Electric Piezometers

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STRUMENTI E MISURE GEOTECNICHE
E STRUTTURALI

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WARNINGS

This instrument must be utilized only for the application it has been designed for, OTR declines all responsability for any improper use.

Do not let the instrument fall into the hole quickly.

Do not put the instrument in flammable liquids or potentially explosive gases.

Do not use the instrument in water where an electric dissipation is in progress.

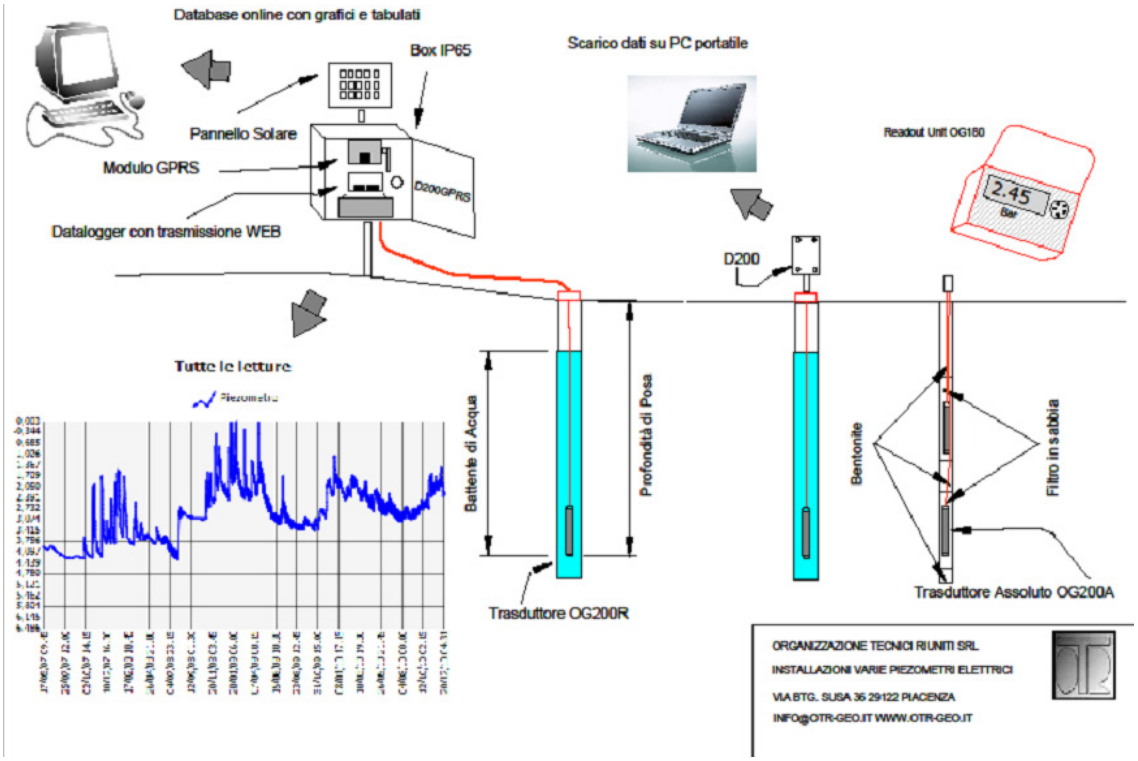
Use protective gloves.

