XTP VW Piezometer

Operation Instruction

User Manual of VW Piezometer

1. Application

The vibrating wire piezometer is suitable for long-term burial in hydraulic structures or other concrete structures and soil to measure the penetration (pore) water pressure inside the structure or soil, and can simultaneously measure the temperature of the buried point.

The vibrating wire piezometer is equipped with supporting accessories and can be used in pressure measuring pipes and foundation drilling. The piezometer has an all-stainless steel structure and a compact size of 24×125mm, which can be easily placed in small areas that need to be measured. The vibrating wire piezometer has intelligent identification function.

2. Specification

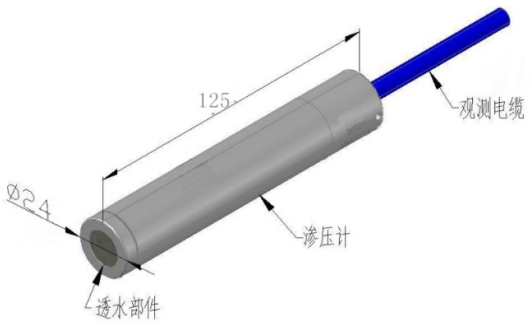
Model		XTP-0.175	XTP-0.2	XTP-0.35	XTP-0.7	XTP-1.0
SIZE	Outside Diameter D/mm	24	24	24	24	24
	Length L/mm	125				
Parameter	Measure Range KPa	0～175	0～200	0～350	0～700	0～1000
	Resolution	≤0.025%F.S				
	Fitting Accuracy	≈0.1%F.S/0.5%F.S				
	Temperature Range	-40～+80℃				
	Sensitivity	±0.1℃				
	Temperature Accuracy	±0.5℃				
	Correction Factor b	≈0.10KPa/℃				
	Water Pressure Resistant	1.2 times of Measuring Range				
	Insulation resistance	≥50MΩ				

Note: Frequency modulus $F=Hz^2\times10-3$

3. Structure and working principle

3.1 Structure

The vibrating wire piezometer consists of water permeable components, sensing membrane plates, observation cables, vibrating wires and galvanic array electromagnetic coils.



3.2 Working Principle

When the measured water load acts on the piezometer, it will cause the deformation of the sensing diaphragm, and its deformation will drive the vibrating wire into changes in the vibrating wire stress, thereby changing the vibration frequency of the vibrating wire. The electromagnetic coil excites the vibrating wire and measures its vibration frequency. The frequency signal is transmitted to the reading device through the cable, and the pressure value of the water load can be measured. Simultaneously measure the temperature value of the buried point.

4. Calculation method

a) When the external temperature is constant and the piezometer is only subject to seepage (pore) water pressure, its pressure value P and the output frequency modulus F have the following linear relationship:

$$P = k \times \Delta F$$

$$\Delta F = F0 - F$$

In Formula: P - --the measurement value of the osmometer, the unit is KPa

k---The measurement sensitivity of the osmometer, in KPa/F

△F --- The reference value of the osmometer is equivalent to the change in the real-time measurement value, the unit is F;

F --- the real-time measurement value of the osmometer, in F;

F0 --- the reference value of the osmometer, the unit is F。

b) When the seepage (pore) water pressure acting on the piezometer is constant and the temperature increases △T, the piezometer has an output △F′. This output is caused by the temperature change, so in the calculation should be deducted. Experiments show that △F′ and △T have the following linear relationship:

$$P' = k \times \triangle F' + b \times \triangle T = 0$$

$$K \times \triangle F' = -b \times \triangle T$$

$$\triangle T = T - T0$$

In the formula: b------temperature correction coefficient of piezometer, unit is KPa/℃;

△T-----The change of the real-time temperature measurement value relative to the reference value, the unit is ° C;

T------- real-time measurement value of temperature, unit is ℃;

T0------- the reference value of temperature, unit is ℃。

c) When the piezometer is subject to the dual effects of seepage (pore) water pressure and temperature, if the atmospheric pressure changes, it should be corrected. The general calculation formula of the piezometer is:

$$Pm = k \times \triangle F + b \times \triangle T + \triangle Q = k \times (F0 - F) + b \times (T - T0) + (Q0 - Q)$$

In the formula: Pm----the measured penetration (pore) water pressure value, the unit is KPa;

Q0----Atmospheric pressure measurement reference value, unit is KPa;

Q-----real-time measurement value of atmospheric pressure, unit is KPa;

d) The formula for calculating the water level elevation of the piezometer is:

$$Hm = ((k\times(F_0 - F) + b\times(T-T_0))/9.81) + H$$

H -----Piezometer installation elevation m

5. Installation

The piezometer is used to measure the pore water pressure in the soil and the seepage water pressure in the rock mass and concrete. The measurement points should be laid out according to the design requirements, and the corresponding embedding method should be adopted according to the structural characteristics of the structure to be measured.

