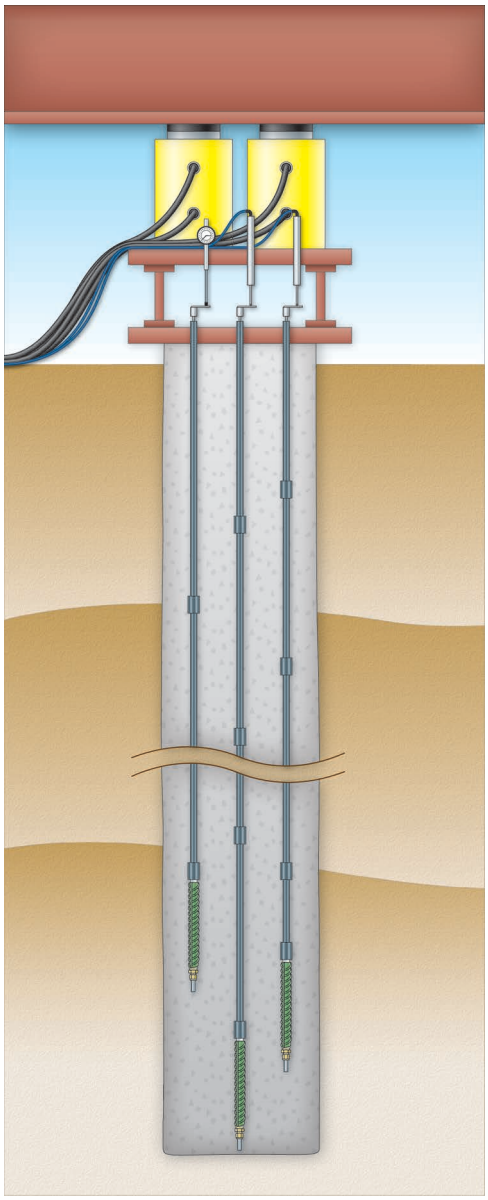
Model 1800

Telltales

Instruction Manual



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1. INTRODUCTION

The Model 1800 Telltale is a simple means of measuring displacement between two points, typically in a vertically oriented position. The telltale system consists of a rod installed within a protective tubing to provide protection and a means for the rod to move freely along its alignment. The bottom of the system can be a fixed anchor point or, as a temporary and re-usable/removable option, the weight of the rods on their own can be sufficient to keep them in place in a vertical installation.

This instrument is typically installed in pile load tests or drilled boreholes in short term applications, where displacements from the tip of the instrument are measured at the ground surface to evaluate deflection.

Rods are flush-coupled, 6 mm (0.25 inch) in diameter, and are manufactured from stainless steel, 1018 mild steel, or graphite rod. Flush-coupled rods limit friction and potential for interference from joints or irregularities inside the protective PVC tubing, which has enough clearance inside to allow the rod to move freely.

Anchors are suggested for all applications as a secure and permanent option.

Anchor/bayonet systems are a re-usable/removable option available. This allows the rod to be removable from the secured anchor by twisting to unlock.

Anchors can also be omitted, if no anchor is used a cap or plug is required on the bottom of the protective tubing to keep debris, drilling fluid, and grout from entering.

Measurements can be performed with a dial indicator or electronic displacement transducer at the top of the assembly. Two displacement transducer variations are available:

1450 DC-DC LVDT DISPLACEMENT TRANSDUCERS

- These transducers operate with a spring-return rod ideal for use with a telltale system. Equipment is required to supply voltage to the sensor in order to collect data, thus data acquisition will be different compared to a traditional vibrating wire sensor. For further details consult the Model 1450 Manual.

4450 VW DISPLACEMENT TRANSDUCERS

- The VW displacement transducer may be a more familiar alternative and is also a good option for use with these systems. The transducer requires an additional threaded receptacle with magnetic base that allows the rod to maintain contact with the telltale clip or monitoring surface. For further details consult GEOKON and the Model 4450 Manual.

