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Instruction Manual

Model 3400

Piezometer

(Doc Rev F, 04/07)

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1. GENERAL DESCRIPTION

Geokon Model 3400 Piezometers are intended for dynamic measurements of fluid and/or pore water pressures in standpipes, boreholes, embankments, pipelines, pressure vessels, reservoirs, etc. They are also used for static pressure movement where the readout system is incompatible with vibrating wire type transducers.

The piezometer assembly is shown in figure 1.

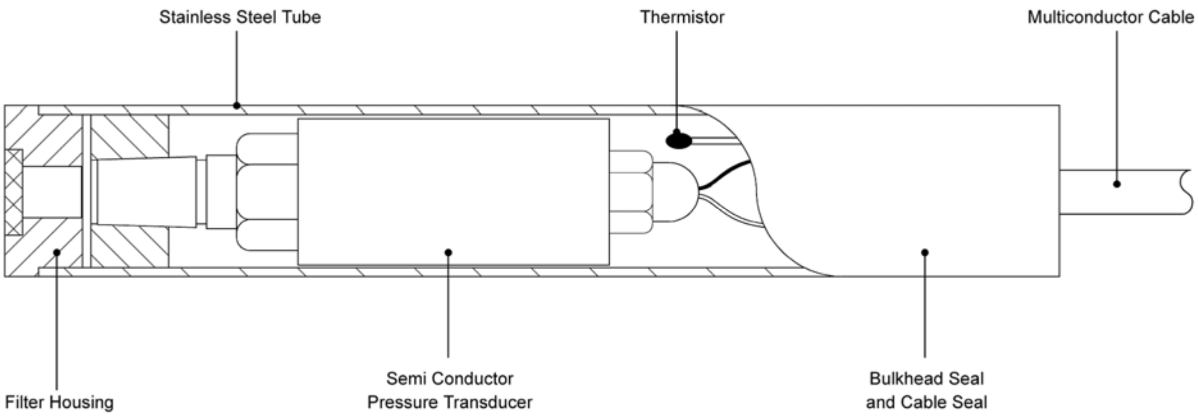

Figure 1. Model 3400 Piezometer Assembly

The basic pressure transducer is semi-conductor based and is made by others. The output from the transducer may be 100mV/volt, 0 to 5 volts, or 4 to 20mA at the option of the user. The transducer is packaged inside a 1¼ (32mm) diameter stainless steel tube (standard 304 SS or optional 316 SS for aggressive environments). At one end of this tube is a filter housing to allow the passage of water while preventing the entry of soil particles. At the other end is located a bulkhead seal and cable entry seal to prevent water from reaching the backside of the transducer. A thermistor included inside the main housing allows the measurement of temperature.

The output cable is multi conductor with from 2 to 4 shielded pairs depending on the transducer output. Voltage types are generally read using remote sensing techniques. Low pressure models may also be vented to the atmosphere through a vent tube inside the cable. Venting of the transducer is necessary if the effects of barometric pressure changes on the transducer are to be eliminated.

Where venting is used, the outer end of the vent tube is connected to a dessicant chamber to prevent moisture from migrating to the transducer interior.

2. PRELIMINARY TESTS

- Upon receipt of the piezometer, connect it to the readout using the wiring charts shown in Appendix C, and check that the zero pressure reading is within 1% F.S. of the value shown on the calibration sheet after due correction for barometric pressure, elevation above sea level and temperature.

- Apply a pressure or vacuum to the piezometer and check that the readout response is reasonable.

- Check the insulation resistance. Use an ohmmeter to measure the resistance between any conductor and the shield. The resistance should be greater than 50 megohms.

- If an attempt is made to check the calibration, make sure that the applied pressure is accurate. Be aware that calibration performed by raising and lowering the piezometer inside a borehole or well may be compromised by displacement of water level caused by changing volumes of immersed cable.

  Calibrations performed in this way should be done with the filter housing removed. If the filter is left in place, be sure that it is completely saturated and that the space between filter and transducer is filled with water. Also be sure to allow sufficient time (15-20 minutes) for the piezometer to reach thermal equilibrium before beginning the test.

3. INSTALLATION

Before attempting an installation be sure that the filter stone is completely saturated (see section 4) and that the space between the filter stone and the transducer diaphragm is filled with water.

3.1 Establishing A Zero Pressure Reading

It is essential, in many cases, to establish an accurate zero pressure reading at the job site under known conditions of barometric pressure and temperature. The following procedures are important.

- Either remove the filter housing completely (preferred) or make sure that the filter stone is saturated and that the space between the filter and transducer diaphragm is completely filled with water.

- Lower the piezometer into the borehole or well until it is just above the water level.

- Allow 15-20 minutes for the temperature to stabilize before taking the reading.

3.2 Installation in Standpipes or Wells

A zero reading is first established (follow the procedures outlined in Section 3.1). The filter stone is saturated (follow the procedures in Section 4). The piezometer can then be lowered to the desired position in the standpipe using the cable to serve as a depth marker so that the position (elevation) of the piezometer tip is accurately known.