5.1 Preparation before installation

Before installation, the piezometer should be tested and installed only after passing the test.

Saturation of the permeable plate of the piezometer: The permeable plate of the piezometer has a certain density, and the pressure water will pass through the permeable plate and act on the sensing membrane. If the water storage cavity between the permeable plate and the sensing membrane is not filled with water (containing blisters), which will cause serious lag in the osmotic pressure measurement value.

The permeable plate and water outlet cavity of the piezometer must be driven out of air before being buried. There is an operation method. First, unplug the permeable plate component from the piezometer body, and then put the permeable plate component into the water and soak it for more than 2 hours to remove the permeable stone. soak in water to fully saturate it, then immerse the piezometer and permeable plate components in water and reassemble them.

5.2 Embedding diagram in concrete (Figure 1)

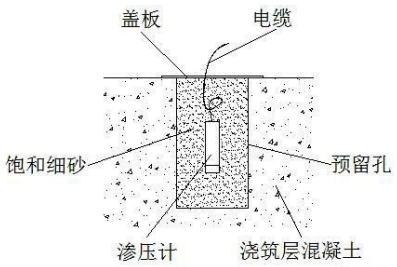
When the concrete pouring layer reaches the designed burial height of the piezometer, dig a pit 30cm deep and 20cm in diameter at the base of the buried location. Pave medium-fine sand in the pit, place the prepared piezometer in the medium-fine sand in the hole, then fill it with medium-fine sand, lead the observation cable according to the designed direction, and pour concrete.

5.3 Burial in bedrock (Figure 2)

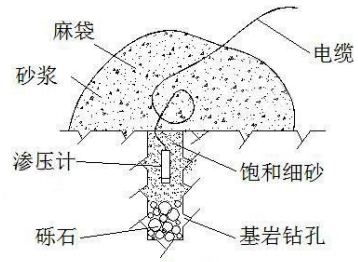
Drill a water collection hole with a depth of 100cm and a diameter of 5cm in the bedrock to be buried. After the borehole passes the water penetration test, the hole is filled with medium-fine sand. The prepared piezometer is placed in the medium-fine sand in the hole, and then filled with medium-fine sand. The observation cable is led out according to the designed direction and poured. Concrete.

5.4 Tunnel and slope embedding (Figure 3)

Drill the hole where the piezometer is buried to a depth of 20cm to 30cm. If there is no water-permeable crack in the hole, drill a small hole at the bottom of the hole to collect water. After passing the water seepage test, fill the small holes with fine stones, fill the holes with medium-fine sand, place the piezometer in the medium-fine sand, and fill the holes with medium-fine sand. Lead the long observation cable connected to the piezometer in a serpentine shape according to the designed direction, and then seal it with cement mortar.



（图一）



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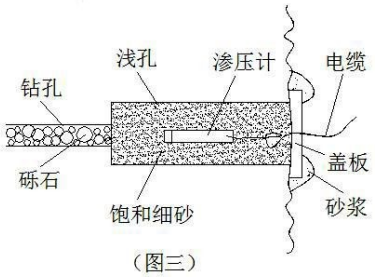


（图三）

5.5 Burial under concrete dam foundation

When burying a piezometer under the concrete floor of the dam foundation, you should first drill a hole, measure the hole depth, and clean the hole. Before installation and burial, first put the piezometer into a permeable sand bag, fill the bag with fine sand, or wrap it with permeable geotextile.

Pour medium-fine sand into the lower part where the piezometer is installed, and adjust the sandbag containing the piezometer into the hole. If the hole is too deep and the weight of the sandbag and cable exceeds the strength of the cable, use a steel wire to hang the tail transverse hole of the piezometer and tie the cable to the steel wire for lifting. This can avoid cable damage.

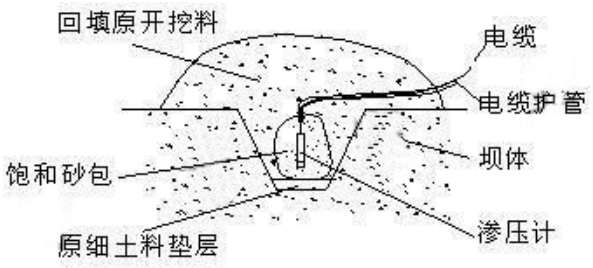
After the piezometer is installed, it should be measured in time to confirm whether the piezometer is intact. Medium-fine sand should be buried in the hole, and water should be poured into the hole at the same time to make the hole saturated with water. Concrete should be poured on the upper part of the side hole.