2. INSTALLATION

2.1 INSTALLATION CONSIDERATIONS

Telltales can be installed in boreholes, reinforced concrete piles, or on steel pipe/driven piles. There are different factors to keep in mind depending on the installation.

2.1.1 BOREHOLES

For telltales in drilled boreholes, consideration must be given for determining how and where to position the bottom of the telltales or the anchors, how to account for buoyancy of the protective tubing, and how to fix the top of the installation.

If installed into a borehole that has water or drilling fluid, the weight of the anchor and rod/tubing should be sufficient to overcome buoyancy, but advancement of the assembly should be done by holding/pushing on the rod and tubing.

The top of the protective tubing should be sealed from allowing entry of any debris, drilling fluid, or grout. Debris getting between the rod and tubing would increase friction and reduce the effectiveness of the instrument. If possible, have the rod and tubing extend above the ground surface.

Once the assembly has been lowered to the desired depth, the area between the outside of the protective tubing and the borehole should be filled with grout having strength parameters slightly less than the surrounding formation (See Section 2.3).

2.1.2 CONCRETE PILES

For concrete piles that are formed in the ground, the telltale tubing and rod assembly can be tied to the reinforcement prior to placement in the ground. An anchor can be used to secure the tip of the rod, or the weight of the rod can be used to keep it in place temporarily. If no anchor is used, the bottom of the tubing should be plugged or capped to prevent inflow of grout/cement.

2.1.3 STEEL PIPE/DRIVEN PILES

The protective tubing can be installed in advance with a driven pile application using the anchor/bayonet system, or no anchor. After the pile is driven, the rods can be assembled and lowered into the tubing. If using an anchor/bayonet system, the rods can be lowered and then locked into the anchor after the pile has been driven.

2.2 TELLTALE AND ANCHOR ASSEMBLY PROCESS

Depending on the site and considerations above, the telltale components can be assembled prior to install or assembled in series as the pieces are lowered into the hole. See the following steps for typical assembly. See Figure 1 for a standard anchor and rod assembly.

Note: If there is sufficient clean working space on the ground and the hole depth is known, it may be quicker to pre-assemble and lower the entire telltale into the borehole as one piece.

1. **Skip this step if using an anchor/bayonet system.** Slide the female end of the telltale rod through the anchor, until it protrudes 25 mm (1 inch) beyond the Swagelok connector. Tighten the Swagelok connector nut per the instructions in Appendix A.

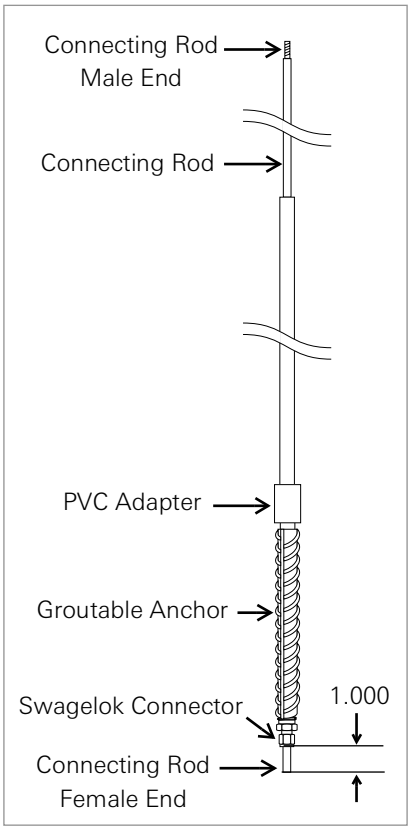

FIGURE 1: *Anchor and Rod Assembly*

2. Slide the first section of protective tubing over the rod and glue it into the adapter coupling on top of the anchor using PVC primer and cement. Allow sufficient time for the cement to harden. (In cold weather, it may be advisable to warm the connector with a propane torch.)

Note: PVC primer and cement must be obtained locally. Airfreight restrictions prohibit GEOKON from shipping these materials.

