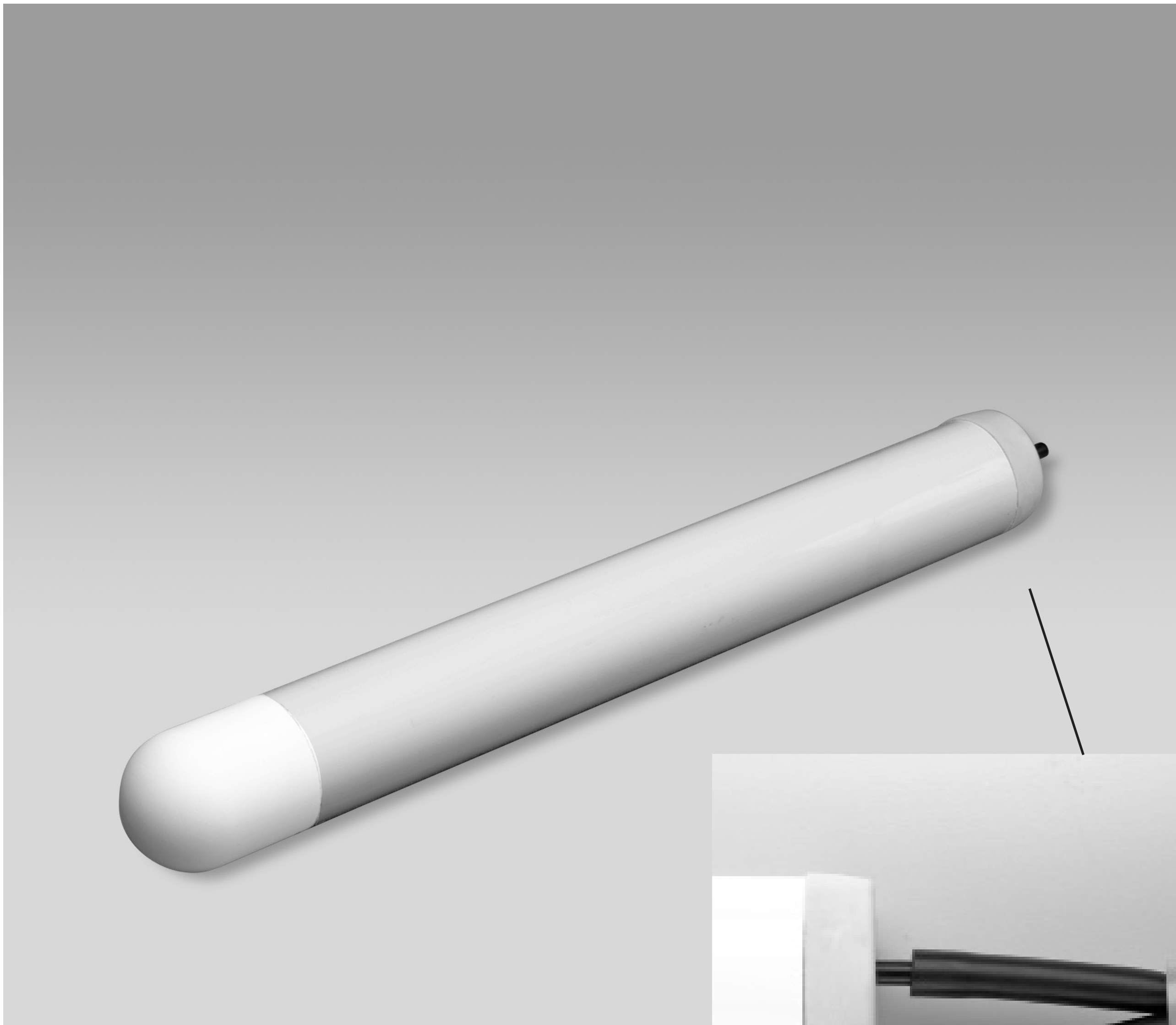
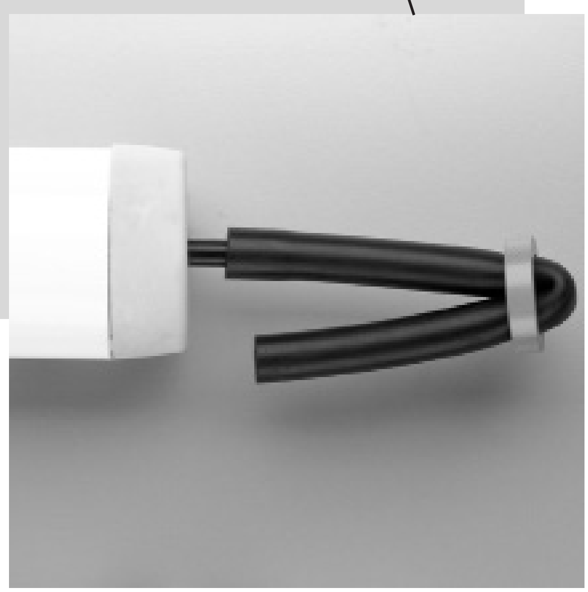
1900

