RST INSTRUMENTS LTD.

P-100-1 Standard Pneumatic Piezometer Installation Manual

RST Instruments Ltd.
11545 Kingston St.,
Maple Ridge, B.C. Canada V2X 0Z5
Tel: (604) 540-1100
Fax: (604) 540-1005
Email: info@rstinstruments.com
Website: www.rstinstruments.com

P-100-1 Standard Pneumatic Piezometer

Product:	P-100-1 Standard Pneumatic Piezometer Installation Manual
Document number:	PPM0026B
Revision:	B
Date:	March 28, 2012

Table of Contents

Table of Figures

1 INTRODUCTION

Pneumatic piezometers are used to measure pore water pressure in boreholes and fills. A typical pneumatic piezometer system includes the following components:

- Pneumatic Piezometer
- Tubing and Quick-Connect Fittings
- Pneumatic Readout

Pneumatic Piezometer: The piezometer is sealed in the borehole, embedded in soil, or suspended in a well.

Tubing: Pneumatic Piezometers use twin tubing which carries gas to and from the piezometer.

Pneumatic Readout: The RST C106 Pneumatic Readout is a portable pneumatic indicator which is carried to the readout station. The readout has an internal supply tank which holds the compressed gas (usually water-pumped nitrogen or carbon dioxide) which is used to activate and read the piezometer.

The RST Standard P-100-1 Pneumatic Piezometer is the recommended general-use pneumatic piezometer. It consists of a P-100 transducer encapsulated in a slotted PVC, sand filled, Casagrande-type piezometer body. This body employs a protected 70-micron porous plastic filter in addition to the 50-micron stainless steel filter on the piezometer tip (Figure 1).