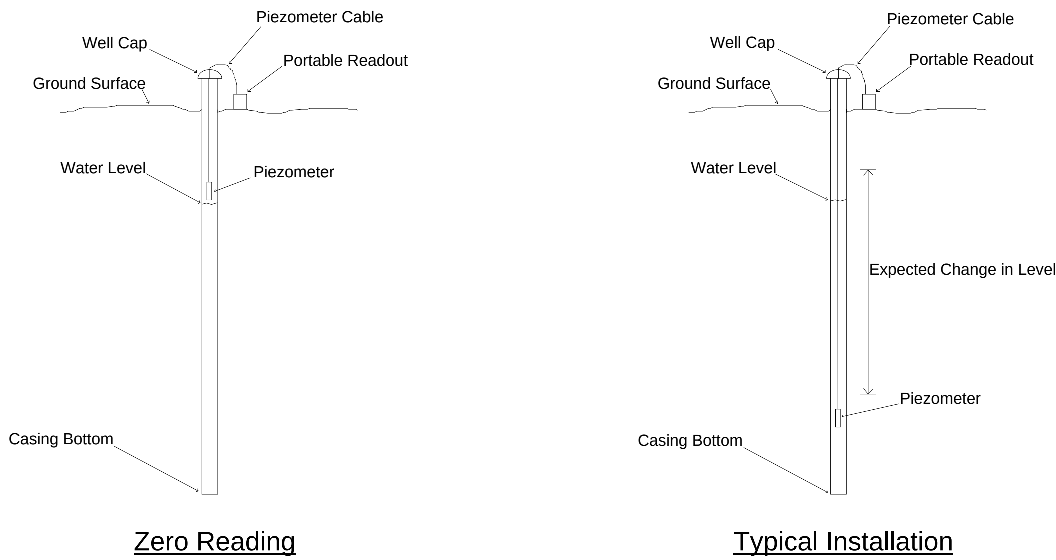

Figure 3. Typical Level Monitoring Installations

Be sure the cable is securely fastened at the top of the well or readings could be in error due to slippage of the piezometer into the well.

It is not recommended that piezometers be installed in wells or standpipes where an electrical pump and/or cable is present or nearby. Electrical interference from these sources can cause unstable readings. Where such installations cannot be avoided, the piezometer should be encased inside a section of mild steel pipe.

In situations where packers are used in standpipes the same sequence as above should be noted and special care should be taken to avoid cutting the cable jacket with the packer since this could introduce a possible pressure leakage path.

3.3 Installation in Boreholes

Geokon piezometers can be installed in boreholes in either single or multiple installations per hole, in cased or uncased holes. See Figure 4. Careful attention must be paid to borehole sealing techniques if pore pressures in a particular zone are to be monitored.

Boreholes should be drilled either without drilling mud or with a material that degrades rapidly with time, such as Revert™. The hole should extend from 6 inches to 12 inches below the proposed piezometer location and should be washed clean of drill cuttings. The bottom of the borehole should then be backfilled with clean fine sand to a point 6 inches below the piezometer tip. The piezometer can then be lowered, as delivered, into position. Preferably, the piezometer may be encapsulated in a canvas cloth bag containing clean, saturated Ottawa sand and then lowered into position. While holding the instrument in position (a mark on the cable is helpful) clean sand should be placed around the piezometer and to a point 6 inches above it. Figure 4 details two methods of isolating the zone to be monitored.

Installation A

Immediately above the "collection zone" the borehole should be sealed with either alternating layers of bentonite and sand backfill tamped in place for approximately 1 foot followed by common backfill or by an impermeable bentonite-cement grout mix. If multiple piezometers are to be used in a single hole the bentonite-sand plugs should be tamped in place below and above the upper piezometers and also at intervals between the piezometer zones. When designing and using tamping tools special care should be taken to ensure that the piezometer cable jackets are not cut during installation.

Installation B

Immediately above the "collection zone" the borehole should be filled with an impermeable bentonite grout.