OPERATING INSTRUCTIONS

1900 Soil Water Samplers **March 2017**



Model 1900 Soil Water Sampler



Z1900-200 Stopper Assembly
(Shows stopper, Neoprene tubing and clamping ring)

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SOILMOISTURE

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HISTORY/GENERAL USES

Soil Water Samplers had their origin back in 1961 when we cooperated with Dr. George H. Wagner at the University of Missouri to manufacture a porous ceramic cup for collecting soil water samples. The outgrowth of this work was our first commercial Soil Water Sampler, Model 1900 Soil Water Sampler. Since that time, these samplers have been generally accepted as an ideal tool for in situ collection of soil water samples for a great variety of soil moisture monitoring work.

The initial and most extensive use of these Samplers was made by Pennsylvania State University, largely under the direction of Dr. L. T. Kardos and others, on the Pennsylvania Waste Water Project. Modifications of the original 1900 Soil Water Sampler by Richard R. Parizek and Burke E. Lane at Pennsylvania State University, reported on in the Journal of Hydrology, produced a pressure vacuum type unit. Some of our Soil Water Samplers have been in continuous use for several years and still yield satisfactory soil moisture samples.

All of our ceramics are made from specialize formulations developed through research and experience accumulated over more than 4 decades.

Our samplers find applications not only in research work such as quantitative chemical analysis of soil water, but also for pollution control purposes in monitoring moisture under sanitary landfills, irrigated areas with wastewater, and areas where reclaimed or recycled water is used on a routine basis to assure compliance with government standards.

Soilmoisture's line of Soil Water Samplers has proven to be an excellent and reliable means for obtaining soil water samples from both saturated and unsaturated soils at depths ranging up to several hundred feet.

OPERATING PRINCIPLES

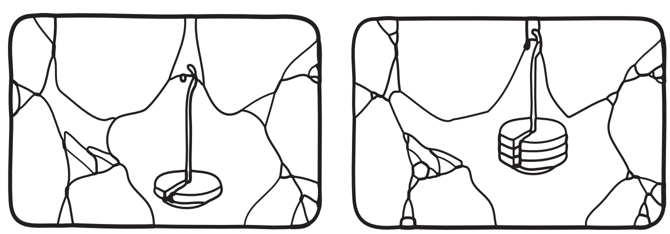
Soilmoisture's Soil Water Samplers, which are also referred to as "suction lysimeters" or "lysimeters", have been in general use around the world for many years.

Soil water is held largely under a state of tension (negative pressure) within the soil by capillary forces. The capillary force is the sum of the adhesive and cohesive forces. The adhesive force is characterized as the attraction of water for soil solids (soil and organic matter). Cohesive force is characterized as the attraction of water for itself. Adhesive force is far greater than the cohesive force.

Water is naturally attracted to soil particles (by its adhesive quality) and "sticks" to the surface of each particle and in the various sized "capillary" spaces or "pores" between the soil particles. When the soil is very wet, the large pores fill with water. This "excess" water has no direct surface contact with the soil and is held cohesively, one water molecule to another, and can move quite freely. As a soil dries out, the "excess" water first evaporates as it requires less energy to break the cohesive bonds. The remaining water, held tightly inside the capillary spaces by adhesive qualities, requires more energy to be removed from the soil.

The following illustration (see Figure 1) shows the increasing force required to remove water from the small-sized capillary pores compared to the large pores as the soil dries out. When the remaining water is held only in extremely small pore spaces, it requires more energy to remove the water from these pores. Even though there may be a considerable volume of water in the soil, the tension that holds the water determines how readily it can be removed.

Figure 1.



Wet Soil   Dry Soil

This tension that determines how moisture moves in the soil is referred to as "soil water tension", "negative pore pressure", or "soil suction". For simplicity's sake we refer to this tension as "soil suction" in these instructions, but keep in mind that negative pressure is the most descriptive term.