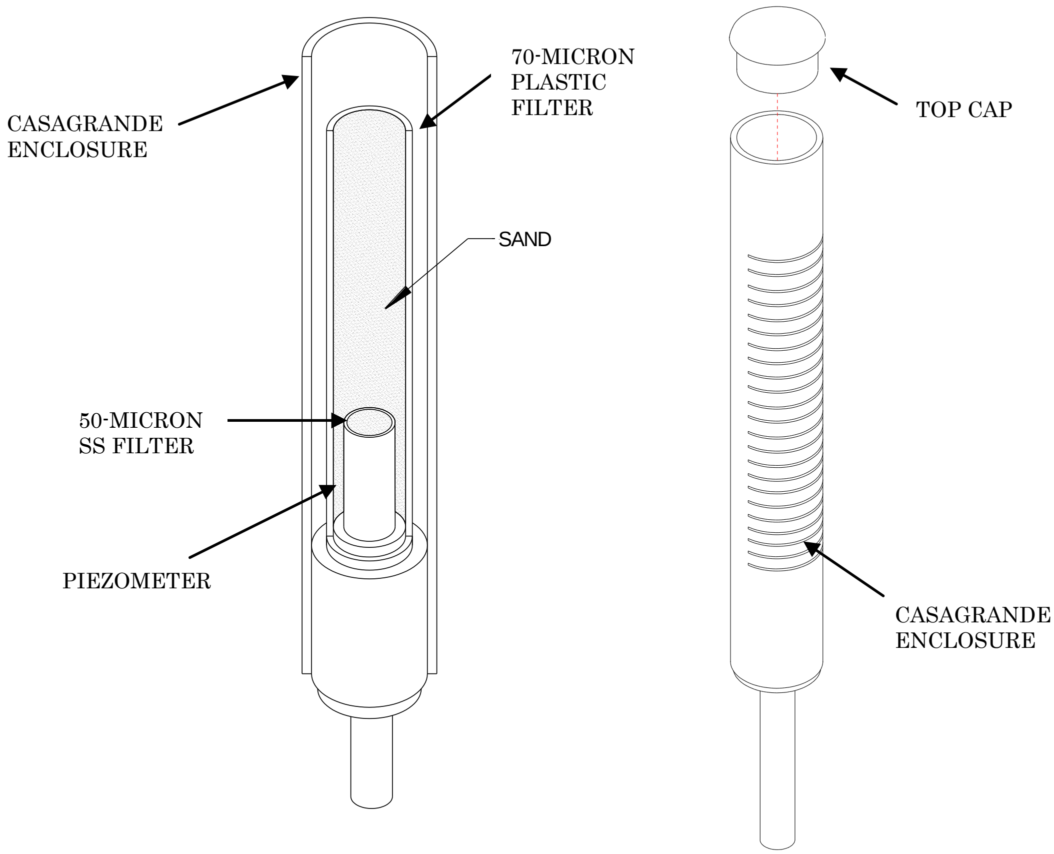

Figure 1 – P-100-1 General Arrangement

2 RST ADVANTAGES

- Over 22 years of proven, long term reliability and accuracy.
- Lowest displacement pneumatic piezometer available.
- Low cost.
- Standard accuracy – 0.1% F.S. with C-106 digital readout.
- No internal metal parts. All piezometer components are non-metallic corrosion-resistant nylon. Flow or non-flow methods supported.
- Compatible with most brands and readouts.
- In-line ***filtered*** quick couplers which prevent dirt from entering the system.
- Remote readings via flexible direct burial tubing avoids construction obstacles.
- RST twin-tube pneumatic tubing uses a compression molded jacket rather than PVC for increased strength. This tubing also has a central web which adds strength and prevents the tubing from becoming a water conduit.

3 PRINCIPLE OF OPERATION

The RST P-100-1 Pneumatic Piezometer is operated by pore-water pressure acting on a diaphragm. This pressure is balanced by gas pressure (usually nitrogen) applied externally through tubing from the surface. When the applied gas pressure exceeds the pore-water pressure acting on the reverse side of the diaphragm, the diaphragm moves outward and allows flow along a return line. When the return flow is detected, the gas supply is shut off at the inlet valve. Any pressure in the tubes greater than the pore-water pressure bleeds away, and the diaphragm returns to its original position. At this point, a null-balance condition is achieved and the gas pressure, which equals the pore pressure, is read on the input tube by the readout instrument. Since interaction between the tip and the surface is by gas flowing through thin tubing, pneumatic piezometers are unaffected by frost penetration at the surface. During installation, however, enough slack should be included in the line to provide for differential movement and seasonal heaving. For further information on reading pneumatic piezometers, please refer to the RST C106 Pneumatic Readout Manual.

4 INSTALLING THE PIEZOMETER

4.1 GENERAL NOTES

- Always handle the piezometer with special care.
- Saturated, water-filled piezometers are prone to freezing in cold weather. Be sure to store piezometers above 0^{o}C to prevent damage to the instrument.
- Pneumatic tubing should also always be handled carefully. Avoid making small radius kinks or bends. Due not drag the tubing over the ground, this could create nicks and cuts in the tubing. Do not lay the tubing across roads where there is traffic.
- Be sure to mark tubing in order to identify it later. Also label depths on the tubing in order to easily recognize when the piezometer has reached its desired finished location.
- Always avoid damage to the quick-connect ends. It is important to keep them clean and dry. Any dirt in the fitting can create leaks in the system and seriously affect the accuracy of the system.

4.2 INSTALLATION IN FILL

4.2.1 Compacted Clay

Excavate a trench or recess about twenty inches deep by two to three feet square. Form a cylindrical hole in the sidewall of the trench. The hole diameter should be slightly smaller than the piezometer body.

Push the piezometer into the side of the hole in the host material. If necessary, to ensure continuity with the saturated high air entry filter and the pore water, smear the filter with a thin paste of the saturated material.

Before back filling, the tubing must be laid with the utmost care. Loop the tubing around the recess, making sure it rests on a bed of hand placed and hand compacted screened clay.

Make sure that the tubing does not cross over itself or other tubing in the same area.

Backfill the recess with screened clay containing no particles larger than 3mm in diameter. The backfill should have a water content and density equal to that of the surrounding material.

Make sure that the tubing is protected from potential damage caused by angular material, compacting equipment or stretching due to subsequent deformations during construction or fill placement.

4.2.2 Granular Materials

Install the piezometer in the center of the above-described recess excavated for this purpose. Place the piezometer within the trench; loop the tubing and backfill with screened material containing the same moisture content and compacted to the same density as the surrounding fill. In rock fill, it is necessary to place a graded filter around the piezometer. Use fine grain clean sand around the instrument and increase the particle size as the backfill proceeds outwards to the rock fill. The sand placed in the recess, around the instrument and tubing should range in size from 0.5 to 3mm in diameter.

4.3 Installation in Boreholes

The method used to install a piezometer in a borehole depends on the particular conditions in which the installation must be carried out. The method described below will cover most applications. Artesian conditions, borehole stability, available drilling equipment and sealing materials are among the factors that will influence the method chosen.