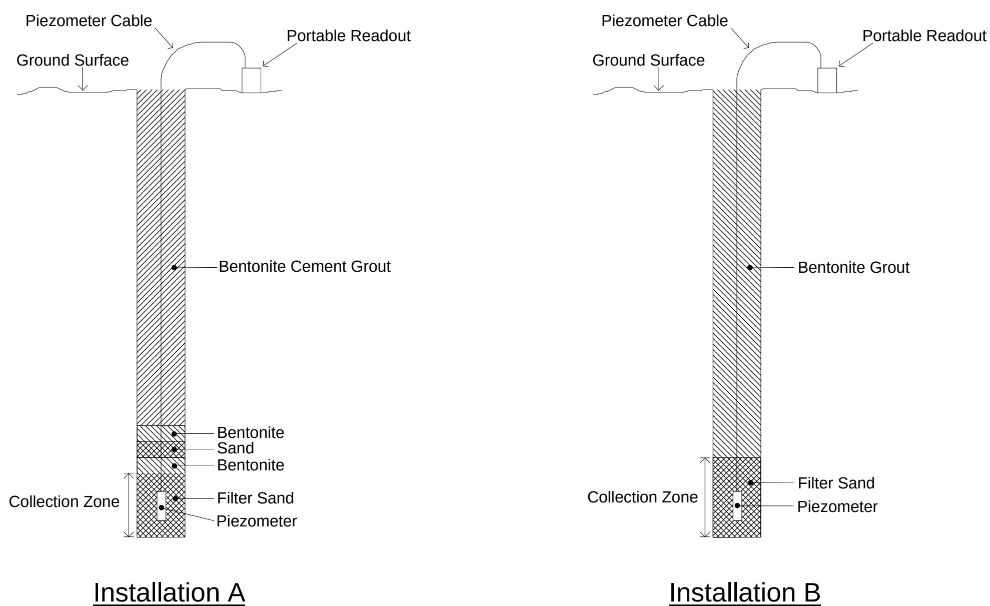

Figure 4. Typical Borehole Installations

It should be noted that since the Model 3400 piezometer is basically a no-flow instrument, collection zones of appreciable size are not required and the piezometer can, in fact, be placed directly in contact with most materials provided that the fines are not able to migrate through the filter.

3.4 Installation in Fills and Embankments

Geokon piezometers are normally supplied with direct burial cable suitable for placement in fills such as highway embankments and dams, both in the core and in the surrounding materials.

In installations in non-cohesive fill materials the piezometer may be placed directly in the fill or, if large aggregate sizes are present, in a saturated sand pocket in the fill. If installed in large aggregate, additional measures may be necessary to protect the cable from damage.

In fills such as impervious dam cores where sub-atmospheric pore water pressure may need to be measured (as opposed to the pore air pressure) a ceramic tip with a high air entry value is often used which should be carefully placed in direct contact with the compacted fill material (see Installation A of Figure 5). In partially saturated fills if only the pore air pressure is to be measured, the standard tip is satisfactory. It should be noted that the coarse tip measures the air pressure when there is a difference between the pore air pressure and the pore water pressure, and that the difference between the two pressures is due to the capillary suction in the soil. The general consensus is that the difference is normally of no consequence to embankment stability. As a general rule the coarse (low air entry) tip is suitable for most routine measurements and, in fine cohesive soils, sand pockets should not be used around the piezometer tip (see Installation B of Figure 5). In high traffic areas and in materials which exhibit pronounced "weaving", a heavy-duty armored cable should be used.

Cables are normally installed inside shallow trenches with the fill material consisting of smaller size aggregate. This fill is carefully hand compacted around the cable. Bentonite plugs are placed at regular intervals to prevent migration of water along the cable path.

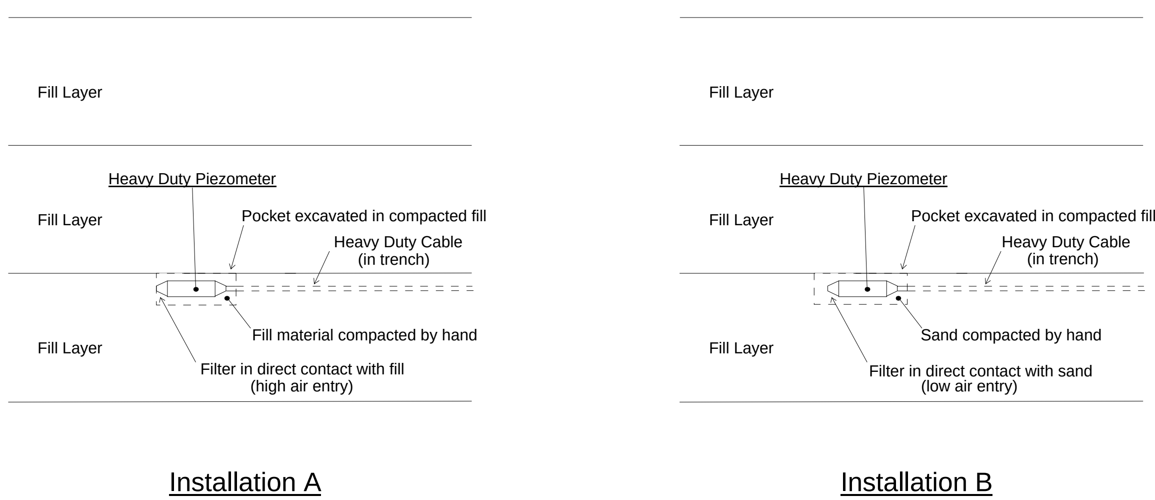

Figure 5. Typical Dam Installations

3.5 Installation by Pushing or Driving into Soft Soils

The Model 3400DP piezometer is designed for pushing into soft soils. See Figure 6. The unit is connected directly to the drill rod (AW, EW or other) and pressed into the ground either by hand or by means of the hydraulics on the rig. The units can also be driven but the possibility of a zero shift due to the driving forces exists.