The following graph shows the relationship between the percent of moisture in a soil and the soil suction required to remove the moisture from three types of soil: clay, loam, and sand. The graph (see Figure 2) illustrates that it is easier to remove water from a sandy soil with 10% moisture, than it is to remove

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water from a clay soil with 30% moisture. This is because the water in the clay soil is held in very small capillary spaces within the soil particles under a higher soil suction, whereas the sandy soil holds water in large capillary spaces under a lower soil suction.

Soilmoisture's Soil Water Samplers allow water to be removed from the soil by

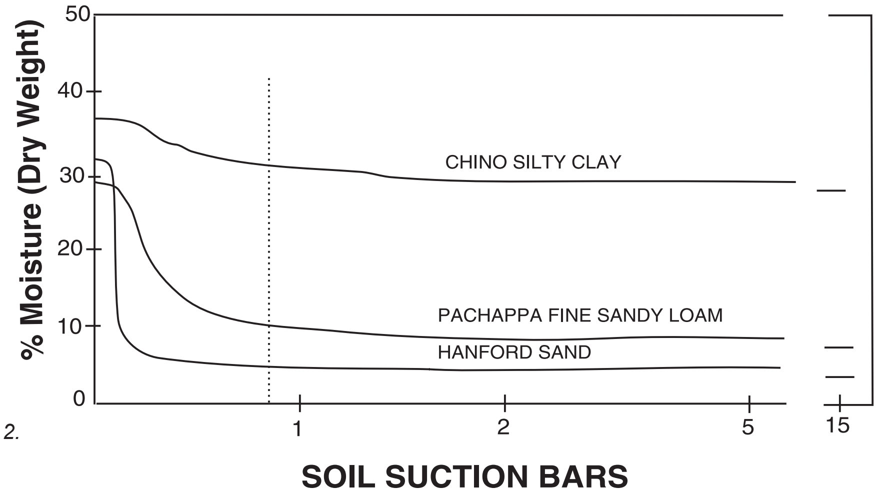

Figure 2.

creating a vacuum (negative pressure or suction) inside the sampler greater than the soil suction holding the water in the capillary spaces. This establishes a hydraulic gradient for the water to flow through the porous ceramic cup and into the sampler. Note: when evaluating soil suction ratings of a ceramic plate or cup, a positive pressure rating is used. Water can be held at tensions far greater than 1 atm (the limit for vacuum-type measurements). Positive pressure can force water out of capillary pores equivalently as negative pressures, and is the practical method for evaluation of soil suction.

In practice, a vacuum is drawn in the Soil Water Sampler that exceeds the soil water tension. Then liquid water will flow to the ceramic cup due to the potential gradient (i.e. water will move from less negative potential to more negative potential). The practical limit for water flow in soils is about 65 cb (centibar) (although in some soils, the value can approach 85 cb). When soil moisture tensions exceed 2 bars, the wetted meniscus in the ceramic pores will break and the Soil Water Sampler will appear to be unable to hold vacuum. The ceramic cup will have to be rewet to hold a vacuum and soil moisture tensions will have to decrease to less than 85 cb before water can again be moved toward the ceramic cup.

Additional information on the advantages and disadvantages of Soil Water Samplers in general can be found in Chapter 19, "Compendium of In Situ Pore Liquid Samplers for Vadose Zone" (Dorrance et al.), of the ACS Symposium on Groundwater Residue Sampling Design (April 22-27, 1990) and the ASTM Designation D4696-92 "Standard Guide for Pore-Liquid Sampling from the Vadose Zone" (Vol. 04.08 Soil and Rock (I): D4696).

YOUR NEW SOIL WATER SAMPLER

Unpacking

Remove all packing materials and check the Soil Water Sampler for any damage that may have occurred during shipment.

If the Sampler is damaged, call the carrier immediately to report it. Keep the shipping container and all evidence to support your claim.

Assembly

The standard 1900 Soil Water Sampler was assembled prior to shipment.

Please read all instructions thoroughly before installing the Sampler. **To assure optimum cleanliness of the assembly, no grease or organic solvents have been used in its manufacture.**

Not Liable for Improper Use

Soilmoisture Equipment Corp. is not responsible for any damage, actual or inferred, for misuse or improper handling of this equipment. The 1900 Soil Water Samplers are to be used solely as directed by a prudent individual under normal conditions in the applications intended for this equipment.