If it is necessary to observe the seepage water pressure in layers, multiple piezometers can be buried in one hole. The burial method is to repeat the above process step by step. Pay attention to the closed partitions between adjacent piezometers.

5.6 Burial during construction period of earth-rock dam (Figure 5)

The pit-type burying method can be used to bury the seepage pressure gauge in an earth-rock dam. When the filling elevation of the dam surface exceeds the burial elevation of the measuring point by about 0.3 meters, dig a pit about 0.4 meters at the measuring point, wrap the seepage pressure gauge with permeable cloth and sand, and place it. Into the pit. Backfill the original soil and compact it carefully. Where the piezometer is buried, the thickness of the rolling safety covering should be greater than 1 meter.

The observation cable of the piezometer is laid along the excavation trench on the dam surface. When crossing the anti-seepage body, a water stop ring should be added. When laying in a rockfill dam, protective pipes should be added. Observation cables must be laid with margins, in a serpentine shape, and are prohibited from intertwining.



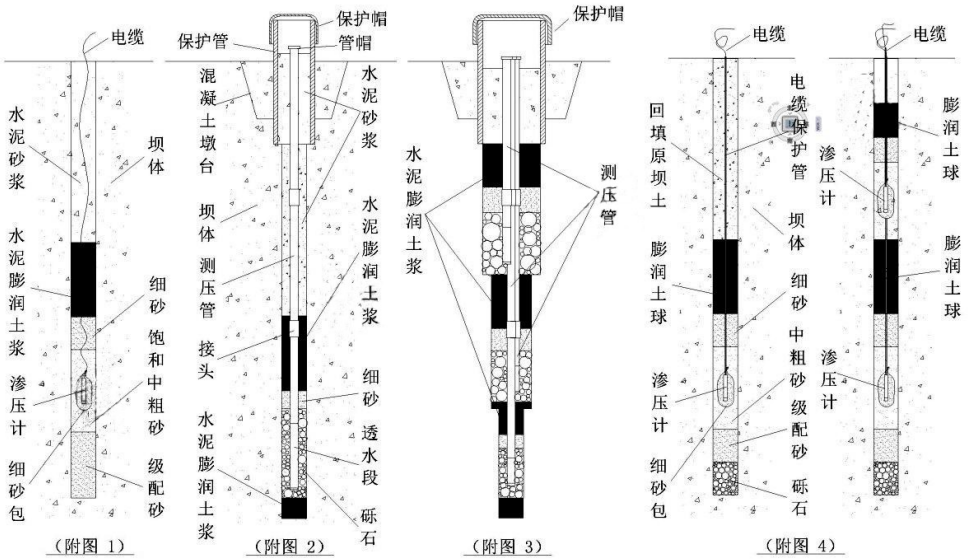
（附图5）

5.7 Construction of earth-rock dam

When burying piezometers in existing projects, the drilling method should be used. The diameter of the drill hole depends on the number of piezometers buried in the hole. The more piezometers, the larger the hole diameter. A single hole can be ¢ 80~100mm. aperture. The depth of the drilled hole should be 40cm or more deeper than the designed burial elevation of the piezometer. After the hole is formed, coarse sand should be poured into the bottom of the hole, and the piezometer should be wrapped with permeable water and emery cloth and placed in the hole, with medium-fine sand

laid on top. As shown below.

After the piezometer is buried, it should be tested in time before sealing the hole. Once any abnormality is found, it should be dealt with in time and re-buried.



5.8 Select base value

The observed value of the osmometer is the change of the real-time measured value relative to the benchmark value, so the accuracy of the benchmark value selection will directly affect the accuracy of the measured value.

If the external load does not change significantly, select three similar readings at the same time and stable temperature, and average them to make a benchmark value. When the piezometer is installed in concrete, the measured value after the heat of hydration should be selected. After the benchmark value is selected, records should be kept as the benchmark value for calculation.

In order to obtain a more accurate reference value, the above operation can be repeated twice. If the two measured values are basically the same (error ≤ 0.5% F.S), it proves that the reference value is correct.

When the measured value of the piezometer deviates, the above method can be used to recalibrate the reference value.