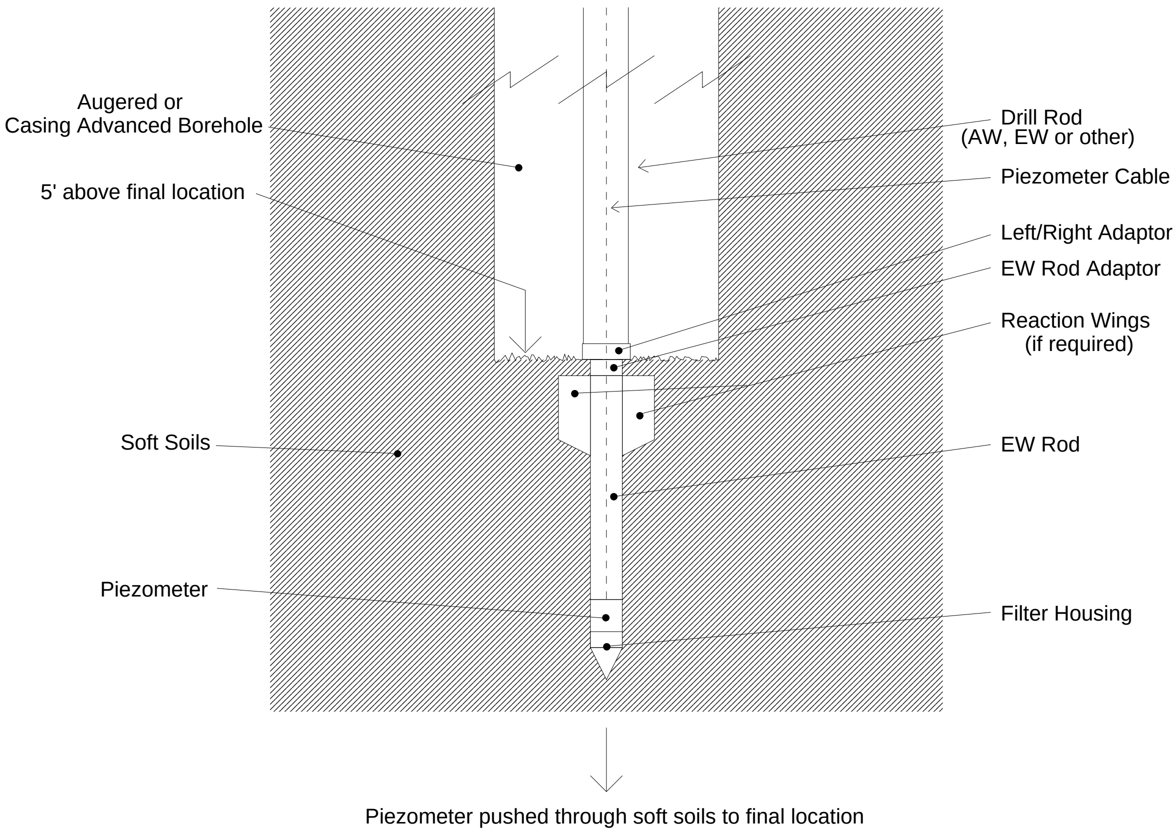

Figure 6. Typical Soft Soils Installation

The piezometer should be connected to a readout and monitored during the driving process. If measurement pressures reach or exceed the calibrated range, the driving should be stopped and the pressures allowed to dissipate before continuing.

The drill rod can be left in place or it can be removed. If it is to be removed then a special 5 foot section of EW (or AW) rod with wings and a left hand thread are attached directly to the piezometer tip. This section is detached from the rest of the drill string by rotating the string clockwise. The left hand thread will then loosen. The wings prevent the special EW rod from turning. A special LH/RH adapter is available from Geokon. The adapter is retrieved along with the drill string.

4. DE-AIRING FILTER TIPS

Most Geokon filter tips can be removed for saturating and re-assembly. The procedures are as follows:

4.1 Low Air Entry Filter

For accurate results, total saturation of the filter is necessary. For the low air entry filter normally supplied, this saturation occurs as the tip is lowered into the water. Water is forced into the filter, compressing the air in the space between the filter stone and the pressure sensitive diaphragm. After a period of time, this air will dissolve into the water until the space and the filter is entirely filled with water. To speed up the saturation process, remove the filter assembly and fill the space above the diaphragm with water, then slowly replace the filter housing allowing the water to squeeze through the filter stone. With low pressure range piezometers (<10 psi) take readings with a readout box while pushing the filter housing on so as not to over-range the sensor.

To maintain saturation, the unit should be kept under water until installation.

If the 3400 piezometer is to be used in standpipes and raised and lowered many times the filter may loosen. A permanent filter assembly may be required. The removable filter may be fixed permanently by prick punching the piezometer tube approximately 1/16" to 1/8" behind the filter assembly joint.

Screens are also available for standpipe installations. Screens are less likely than standard filters to become clogged where salts in the water can be deposited if the filter is allowed to dry out completely.

4.2 Removable Ceramic Filter

The ceramic filter on the 3400 piezometer is also removable for de-airing. Because of the high air entry characteristics, de-airing is particularly important for this filter assembly. Filters with different air entry values require different procedures.