ACQUAINT YOURSELF WITH THE PARTS

The Model 1900 Soil Water Sampler comes fully assembled. The 1900 Soil Water Sampler is a large-volume sampler designed for near-surface installation at depths ranging from 6 inches (15 cm) to 6 feet (1.8 m). The unit consists of a 1.9-inch (4.8 cm) outside diameter PVC tube, a porous ceramic cup with a 2 bar (200 kPa) air-entry value, and a Santoprene stopper. Neoprene tubing that is attached to a 1/4-inch diameter access tube is used as an access port for sample extraction and evacuation. Clamping rings slip over the folded Neoprene tubing to seal the sampler. An extraction kit is required for sample retrieval and a vacuum pump is required to evacuate the sampler.

A Model 2005G2 Vacuum Hand Pump and either Model 1900K3 1,000 ml Extraction Kit or Model 1900K2 50 ml Extraction Kit, are often used for routine operation. The Model 0234 Series Soil Augers can be used for coring a hole to accept the samplers.

REQUIREMENTS PRIOR TO USE AND HOW TO OPERATE

The sampler can be installed in well drained soil or in areas where the water table is above the sampling depth. The surface area directly above the sampler should not be covered in any manner that would interfere with the normal percolation of soil moisture down to the depth of the sampler.

The Model 1900 Soil Water Sampler has been designed so that the body tube of the sampler projects 2 inches above the soil surface when the sampler is installed to the proper depth.

Coring the Hole

In rock-free, uniform soils at shallow depths, use a 2-inch screw or bucket auger for coring the hole (Figure 3a). If the soil is rocky, a 4-inch auger should be used. The soil is then sifted (Figure 3b) through a 1/4-inch mesh screen to free it of pebbles and rocks. This will provide a reasonably uniform backfill soil for filling in around the Soil Water Sampler. Soilmoisture has suitable soil augers for this purpose (230 Series augers). There are other methods for installing the Soil Water Sampler to be used, largely dictated by the type of soil you are dealing with and the tools available. The primary concern in any method of installation is that the porous ceramic cup of the sampler be in tight, intimate contact with the soil so that soil water can move readily from the pores of the soil through the pores in the ceramic cup and into the Soil Water Sampler.

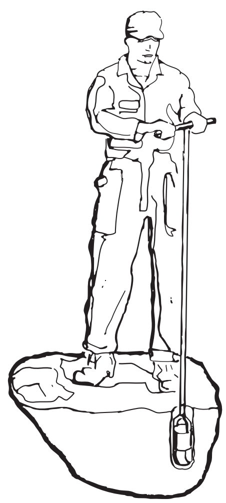

Figure 3a.

Figure 3b.

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Preparing The Hole Using a Soil Slurry - Overall - Non Critical Sampling

In many applications where absolute concentrations are not important but one is interested in relative and /or accumulation data concerning a soluble constituent this method provide an inexpensive install. After the hole has been cored, mix sifted soil with water to make a soil slurry which has a consistency of cement mortar. This slurry is then poured down to the bottom of the cored hole to insure good soil contact with the porous ceramic cup (see Figure 4).

Immediately after the slurry has been poured, insert the Soil Water Sampler down into the hole so that the porous ceramic cup is completely embedded below the level of the soil slurry (see Figure 5). Backfill the remaining area

For medium to five grained soils normal use.

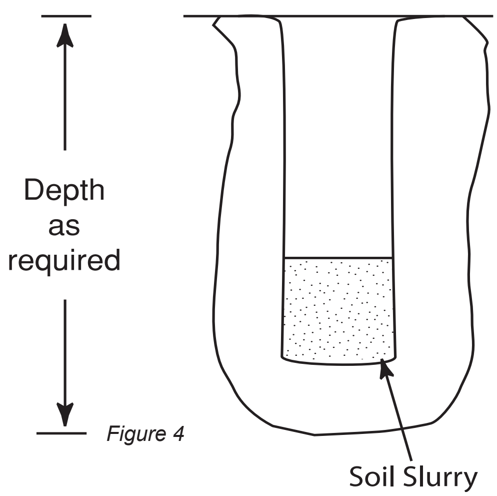

Figure 4

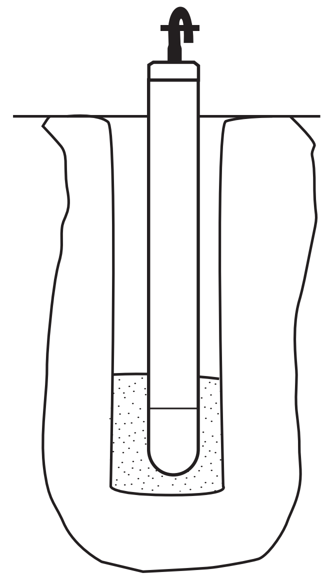

Figure 5

around the Sampler with sifted soil which is free of pebbles and rocks. Tamp the soil firmly to prevent surface water from running down the cored hole (see Figure 6).

