90 m (300') cable52611036

INSTALLATION ACCESSORIES

Small Canvas Bag06240000

Large Canvas Bag06240001

Provides weight to piezometer and also creates a sand filter around the piezometer tip. Not used with grout-in installations.

Small bag measures 64 x 457 mm (2.5 x 18").

Large bag measures 114 x 457 mm (4.5 x 18").

TERMINAL BOXES



Terminal Box for 6 sensors57711606

Terminal Box for 12 Sensors57711600

Terminal Box for 24 Sensors97711624

Provides terminals for signal cable from 6, 12, or 24 sensors. Sensors are selected by rotary switch. Small 6-sensor box is 240 x 190 x 120 mm (9.5 x 7.5 x 4.75"). Larger 12 and 24-sensor box measures 290 x 345 x 135 mm (11.5 x 13.5 x 5.25").

READOUT

VW Data Recorder52613500

Jumper Cable for Terminal Box52613557

The VW Data Recorder displays VW sensor readings in Hz or $\text{H}^2/1000$ and thermistor or RTD data in degrees C. It can also record the readings. See separate datasheet.

The jumper cable is required when the VW Data Recorder is to be connected to a terminal box or to a connector attached to signal cable.

DATA LOGGERS

VW MiniLogger52613310

The VW MiniLogger is a reliable, low-cost data logger for one sensor. See separate datasheet.

Campbell Scientific Data Loggers

Campbell data loggers with a VW interface and the AM16/32 multiplexer can accommodate 16 piezometers with temperature readings or 32 piezometers without temperature readings.



VW PUSH-IN PIEZOMETER

3.5 bar (50 psi) piezometer52621020

7 bar (100 psi) piezometer52621030

17 bar (250 psi) piezometer52621040

35 bar (500 psi) piezometer52621050

Part number does not include signal cable. Cable 50613524 is factory-attached piezometer and must be ordered with the piezometer.

Sensor Type: Same as VW piezometer. Only the housing is different. Top of the housing is threaded for a drill rod adaptor, shown below.

Dimensions: 35 x 270 mm (1.375 x 10.5").

Weight: 1.2 kg (2.75 lb).

DRILL-ROD ADAPTORS

EW Adapter Rod50718042

Optional Accessory. EW adapter rod is 0.6 m (2') long. One end has a right-hand thread to connect to piezometer. The other end has a left-hand thread for easy disconnect from drill rod that is used to push the piezometer into the ground. Order one adapter rod per piezometer, since adapter rod is installed with piezometer.

EW Coupling50718010

Optional accessory. Coupling (pin) has right-hand thread for drill rod and left-hand thread for easy disconnect from EW adapter rod. Coupling is reused, so only one is required.



Pneumatic Piezometer



Applications

Pneumatic piezometers are used to measure pore water pressure in saturated soils. Applications include:

- Monitoring pore pressures to determine safe rates of fill or excavation.
- Monitoring pore water pressures to determine slope stability.
- Monitoring the effects of dewatering systems used for excavations.
- Monitoring the effects of ground improvement systems such as vertical drains and sand drains.
- Monitoring pore water pressures to check the performance of earth fill dams and embankments.
- Monitoring pore water pressures to check containment systems at land fills and tailings dams.

Advantages

Slope Indicator's pneumatic piezometers employ a simple and reliable transducer that is inherently free from drift.

Long term performance is enhanced by corrosion-resistant plastic construction, polyethylene tubing, and in-line filters in all connectors.

Twin-tube design is compatible with both "flow" and "no-flow" reading techniques.

Operating Principle

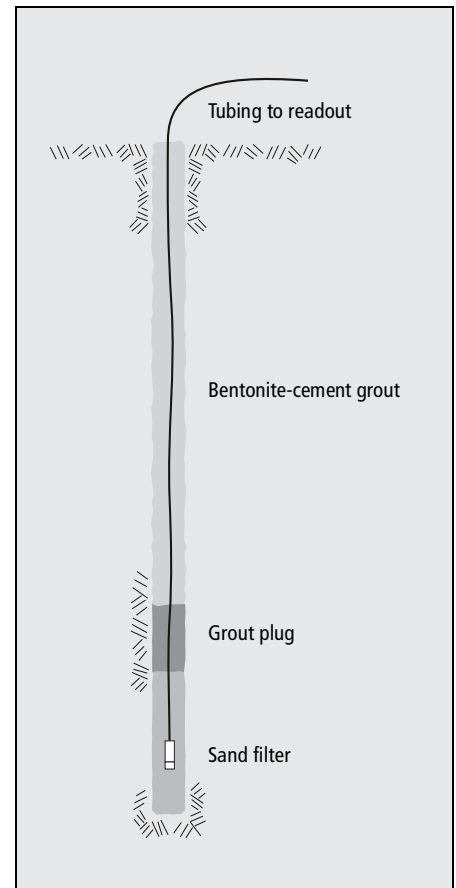
In a typical installation, the piezometer is sealed in a borehole, embedded in fill, or suspended in a standpipe. Twin pneumatic tubes run from the piezometer to a terminal at the surface. Readings are obtained with a pneumatic indicator.