1 Bar Filters

1. Remove the filter from the piezometer by carefully twisting and pulling on the filter housing assembly.

2. Boil the filter assembly in de-aired water.

3. Re-assemble the filter housing and piezometer under the surface of a container of de-aired water. Be sure that no air is trapped in the transducer cavity. While pushing the filter on use a readout box to monitor the diaphragm pressure. Allow over-range pressure to dissipate before pushing further.

4. To maintain saturation, the unit should remain immersed until installation.

2 Bar and Higher

The proper procedure for de-airing and saturating these filters is somewhat complex and should be done either at the factory by Geokon or by carefully following the instructions below:

1. Place the assembled piezometer, filter down, in a vacuum chamber with an inlet port at the bottom for de-aired water.

2. Close off the water inlet and evacuate the chamber. The transducer should be monitored while the chamber is being evacuated.

3. When the maximum vacuum has been achieved, allow de-aired water to enter the chamber and reach an elevation a few inches above the piezometer filter.

4. Close off the inlet port. Release the vacuum.

5. Observe the transducer output. It will take as long as 24 hours for the filter to completely saturate (5 bar) and the pressure to rise to zero.

6. After saturation the transducer should be kept in a container of de-aired water until installation. If de-aired at the factory a special cap is applied to the piezometer to maintain saturation.

4.3 Model 3400DP

The 3400DP Drive Point Piezometer is de-aired in the same way as the 3400 models by first unscrewing the point of the piezometer assembly and then following the instruction for the 3400.

4.4 Model 3400H Transducer

When connecting the Model 3400H transducer to external fittings, the fitting should be tightened into the ¼"-NPT thread with a wrench on the flats provided on the transducer housing. Also, avoid tightening onto a closed system since the process of tightening the fittings could over-range and permanently damage the transducer. If in doubt, attach the gage leads to the readout box and take readings while tightening. Teflon tape on the threads makes for easier and more positive connection to the transducer.

5. SPLICING AND JUNCTION BOXES

Cable splicing should be kept to a minimum since changes in cable resistance can cause changes in calibration if remote sensing techniques or 4-20 mA output are not in use.

The Model 3400 utilizes a semi conductor transducer and, as such, has low level output signals. If cables are damaged or improperly spliced the outputs can be seriously degraded. It is, therefore, absolutely necessary to provide a high degree of cable protection and if cables must be spliced only recognized high quality techniques should be used. The splice should be waterproofed completely – use 3M Scotchcast model 82-A1. These kits are available from the factory.

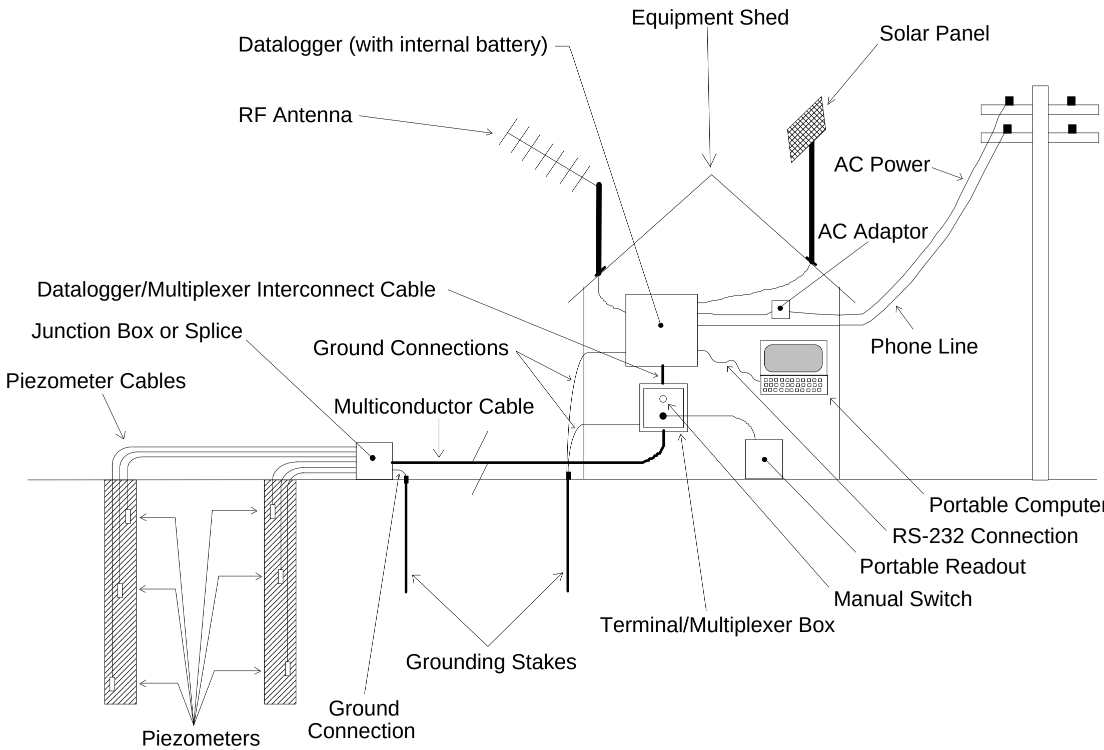

Figure 7. Typical Multi-Piezometer Installation

The cable used for making splices should be a high quality twisted pair type with 100% shielding (with integral shield drain wire). When splicing, it is very important that the shield drain wires be spliced together! Splice kits recommended by Geokon incorporate casts placed around the splice then filled with epoxy to waterproof the connections. When properly made, this type of splice is equal or superior to the cable itself in strength and electrical properties. Contact Geokon for splicing materials and additional cable splicing instructions.