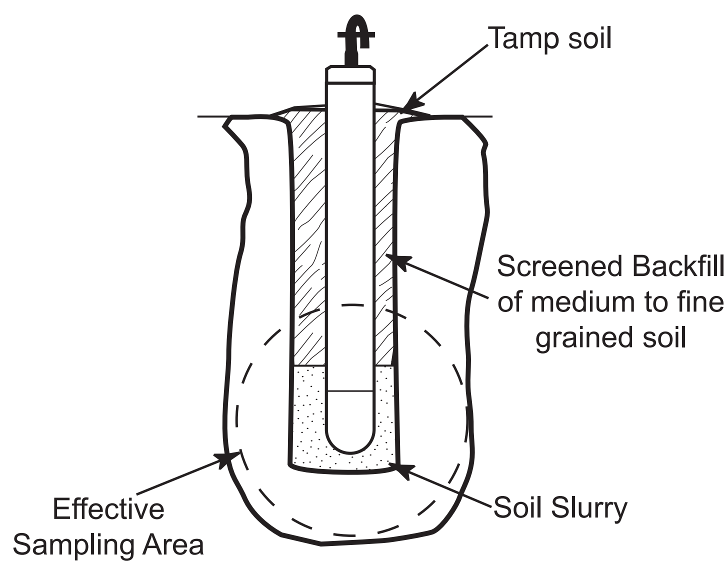

Figure 6

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If the soil is of a sandy nature that does not compact well it is recommended that a bentonite clay seal (expandable clay pellets) be pouted into the hole right after the installation of the of the sampler on top of the soil slurry that will wet and seal the hole.(see Figure 7).

For medium to five grained soils normal use.

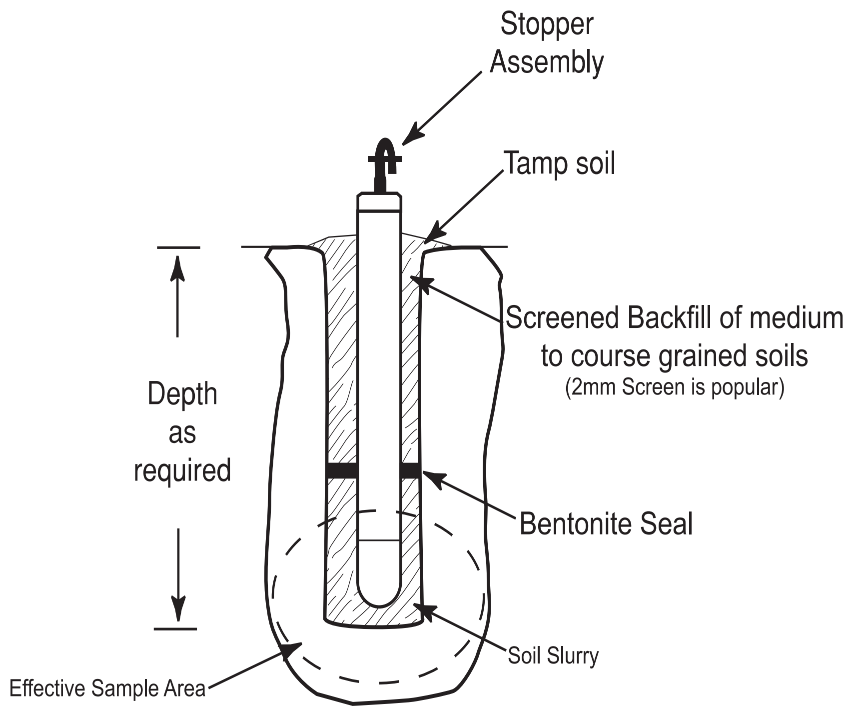

Figure 7

Preparing The Hole Using a Silica Slurry for Overall - Critical Sampling

In today's drive for precision one needs to follow practices that will insure least amount of bias from materials used to backfill to the areas surrounding the porous ceramic cup, or used to backfill the installation hole. A slurry can be made using silica flour, (our model 0930W series) which is then used to establish a pure, clean hydraulic contact between the ceramic cup and the surround hole soil . For a 2-inch diameter hole, 1 lb. of silica flour is needed, while a 4-inch diameter hole will require 4 lbs. of silica. Mix the silica with water to produce a slurry with a consistency of cement mortar.