6. Measuring

Use a hand-held vibrating wire reader to measure the piezometer on site. Connect one end of the measurement line to the reading meter, and connect the various colored clips at the other end of the measurement line to the output cable of the piezometer. Black and red measure frequency, and white and green measure temperature. The piezometer is equipped with an intelligent identification chip, which stores the number of the piezometer, calibration coefficient K, temperature correction coefficient b and other information. When measuring with a reading meter, the identification information will be automatically read, sequentially stored in the reading meter, and communicated to the computer to facilitate fast statistical calculation and query, making the measurement work realize artificial intelligence paperless operation。

Many piezometer cables were accidentally dug out at the project site. The number and identity information corresponding to each piezometer can be automatically identified by just measuring it once with the reading instrument.

7. Piezometer troubleshooting

When a fault occurs in the piezometer measurement, a multimeter can be used to check the resistance value between the core wires of the piezometer cable. Under normal conditions, the resistance value of the red and black core wires is usually about 450~900Ω; the resistance value of the green and white core wires is at a temperature of 25° C. should be about 3kΩ; the insulation resistance value between red and black wires and green and white wires or shielded wires (bare wires) should be >50mΩ (when measuring insulation resistance, a 100V DC megohmmeter can be used, and a multimeter should use the MΩ range to measure insulation resistance. , so that it should be infinity ∞).

8. Cable troubleshooting

The piezometer cable extension is YSPT-4 hydraulic special observation cable, so that the cable resistance value is about 45Ω/km.

8.1 Use a multimeter to measure the resistance value (red and black core wires):

Normally it is about 450~900Ω, plus the resistance value of the cable.

a) If the resistance value is normal, the piezometer may be damaged or water may have entered;

b) If the resistance value is very large or infinite, the cable or wiring is open;

c) If the resistance value is very small, the cable or connector is shorted.

Its performance is that the reader cannot measure the frequency value.

8.2 Use a multimeter to measure the resistance value (green and white core wires): under normal circumstances it should be about 3kΩ at a temperature of 25° C, plus the cable resistance.

a) If the resistance value is normal, please check the reading meter and its measurement connection cable

b) If the resistance value is very large or infinite, the cable or wiring is open;

c) If the resistance value is very small, the cable or connector is shorted.

Its performance is that the reader cannot measure the temperature value.

8.3 Use a 100V DC megohmmeter or multimeter to measure the resistance value of the core wires of the piezometer cable (red and black wires to ground, white and green wires to bottom line, red and black wires to white and green wires). If the measured value is very small <5MΩ, the cable connector may be short-circuited due to water ingress.

The performance of the reading instrument is that the measurement is normal, but the measurement frequency value of the automated measurement module may cause the measurement value to be unstable, and the measured temperature value will be 10 to 20° C lower than the normal value.

9. The reading value is unstable

a) Connect the shielded wire to the black wire clip of the reading meter measuring wire;

b) Water may have entered the cable joint, cut it off and reconnect it;

c) Determine the frequency range of the piezometer and correctly select the excitation type;

d) Determine the temperature resistance base value of the piezometer and select the resistance base value correctly;

e) Check if there are any interference sources nearby, such as motors, generators, antennas or AC power cables, and stay away from the above interference sources

10. Precautions

The water inlet buried in the piezometer (with a long cable connected) should face the direction of water pressure, and a water stop should be installed along the cable lead to prevent high-pressure water from penetrating along the cable. The cable should be buried and fixed according to the designed direction.

After the piezometer is in place, the benchmark value of the piezometer should be measured promptly. The water pressure value measured and calculated by the piezometer is a change relative to the benchmark value, so whether the benchmark value is accurate or not will directly affect the measurement. accuracy of value.

After the piezometer is buried, the benchmark value can be tested without changes in water pressure and the end of the hydration heat of the concrete. The benchmark value should be tested under no pressure and constant temperature. For example, the measured value is relatively stable in the morning. Record the measured values (frequency and temperature) of the osmometer three or more times on different days. If the measured values are basically the same (error ≤ 0.5% F.S), the measured value can be used as the baseline value.

After the piezometer is buried, records should be kept and archived according to the piezometer number and design number, and the lead cables should be strictly protected.

11. Acceptable and storage

When unpacking and accepting the piezometer, the user should first check whether the quantity of the piezometer (including accessories) and the factory inspection certificate are consistent with the packing list. After unpacking each piezometer, the insulation resistance between the circuit and the sealed shell should be measured with a 100V megohmmeter. The measured value should meet the requirements of the insulation resistance requirements. During acceptance, each osmometer should be measured with a reading instrument to check whether the osmometer is normal. The piezometer should be kept in a dry, ventilated room.