Junction boxes and terminal boxes are available from Geokon for all types of applications. In addition, portable readout equipment and datalogging hardware are available. See Figure 7. Contact Geokon for specific application information.

6. Electrical Noise

Care should be exercised when installing instrument cables to keep them as far away as possible from sources of electrical interference such as power lines, generators, motors, transformers, arc welders, etc. Cables should never be buried or run with AC power lines. The instrument cables will pick up the 50 or 60 Hz (or other frequency) noise from the power cable and this will likely cause a problem obtaining a stable reading. Contact the factory concerning filtering options available for use with the Geokon dataloggers and readouts should difficulties arise.

7. Lightning Protection

In exposed locations it is vital that the piezometer be protected against lightning strikes.

7.1. If the instruments will be read manually with a portable readout (no terminal box) a simple way to help protect against lightning damage is to connect the cable leads to a good earth ground when not in use. This will help shunt transients induced in the cable to ground thereby protecting the instrument.

7.2. Terminal boxes available from Geokon can be ordered with lightning protection built in. There are two levels of protection;

- The terminal board used to make the gage connections has provision for installation of plasma surge arrestors.

- Lightning Arrestor Boards (LAB-3) can be incorporated into the terminal box. These units utilize surge arrestors and transzorbs to further protect the piezometer.

In the above cases the terminal box would be connected to an earth ground.

7.3. Improved protection using the LAB-3 can be had by placing the board in line with the cable as close as possible to the installed piezometer (see Figure 8). This is the recommended method of lightning protection.

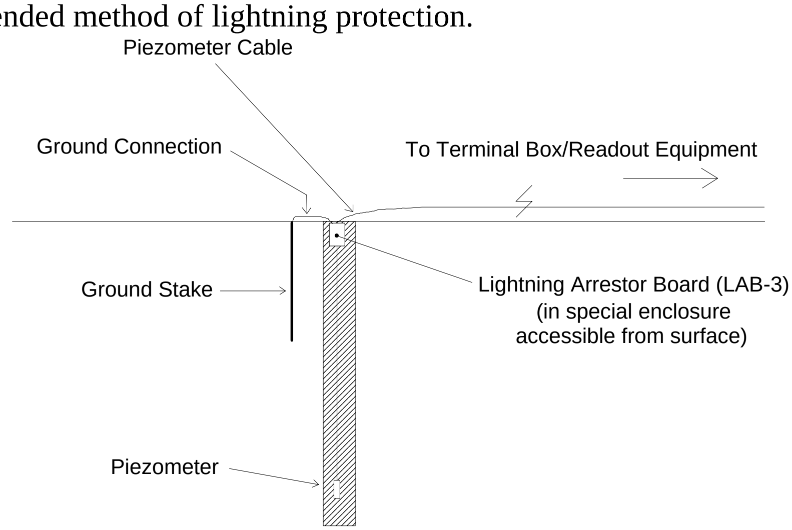

Figure 8. Recommended Lightning Protection Scheme

8. READOUT PROCEDURES

Connect the piezometer to the readout instrument using the appropriate wiring chart given in Appendix C.

8.1 Initial Readings

Initial readings must be taken and carefully recorded along with the barometric pressure and temperature at the time of installation. Follow the instructions of Section 3.1.

8.2 Reading Pressure

The Model 3400 Piezometer uses a semiconductor strain gage type transducer with an output of either 0-100mV (Model 3400-1), 0-5 volts (Model 3400-2), or 4-20 mA (Model 3400-3).
For the 100mV type, the output voltage is directly proportioned to both pressure and input voltage, therefore it is very important that the input voltage be accurately controlled @ 10V DC. If any other voltage is used, the gage factor **G** must be adjusted accordingly. The 0-5 volt and 4-20mA sensors require an unregulated input of 7-35 VDC.

8.2.1 Calibration

The gage factor, **G**, is determined by dividing the full-scale pressure range by the full-scale output which is either 100mV, 5 Volts or 16 mA. For instance a 350 kPa transducer with a 100mv FS output would have a gage factor, G, of 350/100 = 3.5 kPa/mV. Similarly a 3.5Mpa transducer with 4-20mA output would have a gage factor of 3500/16 = 218.75kPa/mA

8.3. Measuring Temperatures

Each piezometer is equipped with a thermistor for reading temperature. The thermistor gives a varying resistance output as the temperature changes. Appendix C shows which cable conductors are connected to the thermistor. These conductors should be connected to a digital ohmeter

A Look up table for converting the measured resistance into temperatures is given in Table B-1 (Appendix B). Alternately the temperature can be calculated using Equation B-1 (Appendix B). For example, a resistance of 3400 ohms is equivalent to 22° C. When long cables are used the cable resistance may need to be taken into account. Standard 22 AWG stranded copper lead cable is approximately 14.7Ω/1000' or 48.5Ω/km, multiply by 2 for both directions.