Core the hole to the desired depth, and pour in about 1/4 of the silica slurry. Insert the Soil Water Sampler and pour in the remainder of the slurry so that the slurry completely covers the ceramic cup. Prior to back filling you want to "seal" off the sampling area from possible by contamination or bias from above. To do this you add Bentonite pellets (our model number approximately to a 2" level above the slurry allowing time for the Benonite to adsorb water from the slurry below. Backfill the hole with sifted soil (free of pebbles and rocks), tamping continuously with a metal rod to prevent surface water from channeling down between the soil and the body tube of the Sampler (see Figure 8).

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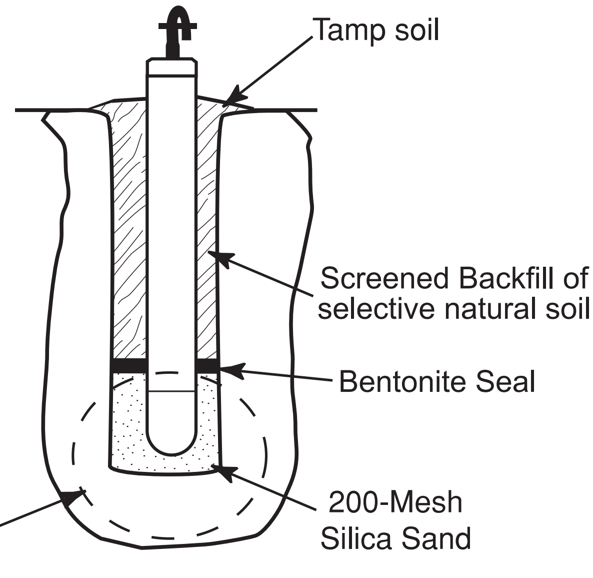

Figure 8

Preparing The Hole Using a Silica Slurry for Lateral - Critical Sampling

Core the hole a few inches deeper than the desired depth, and pour in several inches of wet Bentonite clay (see Figure 9). This will isolate the Sampler from the soil below. Pour in 1/4 of the slurry, either of soil or of Silica, and insert the Soil Water Sampler. Pour the remainder of the slurry around the cup of the Soil Water Sampler. Then add sufficient Bentonite as a plug to further isolate

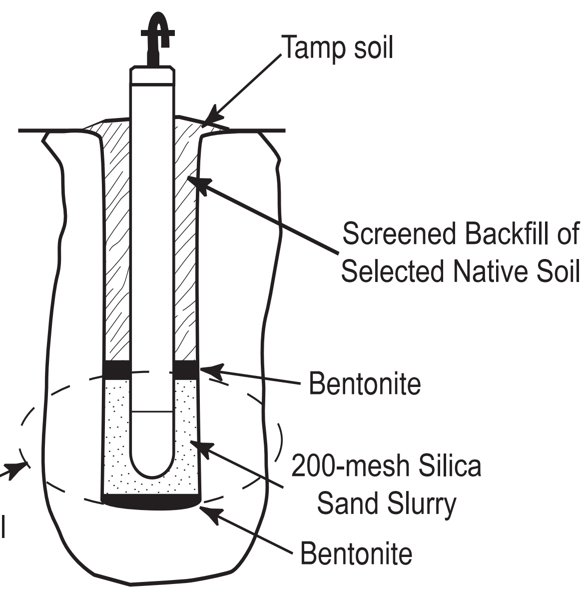

Figure 9

the Soil Water Sampler and guard against possible channeling of water down the hole (see Figure 9). Backfill the remainder of the hole slowly, tamping continuously with a metal rod using native soil, free of pebbles and rocks.

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Alternate Methods for Sampler Installation

There are other methods of installing the soil water sampler that may be used, largely dictated by the type of soil you are concerned with and the tools available. The primary concern in any method of installation is that the porous cup of the sampler be in tight, intimate contact with the soil, so that soil moisture can move readily from the soil pores into pores within the ceramic cup and into the soil water sampler. The other is to assure that the samples taken are not biased by preferential flow down the “installation hole” , this can be prevented by adequate tamping of the surface and the use of Bentonite seals.

Collecting a Sample in the Sampler

After the soil water sampler has been installed in the field, the accessory items as shown on page 15 are used for collecting a soil water sample.