3. Alternating sections of connecting rods and protective tubing are assembled as follows until the desired length of the telltale system is achieved. When complete, the rod should extend above the top of the tubing to allow measurement. This length should account for the depth of settlement expected. The rod can be trimmed later during final assembly. If possible, the rod and tubing should extend above ground surface.

   - Rods are assembled using two pairs of locking pliers and thread locker. Wipe excess thread locker off joints to prevent rods from gumming up inside the tubing.
   - Protective tubing is connected using couplings and PVC primer/cement on each joint. *Primer* is added to both ends of the pipes and the interior of the couplers. PVC *cement* must only be applied to the pipe ends, not the interior of the coupler. This reduces potential for pushing cement inside the pipe and onto the rods, inhibiting movement of the rods. (If desired, the annular space between the rod and tubing can be filled with grease or other compound for lubrication.)

Note: If assembling over a long day where significant temperature changes are expected, the PVC pipe will contract and expand accordingly and could change length.

4. The top of the protective tubing should be sealed against debris, drilling fluid, grout, etc. Foreign objects may increase friction and reduce the effectiveness of the instrument.

2.3 SETTING ANCHORS

A cement-bentonite grout mix is suggested for backfilling a borehole. The cement-bentonite grout uses any kind of bentonite powder combined with Type I or Type II Portland cement. The exact amount of bentonite needed will vary. Grout should be tremie-placed from the bottom of the borehole.

Grout mixtures should be determined and adjusted to be of strength parameters slightly less than the surrounding soil. Throughout the depth of a borehole, the surrounding soil will typically not be all of the same strength and permeability. However, the use of several types of grout mixes within the same borehole may not be cost effective and practical. Unless it is necessary to do so, identify one type of grout mix that would be applicable to the entire length of the borehole.

The table below shows two possible mixes for strengths of 50 psi and 4 psi.

	50 PSI Grout for Medium to Hard Soils		**4 PSI Grout for Soft Soils**	
	Amount	**Ratio by Weight**	**Amount**	**Ratio by Weight**
Water	30 gallons	2.5	75 gallons	6.6
Portland Cement	94 lb. (one sack)	1	94 lb. (one sack)	1
Bentonite	25 lb. (as required)	0.3	39 lb. (as required)	0.4
Note:	The 28-day compressive strength of this mix is about 50 psi, similar to very stiff/hard clay. The modulus is about 10,000 psi.		The 28–day strength of this mix is about 4 psi, similar to very soft clay.	

TABLE 1: *Cement / Bentonite / Water Ratios*

Perform the following steps to mix the cement-bentonite grout:

1. Add the measured amount of clean water to the barrel then gradually add the cement in the correct weight ratio. Mix the cement thoroughly into the water.

   Tip: The most effective way of mixing the two substances is to use a drill rig pump to circulate the mix in a 50 to 200 gallon barrel or tub.

2. While mixing, slowly add the bentonite powder so that clumps do not form. Keep adding bentonite until the watery mix turns to a slimy consistency. Continue mixing for approximately five to 10 minutes to allow the grout to thicken.

3. Add more bentonite as required until it is a smooth, thick cream, similar to pancake batter, which is as heavy as it is feasible to pump.

4. Connect the gate valve assembly to the grout pump. It may be advisable to prime the grout tube that is routed to the bottom of the borehole and verify that it is not plugged by pumping water through the line before grouting.

5. Pump the grout into the borehole slowly through the tremie grout pipe, displacing any fluid (water or drilling fluid) left in the borehole. while slowly pulling the grout tube from the borehole.

   - If the grout pipe is sacrificial it can be left in place.
   - If using a hollow core auger, or if the borehole has been lined with casing, remove the casing/hollow core auger from the borehole during grouting. Care should be taken to support the assembly during removal of the augers or casing sections.

6. Disconnect the grout pump from the gate valve assembly and then disconnect the gate valve assembly from the grout tube. Allow enough time for the grout to fully cure before continuing with the installation. (allow grout to set for at least 1 day, but 3 days is ideal).