The casing is driven one foot below the required piezometer elevation. If the piezometer is to measure the pore water pressure in a specific horizon, it will be necessary to drive the casing three feet below the piezometer elevation to enable the placement of a bentonite seal at the bottom of the hole.

After driving the casing the cuttings must be removed. Wash the borehole until the water emerging runs clear.

If required, place a two-foot bentonite seal at the bottom of the borehole. Raise the casing six inches and place the bentonite in six-inch increments until the bentonite level is one foot below the piezometer elevation. Pull the casing as the bentonite is set in place. Be very careful not to plug or allow bentonite to stick to the inside walls of the casing. This is accomplished by making sure the bentonite level is at all times below the casing and by slowly dropping the bentonite chips in single file down the hole. Trying to feed the bentonite chips too rapidly will result in bridging of the chips in the casing or borehole. This will make it extremely difficult to complete the seal. Tamping of compressed bentonite chips is not required.

Prior to setting the sand in place, lower a cylindrical weight down the hole to ensure that the hole is clear from any obstructions and if necessary, rinse the borehole until clear water emerges.

In the same manner, place twelve inches of fine, clean sand in six-inch increments below the level of the piezometer tip. Pull the casing as the sand back-filling proceeds. Lower the piezometer into the hole and take the initial reading as described below.

Pull the casing six inches and back fill with fine clean sand. Repeat until the sand and casing is one foot above the top of the piezometer. Then take a reading on the piezometer.

Lift the casing in six-inch increments and backfill with bentonite until a minimum four-foot seal has been formed. During the bentonite placement keep the cable taut to prevent the bentonite from hooking up in the casing. Pour the bentonite in the hole one at a time to avoid bridging.

If more than one piezometer is to be installed in the hole, backfill the casing with either a cement/bentonite grout, host material or sand/bentonite mixture to an elevation of 4 feet below the second piezometer, then use 3 feet of bentonite, 1 foot of sand, then the piezometer. Proceed as described above.

Pull the casing. Use care when pulling the casing so that you do not twist or damage the pneumatic tubing.

Once the entire casing has been removed, top off the borehole with grout.

4.4 INITIAL READING

When installing a piezometer the user must be aware that the act of drilling and backfilling a hole changes the pore-water pressure in the ground. Therefore, the initial readings following the installation will not be representative of the actual conditions. Recovery of the natural pore-water pressure may take some time (hours to weeks) depending on the conditions and the permeability of the soil. When readings have stabilized over the period of a few days, it can be assumed that the sampling zone has returned to original conditions.

5 FILTER SATURATION

The P-100-1 Piezometer does not require any elaborate saturation procedures because it has both 50-micron and 70-micron filters which pass both air and water. Only high-air entry filters require elaborate saturation procedures. However, as mentioned above, the recovery of pore water pressure can take some time in a freshly drilled borehole. Readings need to stabilize before it can be assumed that the sampling zone has returned to original conditions. Field-testing has shown that when placed in a borehole, the P-100-1 Casagrande assembly saturates immediately and yields response times identical to the P-100 piezometer. These response times are on the order of seconds, therefore pre-saturation is not an issue.

6 TAKING READINGS

Please refer to the *RST C-106 Pneumatic Readout Instrument Instruction Manual* for a complete description on how to take readings with the P104 Piezometer.

7 SPLICING PNEUMATIC TUBING

7.1 SPLICE KIT

The CT1100 Splice Kit is used to join two lengths of twin pneumatic tubing.

7.2 MATERIAL LIST

- 1 male & 1 female vinyl closures
- Emery cloth
- Encapsulating resin
- Gloves
- Mixing paddle
- Wrapping Mesh
- 2 brass compression fittings
- Extra Ferrule & Nut
- Electrical Tape (customer supplied)

7.3 INSTRUCTIONS

It is imperative that dirt does not enter the pneumatic lines during the splicing process. This cannot be over-emphasized, as the introduction of dirt into the factory sealing system can seriously affect the performance of the system.

In the event that a break is being repaired in the field, it is necessary to cut a few feet back on each side of the break to avoid the inclusion of dirt.

1. Cut the PVC jacket back 2½ - 2¾ inches in order to expose the black and white pneumatic tubes. Check that there is not damage to the tubing in the form of nicks or cuts.

2. Lay out the tubing and cut the individual tubes so that the unions will be staggered when the tubes are joined (Figure 1). Make sure to cut the tubes as square as possible.