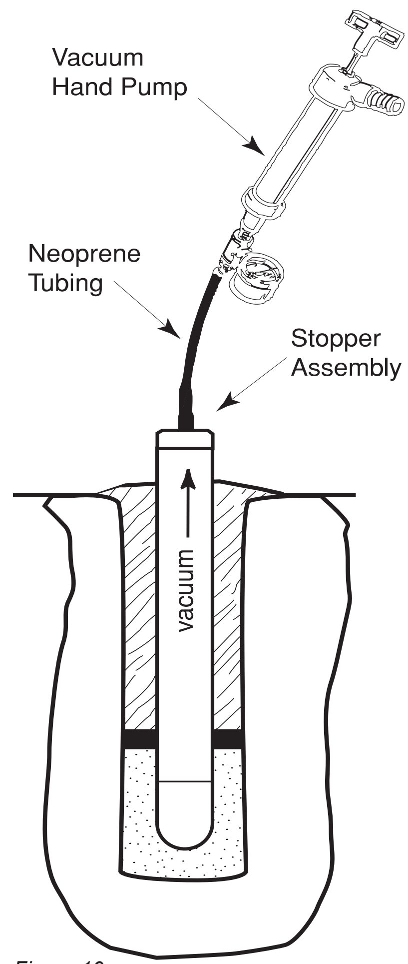


Figure 10

To collect a sample, the clamping ring on the stopper assembly is removed. The tube fitting on the end of the vacuum dial gauge adapter is then inserted into the neoprene tube of the stopper assembly. The vacuum hand pump is then stroked until a vacuum of about 60 centibars (18 inches of mercury) is created within the sampler, as read out on the vacuum dial gauge (Figure 10).

Fold the neoprene tube and replace the clamping ring to seal the sampler under vacuum. The sampler is allowed to set for a period of time under vacuum.

The vacuum within the sampler causes the moisture to move from the soil, through the porous ceramic cup, and into the sampler. The rate at which the soil solution will collect within the sampler depends on the hydraulic conductivity of the soil, the soil suction value within the soil (as measured with tensiometers), and the amount of vacuum that has been created within the sampler, In moist soils of good conductivity, at field capacity (10 to 30 centibars of soil suction as read on a tensiometer), substantial soil water samples can be collected within a few hours. Under more difficult conditions it may require several days to collect an adequate sample.

In general, a vacuum of 50 to 85 cb is normally applied to the Soil Water Sampler. In very sandy soils, however, it has been noted that very high vacuums applied to the Soil Water Sampler seem to result in a lower rate of collection of the sample than a lower vacuum. It is our opinion that in these coarse, sandy soils, the high vacuum within the Sampler may deplete the moisture in the immediate vicinity of the porous ceramic cup reducing the hydraulic conductivity, which creates a barrier to the flow of water to the cup. In loams and gravelly clay loams, users have reported collection of 300 to 500 ml of solution over a period of a day with an applied vacuum of 50 cb, when soils are at field capacity. At waste water disposal sites, users have obtained 1500 ml of sample solution in 24 hours following cessation of irrigation with 1 to 2 inches of waste water on sandy or clay loam soil.

Recovering the Collected Soil Water Sample From the Sampler

To remove the soil water sample from the sampler, a simple assembly can be made using a small diameter (3/32 inch O.D. or less) plastic tube, a two-hole rubber stopper, a flask or bottle, as shown (Figure 11).

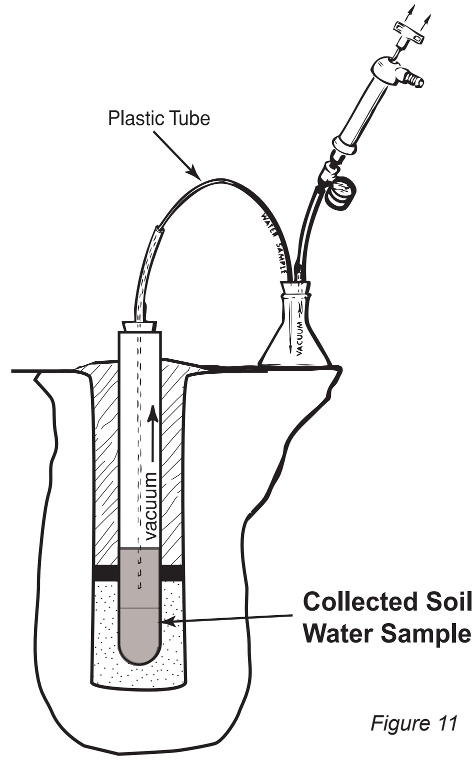


Figure 11

The clamping ring on the sampler is opened and the small diameter plastic tube is inserted into the end of the neoprene tube on the stopper assembly and pushed down until it reaches the bottom of the sampler.