2.4 FINAL ASSEMBLY PROCESS

After the telltales have been installed at the installation site, and any concrete/ bentonite grout has been cured, these final assembly steps can be completed.

1. Trim the rod and tubing as necessary. If using a dial gauge or displacement transducer, the rod should be capped or topped with a tell tale clip.

FIGURE 2: *Model 1150-42 Telltale Clip*

2. Position the dial gauge or displacement transducer vertically, so that it is in contact with the rod cap or telltale clip.

3. Secure the gauge/transducer in a fixed position that will not be disturbed for the duration of the monitoring program. When used in piles, the gauge/ transducer is secured to the top of the pile to allow measurement of displacement between the top of the pile and the bottom of the telltale.

3. TAKING READINGS

The most important reading is the first reading; it is the base reading to which all subsequent readings will be compared. Most installations are subject to a bedding-in process during which slight movements can occur. These movements generally cease after two or three days but can sometimes take longer.Obtain an initial reading after the bedding-in process and prior to any loading or changes in conditions.

Initial baseline measurements are compared to subsequent measurements to determine displacements of the rod tips relative to the top of the piles (or ground surface). Initial measurements are subtracted from the current measurements for each telltale to determine this displacement.

All readings should be compared with previous readings as soon as they are taken. In this way, sudden changes of readings can be instantly checked to see if they are real or a reading error. If the changes are real, the observer is alerted to the possibility of serious ground movements, or to possible instrument damage, and can look for further evidence of either.

Measurements from the top of the rod can be obtained through a variety of methods, as described below.

3.1 LEVEL SURVEY EQUIPMENT

Obtain a series of three separate readings for the top of the rod, using standard level surveying techniques. All three readings can be done in the same time period, but should involve removal of the level staff from the telltale rod and then replacement to get the next reading. Once the three readings are obtained, calculate an average of the three to determine the initial baseline measurement. Subsequent readings are performed in the same manner.

3.2 DIAL INDICATOR

Obtain an initial baseline measurement from the dial gauge and record for comparison to subsequent measurements.

3.3 DISPLACEMENT TRANSDUCER

Displacement transducers should be wired into a corresponding data acquisition system for automated monitoring, or connected to a portable readout device capable of providing measurements of the instrument.For more information refer to the applicable displacement transducer manual.

4. DATA REDUCTION

Measurements taken at the top of the telltale rod are compared to the initial baseline readings to determine displacements of the rod tips relative to the top of the piles (or ground surface). Initial measurements are subtracted from the current measurements for each telltale to determine this displacement.

4.1 LOAD CALCULATION FOR PILES

By noting the location of the specific telltale anchor and measuring the relative movement of the individual rod, elastic shortening of the pile at that location can be obtained. With this information, the load (Q) in the pile at the midpoint between two telltale anchors can be calculated using the equation below.

$$Q = A(\Delta L / L)E$$

EQUATION 1: *Load at Pile Midpoint*

Where:
A = The cross sectional area of the pile
E = Modulus (composite for the pile)
L = Anchor separation distance

4.2 ENVIRONMENTAL FACTORS

Factors that may affect conditions at the site should be observed and recorded. Seemingly minor effects may have real influence on the behavior of the site being monitored and may give an early indication of potential problems. Some of these factors include, but are not limited to, blasting, rainfall, tidal or reservoir levels, excavation and fill levels and sequences, traffic, temperature and barometric changes, changes in personnel, nearby construction activities, seasonal changes, etc.

APPENDIX A. SWAGELOK TUBE FITTING INSTRUCTIONS

These instructions apply to one inch (25 mm) and smaller fittings.