9. DATA REDUCTION

9.1. Pressure Calculation

The pressure measured by the piezometer is determined by the following:

$$\mathbf{P} = (\mathbf{R_1} - \mathbf{R_0})\,\mathbf{G}$$

Where, **P** is the applied pressure in kPa or psi, $\mathbf{R_1}$ and $\mathbf{R_0}$ are the current and initial output, in millivolts, volts or milliamps

G is the gage factor, as defined in Section 8.2.1

Example, Model 3400 –1 - 700kPa

$\mathbf{R_0}$ = -0.25 mV
$\mathbf{R_1}$ = 18.0 mV
G = 700/100 = 7 kPa/mV
P = (18.0 – (– 0.25)) 7 = 127.75kPa

The Initial Reading (R_0) is normally obtained at the time of installation, as described in Section 3.1.

To convert the output to other engineering units, multiply the Calibration Factor by the conversion multiplier listed in Table 1.

From → To ↓	psi	"H_2O	'H_2O	mm H_20	m H_20	"HG	mm HG	atm	mbar	bar	kPa	MPa
psi	1	.036127	.43275	.0014223	1.4223	.49116	.019337	14.696	.014503	14.5039	.14503	145.03
"H_2O	27.730	1	12	.039372	39.372	13.596	.53525	406.78	.40147	401.47	4.0147	4016.1
'H_2O	2.3108	.08333	1	.003281	3.281	1.133	.044604	33.8983	.033456	33.4558	.3346	334.6
mm H_20	704.32	25.399	304.788	1	1000	345.32	13.595	10332	10.197	10197	101.97	101970
m H_20	.70432	.025399	.304788	.001	1	.34532	.013595	10.332	.010197	10.197	.10197	101.97
"HG	2.036	.073552	.882624	.0028959	2.8959	1	.03937	29.920	.029529	29.529	.2953	295.3
mm HG	51.706	1.8683	22.4196	.073558	73.558	25.4	1	760	.75008	750.08	7.5008	7500.8
atm	.06805	.0024583	.0294996	.0000968	.0968	.03342	.0013158	1	.0009869	.98692	.009869	9.869
mbar	68.947	2.4908	29.8896	.098068	98.068	33.863	1.3332	1013.2	1	1000	10	10000
bar	.068947	.0024908	.0298896	.0000981	.098068	.033863	.001333	1.0132	.001	1	.01	10
kPa	6.8947	.24908	2.98896	.0098068	9.8068	3.3863	.13332	101.320	.1	100	1	1000
MPa	.006895	.000249	.002988	.00000981	.009807	.003386	.000133	.101320	.0001	.1	.001	1

Table 1 - Engineering Units Multiplication Factors

9.2 Temperature Correction

The basic transducers are thermally compensated over normal temperatures and thus a temperature correction is not required so long as the temperature is not changing rapidly. If this occurs, time should be allowed for the transducer to reach thermal equilibrium.

9.3 Barometric Corrections

If the piezometers are unvented, they will respond directly to barometric fluctuations. If a correction is required, it will be necessary to record the barometric pressure at the time of each pressure reading. The change in Barometer, **(S_1 - S_0),** must be subtracted from the measured pressure change, **P**.

10. TROUBLESHOOTING

Maintenance and troubleshooting of Model 3400 Piezometer is confined to periodic checks of cable connections. Once installed, the piezometers are often inaccessible and remedial action is limited. Consult the following list of problems and possible solutions should difficulties arise. Consult the factory for additional troubleshooting help.

Symptom: Pressure Cell Readings are Unstable

- ✓ Is there a source of electrical noise nearby? Most probable sources of electrical noise are motors, generators, transformers, arc welders and antennas. Make sure the shield drain wire is connected to ground whether using a portable readout or datalogger.
- ✓ Does the readout work with another piezometer? If not, the readout may have a low battery or be malfunctioning. Consult the appropriate readout manual for charging or troubleshooting directions.
- ✓ Is the filter clogged? Remove piezo (if possible) and inspect.

Symptom: Piezometer Fails to Read

- ✓ Is the cable cut or crushed? This can be checked with an ohmmeter. If the resistance reads infinite, or very high (megohms), a cut wire must be suspected. If the resistance reads very low (<100Ω) a short in the cable is likely.
- ✓ Does the readout or datalogger work with another piezometer? If not, the readout or datalogger may be malfunctioning. Consult the readout or datalogger manual for further direction.