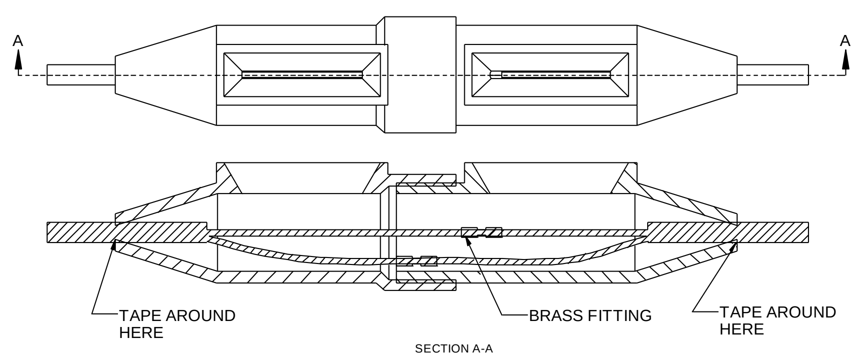

Figure 2 – Splicing Pneumatic Tubing

3. Determine where to cut off closures tapered ends by inserting cable into each closure. Cut closure ends, ensuring snug fit around cable.

4. Slip the halves of the closure onto respective tubing or cable ends and slide along the tubing or cable.

5. Using ONLY the brass compression fittings provided, join the pneumatic lines maintaining the black to black, white to white, colour coding (see Figure 1). **Never re-use any old**

compression fittings. Insure that the tubing has bottomed in the fitting. Finger tighten the compression nuts, and then apply 1 full turn with a wrench. **Do not over tighten!**

6. Use Emery cloth to roughen cable jackets.

7. Wrap mesh provided around splice. The square mesh provided with the CT1100 closure will fit around the whole connector. Tear off or tuck in end of mesh wrap. Slide the two closures halves together.

8. Use electrical tape to seal any gaps between the closure ends and the jackets.

9. Remove one tube of encapsulant material from the white barrier bag but keep it in the mixing bag. Using your thumb and forefinger, flip the plastic wafer inside the tube. Mix the tube according to the chart below.

   Encapsulating resin must be used immediately after mixing

Temperature	**86°F - 100°F** **30°C - 38°C**	**66°F - 85°F** **18°C - 30°C**	**Below 65°F** **Below 18°C**
Mixing Time	Shake for 30 seconds	Shake for 60 seconds	Use Alternative Mix Method

Table 1: Temperature vs. Mixing Time

   Alternative Mixing Method:

   At temperatures below 65F, **DO NOT SHAKE**. After flipping the plastic wafer, remove the tube from the mixing bag. Work the wafer to the heat sealed end. Cut the heat sealed end; remove the wafer with the wooden paddle. Stir vigorously with the wooden mixing paddle for one minute to blend the components together. Pour mixed material in fill port(s).

10. After the mixing time specified, remove tube from mixing bag. Point crimped end of tube down and uncap. Dispensing tips have been provided that screw on the capped end when the cap is removed. Slowly pour encapsulating material into pour spouts of closure, working air bubbles out as you pour.

11. The completed splice must allow the epoxy to bond to the jacket, as well as the closures. Pressurize the tubes, and check for leaks.

7.4 Caution

Avoid contact with the enclosed liquids. Wear protective clothing, including splash proof goggles and disposable plastic gloves. Avoid breathing vapors. Use only in areas with adequate ventilation.

8 Shortening/Extending the Tubing

1. Cut the male quick connect off the black tube

2. Cut tubing to design length.

3. Peel the PVC jacket back a few inches (score with a knife), taking care not to cut the pneumatic lines.

4. Using the compression fitting, ferrule, and nut provided, re-attach the quick connect to the black line. Tighten 1 turn past finger tight with a wrench (be careful not to over-tighten).

RST recommends that only the compression fittings supplied with the splice kit be used. The use of other brands with fittings not specifically designed for plastic tube may misalign during installation, causing leakage. **Never re-use old compression fittings!**

The male quick connect fitting supplied with the piezometer has an integral 50 micron filter. The use of non-filtered types is not recommended as this will permit the ingress of dirt, and may cause failure.

We recommend that the piezometer be read before and after splicing to insure proper operation, and provide an indication of any possible calibration offset caused by the addition of extra tubing. This offset, caused by friction head loss in the pneumatic lines should not be a factor, unless a considerable length of tubing is added.