A.1 INSTALLATION

1. Fully insert the tube into the fitting until it bumps against the shoulder.

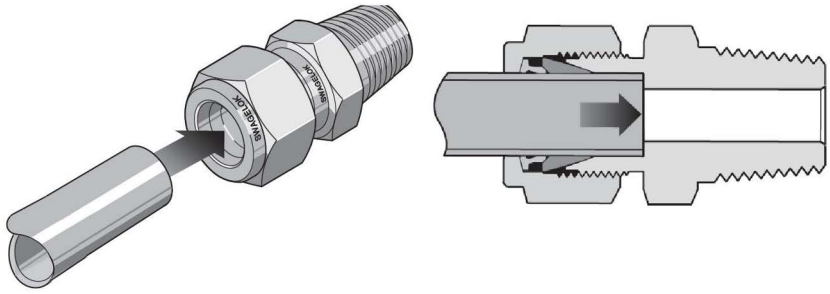

FIGURE 3: *Tube Insertion*

2. Rotate the nut until it is finger tight. (For high-pressure applications as well as high-safety-factor systems, further tighten the nut until the tube will not turn by hand or move axially in the fitting.)
3. Mark the nut at the six o'clock position.

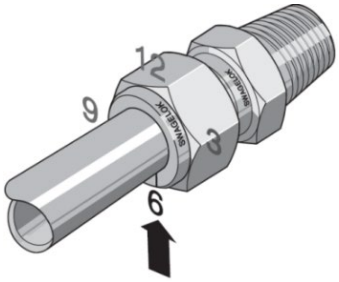

FIGURE 4: *Make a Mark at Six O'clock*

4. While holding the fitting body steady, tighten the nut one and one quarter turns, until the mark is at the nine o'clock position.

Note: For 1/16-inch, 1/8-inch, 3/16-inch, and 2, 3, and 4 mm fittings, tighten the nut three-quarters of a turn until the mark is at the three o'clock position.)

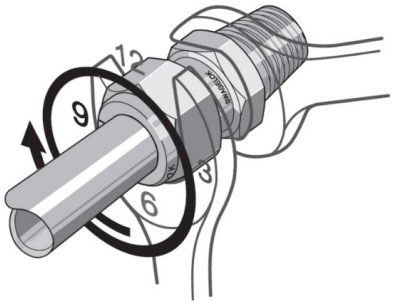

FIGURE 5: *Tighten One and One-Quarter Turns*

A.2 REASSEMBLY INSTRUCTIONS

Swagelok tube fittings may be disassembled and reassembled many times.

Warning! Always depressurize the system before disassembling a Swagelok tube fitting.

1. Prior to disassembly, mark the tube at the back of the nut, then make a line along the nut and fitting body flats. **These marks will be used during reassembly to ensure the nut is returned to its current position.**

FIGURE 6: *Marks for Reassembly*

2. Disassemble the fitting.
3. Inspect the ferrules for damage and replace if necessary. If the ferrules are replaced the connector should be treated as a new assembly. Refer to the section above for installation instructions.
4. Reassemble the fitting by inserting the tube with pre-swaged ferrules into the fitting until the front ferrule seats against the fitting body.

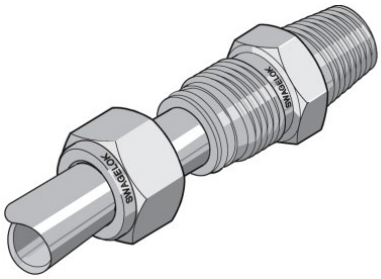

FIGURE 7: *Ferrules Seated Against Fitting Body*

5. While holding the fitting body steady, rotate the nut with a wrench to the previous position as indicated by the marks on the tube and the connector. At this point, there will be a significant increase in resistance.
6. Tighten the nut slightly.

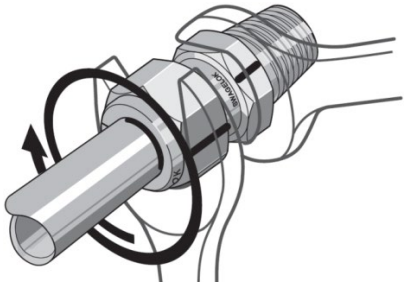

FIGURE 8: *Tighten Nut Slightly*

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