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Operating Guidelines for the Direct Push Sampling System

U.S. Army Center for Health Promotion and Preventive Medicine
5158 Blackhawk Road
Aberdeen Proving Ground, MD 21010-5403

Ground Water & Solid Waste Program

MISSION

To provide worldwide support of the Army's goal to protect health and environmental quality through pollution prevention, restoration, and compliance by accomplishing consultations, surveys, and studies to determine the potential source, existence, magnitude, or extent of subsurface soil and ground-water contamination and by evaluating solid waste management practices and facilities.

Engineering Services Section

One of three sections in the Ground Water & Solid Waste Program that provides the following services—

- **Collects, analyzes, and interprets (short- or long-term) ground water or soil samples**
- **Installs ground-water or methane monitoring wells**
- **Inventories monitoring wells (records review, accurate location verification, condition database, and geographical information system)**
- **Inspects and rehabilitates monitoring wells**
- **Decommissions monitoring wells**

The point of contact for obtaining these services is Mr. William Smithson, DSN 584-4211 or C-410-436-4211.

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FIGURES

PURPOSE

This technical guide (TG) provides--

- Procedures for equipment operators and sampling crew on the operation of the Direct Push Sampling System (DPSS) and the various associated intrinsic probing and sampling equipment.
- Responsibilities for the Project Officer, Operators, and Sampling Crew.
- Step-by-step procedures for general operations such as onsite set up, pre-probing, concrete drilling, and stowing of the unit.
- Procedures for performing soil sampling using the--
  - Large-bore sampler.
  - Macro-core® sampler.
- Procedures for water sampling when using the--

Macro-Core® is a registered trademark of Kejr, Inc., 601 N. Broadway, Salina, Kansas 67401.

PURPOSE Cont'

  - Screen-point ground water sampler.
  - Screened implant.
  - Mill-slotted well point.
  - Screen-point 15 ground water sampler.
- Procedures for using the post-run tubing system when sampling for soil gas.

BACKGROUND

The DPSS is a device that through the use of a hydraulic hammer drives a sampler into the ground.

By using various sampler probes, the DPSS can be used to obtain the following samples--

- Soil.
- Water.
- Vapor (soil gas).

The DPSS has been used to perform all types of sampling to depths of 100 feet (30 meters) or more.

The DPSS can be mounted on several types of vehicles, including tractors, drill rig trailers, and pickup trucks. The system as described in this TG is mounted on a 1 ton, 4 x 4 pickup truck.

BACKGROUND Cont'

The DPSS is beneficial for the following reasons--

- Provides a fast method of retrieving a sample with minimum disturbance of the surrounding soil.
- Can enter areas that are too small for conventional drill rigs.
- Can collect small individual soil samples (less than 500 grams).
- Can collect water and vapor samples when they are temporary or when the use of permanent wells is not needed.

The DPSS has some limitations.

- It is typically used only for site investigations to depths of 30 to 60 feet.
- It is difficult to use in dense medium, rocks, boulders, or gravel.

BACKGROUND Cont'

Safety concerns when driving the sampler probes are as follows--

- Potential noise and vision hazards.
- Bodily injuries due to the pinching and crushing of body parts within the equipment.
- Head injuries. Wearing of hard-hats is essential.

APPLICABILITY

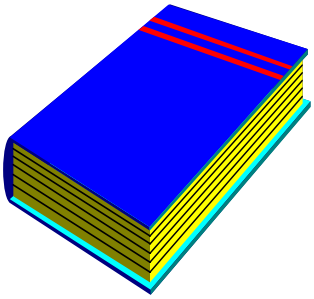
This TG applies to all personnel of the Ground Water and Solid Waste Program and any other personnel who will operate the DPSS.

REFERENCES

- Kejr, Inc., Geoprobe® Systems – 1998-99 Tools and Equipment Catalog. Salina, Kansas: Kejr, Inc., 1998-99.
- American Society for Testing and Materials D 5299-92, Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities, 1993.

EXPLANATION OF ABBREVIATIONS AND TERMS

The glossary contains the abbreviations and terms used in this TG.



Geoprobe® is a registered trademark of Kejr, Inc., 601 N. Broadway, Salina, Kansas 67401.

RESPONSIBILITIES

This section provides general guidelines for the responsibilities of the Project Officers, Operators, and Sampling Crew. More specific responsibilities for each appear in the sections of the TG which describe the different types of sampling.

Project Officer

- Maintains communication channels between the customer and all participating personnel.
- Must be familiar with all State regulations that may affect the sampling project.
- Conducts a preliminary site visit or investigation to include the following--
  - Requesting a history of the site.
  - Identifying the actual problem after a discussion with the customer.
  - Viewing the site to determine any access problems and underground utilities.

RESPONSIBILITIES Cont'

- Writing the sampling plan to identify the area to be sampled, constituents, number of samples, and method of sampling.

- Writing the health and safety plan to be approved and reviewed by the customer and U.S. Army Center for Health Promotion and Preventive Medicine personnel. The plan should provide additional safety procedures if sampling in areas of suspected/known biological or radiological agents or unexploded ordnance.