The vacuum hand pump is then connected to the other hole in the stopper. Stroking the hand pump creates a vacuum within the bottle or flask which in turn sucks the sample up from the sampler and into the collection bottle.

If it is more convenient, the stopper assembly can be removed from the sampler so that the collected sample can be removed with a pipette or other means. However, repeated removal and replacement of the rubber stopper assembly can disturb the seal between the soil and the body tube of the sampler, particularly on shallow units.

Subsequent samples are collected by again creating a vacuum within the sampler and following the steps as outlined above.

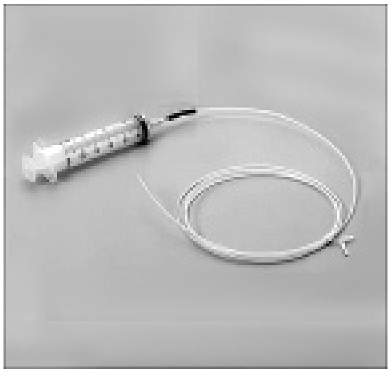
MAINTENANCE AND PRECAUTIONS

There are no maintenance requirements for the 1900 Soil Water Sampler other than protecting the access tubes from damage. Tube ends should be covered or plugged to prevent debris from entering the tubes and later contaminating the sampler.

Freezing conditions will not damage the subsurface parts of the samplers. The samplers are normally left permanently in place all year round. Water may freeze in the sample line near the surface during saturated freezing conditions. Be sure all the water is removed from the sample line before clamping it for the next sample.

If the soil suction exceeds 2 bars, the ceramic cup may need to be rewetted to obtain a sample. This is accomplished by pouring approximately 250 ml of deionized water down the access tube. After waiting approximately one hour, remove any excess water. A vacuum can be applied after the ceramic cup has been rewetted. If no sample is obtained after following the above rewetting procedure, the soil suction is probably in excess of 85 cb.

SPARE PARTS AND ACCESSORIES LIST



1900K2, Extraction Kit 50 ml

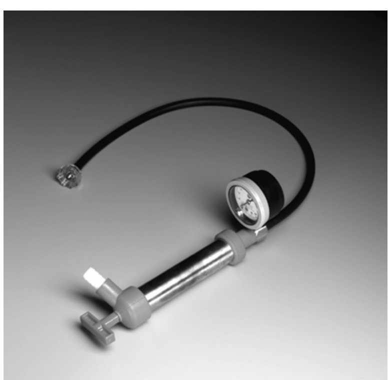
Accessories

0922W005	Bentonite, 5 lb. bag
0922W010	Bentonite, 10 lb. bag
0922W050	Bentonite, 50 lb. bag
0930W005	Silica Flour, 5 lb. bag
0930W010	Silica Flour, 10 lb. bag
0930W050	Silica Flour 50 lb. bag
1900K2	Extraction Kit, 50 ml (see photo at left)
1900K3	Extraction Kit, 1,000 ml (see photo at left)
2005G2	Vacuum Test Hand Pump (see photo at left)

Replacement Parts

Z1900-200	Stopper Assembly (Includes stopper, tubes, and 2 clamping rings - see Page 1)

1900K3, Extraction Kit, 1,000 ml



2005G2, Vacuum Test Hand Pump (shown with tubing and service cap for servicing tensiometers)

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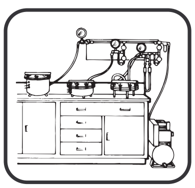
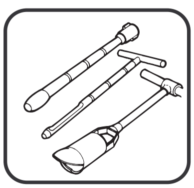
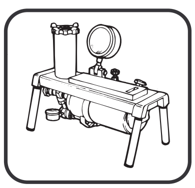
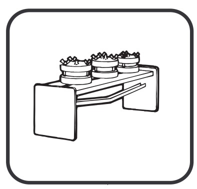

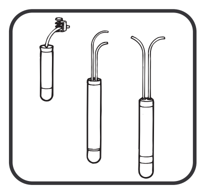
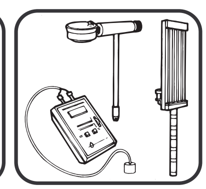

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Your nearest representative:

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