APPENDIX A - SPECIFICATIONS

A.1. Piezometers

Specifications	***Model 3400***
Input	
Pressure Range	Vacuum to 400 bar (6000 psi)
Proof Pressure	2 x Full Scale(FS) (1.5 x FS for 400 bar, >=5000psi)
Burst Pressure	>35 x FS <= 6 bar (100psi) >320 x FS <= 60 bar (1000psi) >5 x FS <= 400 bar (6000psi)
Fatigue Life	Designed for more than 100 million FS cycles
Performance	
Long Term Drift	0.2% FS/year (non-cumulative)
Accuracy	0.25% FS typical (optional 0.15% FS)
Thermal Error	1.5% FS typical (optional 1% FS)
Compensated Temperatures	-20° to 80° C (-5° to 180° F)
Operating Temperatures	-40° to 125° C ((-22° to 260°) for elec. codes A, B, C, 1 -20° to 80° C (-5° to 180° F) for elec. codes 2, D, G, 3 -20° to 50° C (-5° to 125° F) for elec. codes F, M, P Amplified units > 100C maximum 24 Vdc supply
Zero Tolerance	1% of span
Span Tolerance	1% of span
Mechanical Configuration	
Pressure Port	see ordering chart
Wetted Parts	17-4 PH Stainless Steel
Electrical Connection	see ordering chart
Enclosure	316 ss, 17-4 PH ss IP65 for elec. codes A, B, C, D, G, 1, 2, 3 IP67 for elec. code “F” IP68 for elec. codes M, P IP30 for elec. code “3” with flying leads
Vibration	35g peak sinusoidal, 5 to 2000 Hz
Acceleration	100g steady acceleration in any direction 0.032% FS/g for 1 bar (15 psi) range decreasing logarithmically to 0.0007% FS/g for 400 bar (6000 psi) range.
Shock	Withstands free fall to IEC 68-2-32 procedure 1
Approvals	CE
Weight	Approximately 100 grams (additional cable; 75g/m)

Individual Specifications	
Millivolt Output Units	
Output	100mV ± 1mV
Supply Voltage (VS)	10Vdc (15Vdc max.) Regulated
Bridge resistance	2600-6000 ohms
Voltage Output Units	
Output	see ordering chart
Supply Voltage (Vs)	1.5 Vdc above span to 35 Vdc @6mA
Supply Voltage Sensitivity	0.01% FS/Volt
Min. Load Resistance	(FS output / 2) kohms
Current Output Units	
Output	4-20mA (2 wire)
Supply Voltage(VS)	24 Vdc, (7-35 Vdc)
Supply Voltage Sensitivity	0.01% FS/Volt
Max Loop Resistance	(Vs-7) x 50 ohms.

Table A-1 Piezometer Specifications

APPENDIX B - THERMISTOR TEMPERATURE DERIVATION

Thermistor Type: YSI 44005, Dale #1C3001-B3, Alpha #13A3001-B3

Resistance to Temperature Equation:

$$T = \frac{1}{A + B(LnR) + C(LnR)^3} - 273.2$$

Equation B-1 Convert Thermistor Resistance to Temperature

Where; T = Temperature in °C.
LnR = Natural Log of Thermistor Resistance
$A = 1.4051 \times 10^{-3}$ (coefficients calculated over the −50 to +150° C. span)
$B = 2.369 \times 10^{-4}$
$C = 1.019 \times 10^{-7}$

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	+30	525.4	+70	153.2	+110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.1	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	+1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342.2	83	107.9	123
77.66K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-34	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	292.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	5692	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965.0	53	250.9	93	83.6	133
41.56K	-26	4939	14	929.6	54	243.4	94	81.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	**3000**	**25**	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

Table B-1 Thermistor Resistance versus Temperature

APPENDIX C - WIRING CHARTS

Model # 3400

mV/V output

Geokon Cable #04-375V9 (Violet)	Internal Sensor Wiring	Function / Description
Red	Red	**Power +**
Red's Black	Black	**Power -**
White	White	**Signal +**
White's Black	Black	**Signal -**
Green	Red	**Remote Sense +**
Green's Black	Black	**Remote Sense -**
Blue	N/C	**Thermistor**
Blue's Black	N/C	**Thermistor**
Shields (5)	N/C	**Ground**

Note: Input voltage for Model # 3400-1, mV/V output is 10V d.c.
(Power -, Signal -, Remote Sense -, are connected internally.)

0–5VDC output

Geokon Cable #04-375V9 (Violet)	Internal Sensor Wiring	Function / Description
Red	Red	**Power +**
Red's Black	Black	**Power -**
White	White	**Signal +**
White's Black	Black	**Signal -**
Blue	N/C	**Thermistor**
Blue's Black	N/C	**Thermistor**
Shields (5)	N/C	**Ground**

Input voltage for Model # 3400-2, 0–5VDC output is 6.5–35V d.c.

4 – 20mA output

Geokon Cable #02-250V6 (Blue)	Internal Sensor Wiring	Function / Description
Red	Red	**Power +**
Black	Black	**Power -**
White	N/C	**Thermistor**
Green	N/C	**Thermistor**
Shields (1)	N/C	**Ground**

Note: Input voltage for Model # 3400-3, 4–20mA output is 6.5–35V d.c.