Furthermore

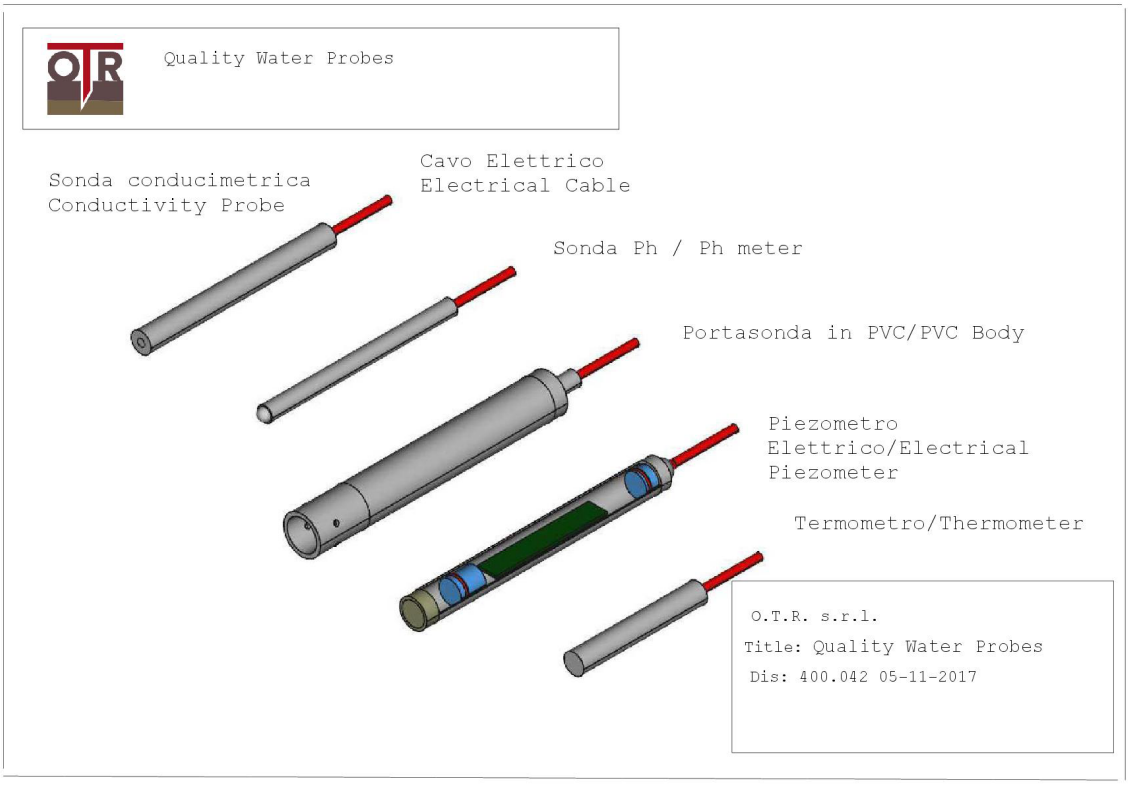
- Do not open the instrument, contact the manufacturer for checks and repairs;
- Keep out of reach of children;
- Do not connect the instrument to the readout unit with wet hands;
- Clean the instrument and its cable with alcohol or water, do not use acetone or aggressive liquids for plastics or labels;
- Use surge arresters for installations with unprotected cables longer than 30 meters.

Application

Electrical piezometers are used for monitoring pore water pressure in fully saturated soils (absolute piezometers) or for measuring the groundwater level in wells or open pipes (relative piezometers). They are available in various models and with different porous filters for any kind of use.



Description



Piezometers consist of a cylindrical metal housing containing a pressure transducer with a front porous filter made of sintered steel or ceramic.
All electronic components are immersed in resin in order to ensure long-term sealing.
The water pressure at the laying depth of the saturated instrument deforms the membrane connected to the sensor, which in turn converts said pressure into a proportional electrical signal.
Electrical piezometers can be used to take absolute or relative measurements. The latter are not affected by changes in barometric pressure, because the sensor membrane is connected to the open air by means of a capillary compensation tube which is built into the signal cable.
Piezometers are customizable and can be provided with any cable length and full scale required. Electrical piezometers can be easily connected to portable readout units and data loggers.

The transducer's vibrating wire output ensures that the signal is not altered by cable length or moisture.

Identification

Every Electrical Piezometer is identified by:

- Serial number associated to calibration report;
- Model;
- Input/Output;

Technical Features

Voltage Supply	13-24 Vdc
Current Consumption	Max 25 mA
Output	4-20 mA
Temp Output	NTC 3 K on demand
Full scale	5-10-20-50 m H2O, 2-5-10 Bar

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Installation

Electrical piezometers are usually installed in a borehole which needs to be not less than 100 mm in internal working diameter, and protected with a temporary casing, if necessary.
In other cases, electrical piezometers are installed directly in the soil on embankments and/or dams.

For relative model OG200R cable has inside a capillar pipe to compensate atmospherical variations. This capillar pipe must be protected during installation (e.g. during installation in a conduit pipe, a sheat..).

In order to protect it :

- Seal it before installation using a lighter and a nipper;
- When capillar pipe is closed instrument will give not correct measures;
- Open it after installation has been finished.

Installation of the transducer

Given the specific nature of this instrument, it is advised not to use drilling mud while drilling boreholes, but to only use only water instead.
For the installation in a borehole, it is advised to acquire the following materials: a depth meter, bentonite pellets, and a water bucket.
Before moving on to the description of the piezometer installation procedure, we would like to give some advice concerning the saturation procedure of the piezometer's filter.
One of the simplest and most common procedures involves putting the filter housing and the filter to be saturated in a container of clean water, then bringing the water to a boil for 5 to 10 minutes, and then letting the water cool down. The saturated filter is then put inside a container together with the water, in order to maintain it saturated for a longer time.
After the hole has been drilled, proceed as follows:

- Starting from the instrument end, unwind the electrical cable. Using a piece of tape, mark directly on the cable the distance indicating the depth under ground level at which the instrument will be positioned, starting from the end of the instrument (filter);
- Before installing the instrument, take a reading with the readout unit, so as to obtain a first measurement in open air without any pressure being applied, and write said measurement on the installation sheet;
- Fill the bucket with clean water and place the piezometer underwater. Then, take the container with the saturated filter and install the filter on the piezometer's terminal, while holding it underwater;
- In order to maintain the saturation of the instrument's hydraulic chamber, insert the instrument in the geotextile bag provided, and fill up the hollow space between the instrument and the bag with fine sand, then close it. All the operations described above have to be performed underwater;
- Using the depth meter, check the depth of the bottom of the borehole;
- Flush the borehole with clean water before lowering the instrument in it;
- Take another preliminary reading with the readout unit, so as to have a zero reading;
- Pull up the borehole casing for about 100 cm;
- Pour fine sand or fine gravel into the borehole to form a 50-centimeter-high pocket at the bottom, checking its depth with a depth meter;
- Lower the piezometer (inside the geotextile bag) to the bottom, laying it on the sand/gravel;
- Pull up the borehole casing for about 100 cm more;
- Pour fine sand or fine gravel into the borehole until the instrument has been covered by a layer of 50 cm to 100 cm. Check the depth with the depth meter;
- Take another reading to make sure the piezometer is working properly;
- Pull up the casing for about 100 cm more using only the upward thrust of the drilling probe, absolutely avoiding any turning motion;
- Make a waterproof seal 50-100 cm thick using bentonite pellets, checking its depth with a depth meter.

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- Fill the remainder of the borehole using fine sand or fine gravel, or a grout made of water, cement and bentonite, while progressively retrieving the temporary casing;
- Complete the installation with a short length of pipe fitted with a protective cap;
- After the installation has been completed, take a reading to make sure the piezometer is working properly;
- It is to be noted that it is necessary to wait a few hours before the readings of the instrument reach stabilization.

Installation of piezometers directly into the soil (dams)

In installations into the soil of embankments under construction and/or dams in fine or impermeable materials, proceed as follows:

- Excavate a small trench in the embankment (50 cm in width, 30-50 cm in depth);
- Excavate a pocket inside the trench, where the piezometer will be installed;
- Before installing the instrument, take a reading with the readout unit, so as to obtain a first measurement in open air without any pressure being applied, and write said measurement on the installation sheet;
- Fill the bucket with clean water and place the piezometer underwater. Then, take the container with the saturated filter and install it on the piezometer's terminal, while holding it underwater;
- In order to maintain the saturation of the instrument's hydraulic chamber, insert the instrument in the geotextile bag provided, and fill up the hollow space between the instrument and the bag with fine sand, then close it. All the operations described above have to be performed underwater;
- Perform another preliminary reading with the readout unit, so as to have a zero reading;
- Install the piezometer inside the pocket in the trench;
- Cover the piezometer with fine material, gently compacting it so as not to damage the instrument;
- Lay the electrical cable loosely inside the trench, so that it is free to strain without breaking as the embankment soil settles.
- Cover the cable with fine material, gently compacting it;
- After the installation has been completed, take a reading to make sure the piezometer is working properly.

Readout

Readings can be taken by means of manual or automatic readout systems. The Geotester 2 readout unit displays a current value (mA) and/or a physical value [mH20].
For indications on how to use a given readout unit, please refer to its instruction manual

Taking Measurements

In order to take a reading, connect the cable to the readout unit, following the indications on the instruction manual of the readout unit being used:

Instrument signals can be different depending on the type of sensor, potentiometer with 4-20 mA converter, or Hz vibrating wire being used.

Here follow the colors and functions of the electrical cables connected to the electrical piezometer with a 4-20 mA output signal:

Red Cable	=	+ 15 volt
Black Cable	=	Loop
Shield	=	Terra da collegare alla terra del datalogger

Electrical piezometer with Hz output signal (vibrating wire instrument):

Red Cable	=	+ segnale
Black Cable	=	- segnale
Green Cable	=	Temp
White Cable	=	Temp
Shield	=	Protective earth to connect to datalogger earth

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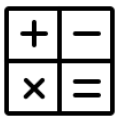
Data processing

The piezometer's pressure reading is the measurement of the output current (mA) or of the frequency (Hz) taken by the electrical pressure transducer.
Depending on the instrument and measurement unit, the electrical reading can be expressed in mA or in Hz to be converted into bar or Kpa using the sensitivity factor shown on the calibration sheet provided by the manufacturer of each instrument:

Calculations and Formulas

P (bar or Kpa) = ExK (Pressure expressed in engineering units (bar and/or Kpa)

P = Pressure expressed in engineering units (bar and/or Kpa)
E = Electrical reading (mA or Hz)
K = Sensitivity factor (shown on the calibration sheet)



The variation of the neutral pressure (interstitial pressure), is the result of the difference between the measurements obtained during operation and the first valid measurement during the installation, also called zero reading, which is expressed in bar and/or Kpa.