The piezometer contains a flexible diaphragm. Water pressure acts on one side of the diaphragm and gas pressure acts on the other.

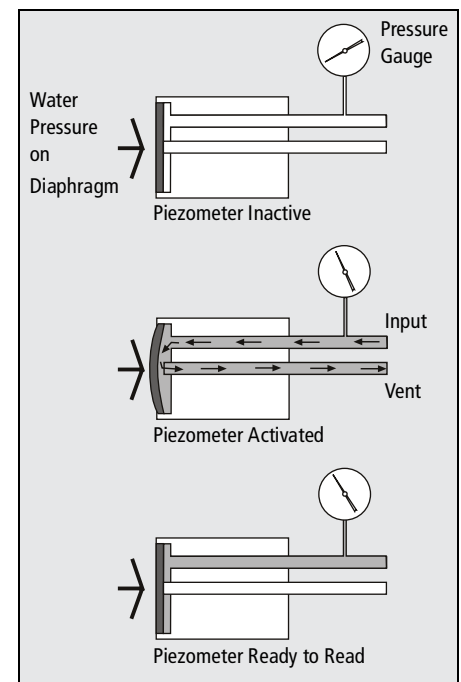
When a reading is required, a pneumatic indicator is connected to the terminal or directly to the tubing. Compressed nitrogen gas from the indicator flows down the input tube to increase gas pressure on the diaphragm. When gas pressure exceeds water pressure, the diaphragm is forced away from the vent tube, allowing excess gas to escape via the vent tube.

When the return flow of gas is detected at the surface, the gas supply is shut off. Gas pressure in the piezometer decreases until water pressure forces the diaphragm to its original position, preventing further escape of gas through the vent tube.

At this point, gas pressure equals water pressure, and a reading can be obtained from the pressure gauge on the indicator.



Typical Installation



Operating Principle

PNEUMATIC PIEZOMETER

Sensor Type: Twin-tube pneumatic transducer.

Range: 12 bar, 180 psi with standard readout. Pressure rated for 27.5 bar or 400 psi.

Resolution: 0.001 bar, 0.01 psi (digital gauge).

Accuracy: $\pm 0.015\%$ FS (digital gauge).

Repeatability: ± 0.005 bar, ± 0.05 psi.

Diaphragm Displacement: 0.01 ml typical.

Filter: Sintered stainless steel, 50 micron pores.

Materials: ABS and PVC plastic body, synthetic rubber diaphragm.

Diameter: 25.4 mm (1").

PIEZOMETER ONLY

Pneumatic Piezometer 51417800

Part number includes only piezometer. Tubing is attached to piezometer at factory and must be ordered at same time as piezometer.

PIEZOMETER WITH TUBING

Piezometer & 50' of tubing 51417801

Piezometer & 100' of tubing 51417802

Piezometer & 150' of tubing 51417803

Piezometer & 200' of tubing 51417804

Order numbers specify a pneumatic piezometer with tubing and quick-connect plug. These piezometers are stocked for faster delivery.

TUBING & CONNECTORS

Twin Tubing 51416900

Two polyethylene tubes bundled in polyethylene jacket.

Tubing Size: 4.76 mm with 1 mm wall (3/16" with 0.04" wall).

Jacket: 12 mm x 7 mm with 1.1 mm wall (0.46" x 0.28" with 0.045" wall).

Burst Pressure: 3.4 MPa (500 psi).

Minimum Bending Radius: 75 mm (3").

Tubing Buoyancy: 0.021 kg per m (0.014 lb per foot).

Weight: 0.06 kg per meter (0.04 lb per foot).

Splice Kit 51401723

Includes 3 brass unions, self-vulcanizing mastic pad, and sealing tape.

Quick Connect Plug 51407302

Brass quick-connect fitting for input tube. Plug includes in-line filter and 90° elbow for insertion into panel.

INSTALLATION ACCESSORIES

Small Canvas Bag 06240000

Large Canvas Bag 06240001

Convenient way to create sand filter around piezometer. Small bag measures 64 x 457 mm (2.5 x 18"). Large bag measures 114 x 457 mm (4.5 x 18").

Push-In Well Point 51400099

Steel well point for piezometer, 30 x 610 mm (1.25 x 24"), 2 kg (4.4 lb). This part number includes labor to insert piezometer into well point, but does not include piezometer, tubing, or quick-connect plug.

TERMINALS

Terminal Pipe, 6 Positions 51409900

Heavy gauge, zinc-plated, iridium treated steel pipe, 70 mm x 2 m (2.75" x 80"). Inside panel accommodates quick connect plugs from 6 piezometers. Includes panel, panel nuts, locking cap, keyed-alike padlock, and 90° PVC sweep for tubing entry.

Terminal Pipe, 20 Positions 51417100

Heavy gauge, zinc plated steel pipe, 127 mm x 178 mm x 1.8 m (5" x 7" x 6'). Inside panel accommodates quick connect plugs from 20 piezometers. Includes panel and panel nuts, locking cap, keyed-alike padlock, and 90° PVC sweep for tubing entry.

Terminal Box, 10 Positions 51401510

Fiberglass box with lockable lid, 292 x 235 x 140 mm (11.5 X 9.25 x 5.5"). Inside panel accommodates quick connect fittings from 10 piezometers. Box can be mounted to wall or post. Includes panel and panel nuts.

Standpipe Piezometer

Applications

Standpipe piezometers are used to monitor piezometric water levels. Observation wells are used to monitor ground water levels. Typical applications include:

- Monitoring pore-water pressure to determine the stability of slopes, embankments, and landfill dikes.
- Monitoring the effectiveness of dewatering schemes.
- Monitoring seepage and ground water movements in embankments, landfill dikes, and dams.

Standpipe Piezometers

The standpipe piezometer, sometimes called a Casagrande piezometer, consists of a filter tip joined to a riser pipe. The filter tip is made from polyethylene or porous stone and has 60 micron pores. The riser pipe is typically made from PVC plastic pipe.

After the filter tip and riser pipe are installed downhole, a sand filter zone is tremied into place around the filter tip. The top of the filter zone is sealed with bentonite to isolate the pore-water at the tip. The annular space between the riser pipe and the borehole is backfilled to the surface with a bentonite grout to prevent vertical migration of water. The riser pipe is terminated above ground level with a vented cap.

Standpipe piezometers can be pushed into very soft soil. In this case, a steel well point is used instead of the filter tip, and steel pipe is used instead of plastic pipe.

Observation Wells

An observation well also uses a filter tip, but there is no bentonite seal and the borehole is backfilled with gravel or sand rather than a bentonite grout. Since the filter tip is not isolated from vertical migration of water, this type of installation is useful for monitoring the general water level, but not pore-water pressure.



Water Level Indicators

Water levels in either the standpipe piezometer or the observation well are measured with a water level indicator.

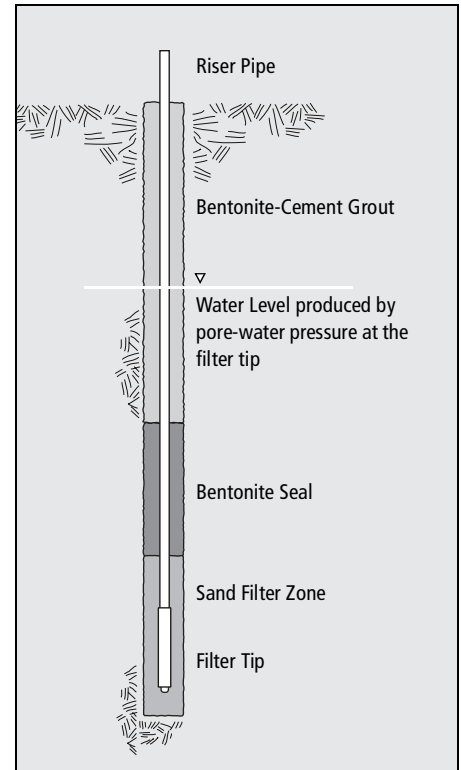
A water level indicator consists of a probe, a graduated cable or tape, and a cable reel with built-in electronics. The probe is lowered down the standpipe until it makes contact with water. Contact is signaled by a light and buzzer built into the cable reel. The depth-to-water reading is taken from the cable or tape.

A unique detection circuit combined with a sensitivity feature helps users obtain consistent measurements and eliminates false triggering in different well and water conditions.

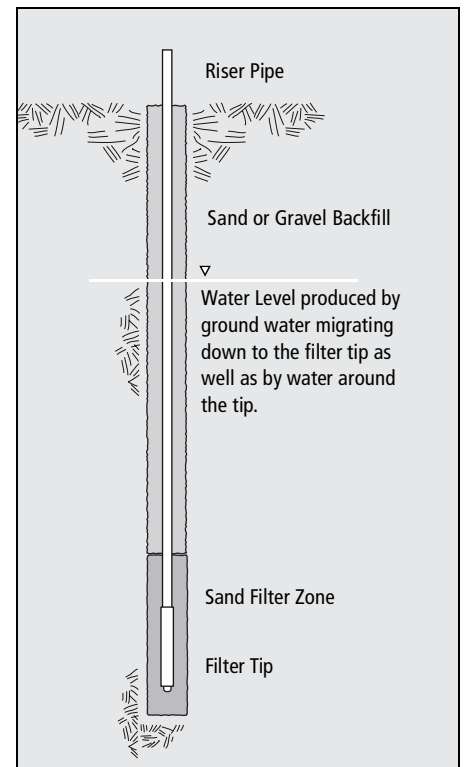
See the Water Level Indicator datasheet for more information.

Advantages

- Economical components.
- Simple to read.
- Excellent, long-term reliability.



Water level in standpipe (Casagrande) piezometer is produced by pore-water pressure at the filter tip.



Water level in observation well is produced by the intake of the entire borehole.

STANDPIPE FILTER TIPS

Polyethylene Tip, 12" (305 mm) . .51417402

Polyethylene Tip, 24" (610 mm) . .51417404

Porous Stone Tip, 12" (305 mm) . .51405102

Porous Stone Tip, 24" (610 mm) . .51405104

Standpipe filter tip is used with plastic riser pipe.

Tip mates directly with 0.75" slip coupling and is supplied with an adapter kit (51405150), which includes adapters for 0.5" and 1" pipe.

Filter Material: Polyethylene tip is made from hydrophilic polyethylene and has 60 micron pores. Porous stone filter is made from fused aluminum oxide (Norton Alundum) and has 68 micron pores.

Filter Size: Filter is 12 or 24 inches long and formed into 1.5" diameter cylinder.

Note on Plastic Pipe Couplings: Slip couplings, although somewhat cheaper, sometimes catch falling bentonite, causing improper placement of the seal due to bridging. To prevent this, construct the riser pipe from flush-coupled plastic pipe. The smooth profile of the flush-coupled pipe allows bentonite chips to fall to the intended depth of the seal.

PIPE ADAPTERS

Adapter from 0.75 to 1.25" pipe .50712521

Adapter from 0.75 to 1.5" pipe . .50712531

WELL POINTS

Well Point51406500

Well point is used with steel riser pipe and is intended to be pushed into very soft soils. Well point is made from corrosion-resistant, double galvanized, low carbon steel and has #10 slot size (equivalent to Gauze #60). Well point is 1.7" in diameter and 24" long (43 x 610 mm). A 1.25" to 2" IPS adapter is included.

WATER LEVEL INDICATORS

Reel Diameter: 180, 230, 280 mm (7, 9, 11").

Reel Construction: Heavy-gage aluminum plate sides, PVC spool, rotating knob. The smallest reel has an aluminum handle, but no stand. The larger two reels have steel stands.

Control Panel: Sensitivity adjustment, LED, beeper, test switch, and battery holder.

Batteries: Two 1.5 v alkaline AA cells.

Probe Size: 10 x 170 mm (3/8" x 6.6").

Probe Construction: Stainless steel body and tip, polyethylene insulator.

Cable Construction: 3.2 mm (1/8") diameter polyurethane jacket with two copper-clad, steel conductors inside. Jacket can be cleaned with laboratory grade detergent, such as Alconox® or Liquinox®. Graduations are marked with laser and cannot be rubbed off.

English Graduations: English-unit cables have 0.01 foot graduations with labels at 0.1 foot and 1 foot intervals.

Metric Graduations: Centimeters are marked and labelled. Numbers in the label serve as 2 mm graduations, as shown below.

Recommended Cleaner: Laboratory grade detergent, such as Alconox® or Liquinox®.

ENGLISH-UNIT INDICATORS

Cable	Reel	Weight	Part Number
100'	7"	3.5 lb	51690010
150'	7"	4 lb	51680014
100'	9"	5 lb	51690012
150'	9"	5.5 lb	51690015
300'	9"	7.5 lb	51690030
500'	11"	11 lb	51690050
1000'	11"	17 lb	51690100

METRIC-UNIT INDICATORS

Cable	Reel	Weight	Part Number
30 m	180 mm	1.6 kg	51690303
50 m	180 mm	1.8 kg	51690304
30 m	230 mm	2.3 kg	51690300
50 m	230 mm	2.5 kg	51690305
100 m	230 mm	3.4 kg	51690310
150 m	280 mm	4.7 kg	51690315
200 m	280 mm	5 kg	51690320
300 m	280 mm	7.7 kg	51690330