- Makes preparations during the pre-sampling stage to include--

  - Coordinating with the installation to grade a trail which the DPSS can maneuver if no other access is found.

  - Contacting the installation facility engineer and safety office to obtain utility maps and guidance in locating the sampling sites.

RESPONSIBILITIES Cont'

  - Requesting the installation mark the location of all underground utilities in the study area.

- Conducts a pre-trip conference with equipment operators and sampling crew to discuss the sampling and health and safety plans.

- Performs the following actions at the site--

  - Chooses the exact sample point(s).

  - Asks for site clearance from the facility engineers or the appropriate Department of Public Works.

  - Coordinates with the installation to clear trees, which may interfere with sampling.

  - Moves the sample point if there are safety concerns or another sample point would provide better data.

- Ensures operators and sampling crews adhere to all safety and personal protective requirements.

RESPONSIBILITIES Cont'

- Conducts daily safety briefings to include the location of the nearest hospital, fire department, and appropriate emergency phone numbers.
- Approves all visitors to the sampling site and briefs them on safety concerns included in the health and safety plan.
- Discusses the soil conditions and sampling procedures with the operator and crew.

Operator

- Sets up the DPSS at the specified sampling site using information gathered from the preliminary site visit/investigation.
- Considers safety aspects when maneuvering the DPSS into the chosen site.
- Drives the vehicle containing the DPSS, avoiding deep muddy areas.
- Sets the vehicle's parking brake and chocks the front wheels if sampling on steep rolling landscapes.

RESPONSIBILITIES Cont'

- Aligns the DPSS straight up and down, not side-to-side.
- Wears hearing and eye protection when the DPSS is in use.
- Prepares the DPSS and samplers for use (See Standard Preparation and Cleaning Procedures section.)

Sampling Crew

- Wears steel-toed footwear, hard hats, and gloves. The gloves can be cloth, leather, surgical, or rubber, depending on the type of contamination.
- Wears hearing and eye protection when the DPSS is in use.

STANDARD TOOL AND EQUIPMENT LIST

To properly operate the DPSS, certain tools and equipment should always be maintained in the vehicle. The operator must always check these items **PRIOR** to leaving for the sampling site.

- First aid kit
- Orange road cones
- Fire extinguisher
- 2-foot level
- 25-foot measuring tape
- Metal snips
- 6-foot folding tape
- Utility knife
- Hammer
- Flashlight
- Files used for metal surfaces
- Wire brush, standard and toothbrush style
- Nylon brushes, 2.5 x 4 inch and 1.5 x 4 inch, both on a 4-foot stainless steel braid
- Toilet brush
- Pipe wrenches, 10 inch, 12 inch, and 24 inch
- Vise grips, standard and chain style
- Pliers, standard and needle-nosed
- Screwdrivers, standard and phillips head

STANDARD TOOL AND EQUIPMENT LIST Cont'

- Tie down straps
- Drill bits, various sizes
- Wrenches, combination set, allen, and crescent
- Socket set
- Buckets of bentonite
- Double-bladed liner cutter set
- 1-inch trimmie pipe
- Caps, pull and drive
- 2.5-inch pre-probe rod
- O-ring service kit
- Rods, 1-foot, 2-foot, and 3-foot sections
- Die tap, reverse thread
- Retrieving rod pieces
- Concrete stem with bit
- Cables for power box
- Dremel™ tool with brush and grinder attachments (thin and thick-edged). Sander attachments must be for metal; they will be gray in color.
- Decontamination set-up to include detergent, potable water, and distilled or deionized rinse water
- Paper towels

Dremel™ is a registered trademark of Dremel, 4915 21st St., Racine, WA 53406.

STANDARD PREPARATION AND CLEANING PROCEDURES

The following procedures apply to all types of sampling equipment and methods. Specific preparation and cleaning procedures can be found within the Sampling Procedures section (see page 27).

- Clean essential equipment (for example, drive heads, sampling tubes, piston rods, cutting shoes, and piston tips) between every sampling interval with detergent in cold or hot water. Always rinse the equipment first with potable water and then with distilled water, unless further decontamination procedures are required.

- Dry all equipment with paper towels thoroughly; this will prevent rust from forming. Always dry sampling tube threads.

- Inspect all equipment for rust. If discovered, remove with a standard wire brush, toothbrush style wire brush, or the Dremel tool. Examples of specific rust cleaning procedures are as follows:

STANDARD PREPARATION AND CLEANING PROCEDURES Cont'

- **Drive head** – Use a standard wire brush, toothbrush style, and/or Dremel tool.
- **Sampler tube** – Use the Dremel tool with brush attachment to clean the two sets of threads. Run the brush attachment in the grooves between the threads, inside to outside, and then wipe with a dry paper towel. Use a standard or toothbrush wire brush to clean the threads again; wipe with a dry paper towel again.
- **Cutting shoe** – Use the Dremel tool to clean the inside groove where the locking ring expands when the core piston is tightened. Wipe with a dry paper towel. It is very important to remove any obstructions in this groove.
- **Core piston** – If dried properly, no rust will appear. Disassemble to check for rust.
- **Piston tip/rod** – If dried properly, no rust will appear. Disassemble to check for rust.

- Inspect each end of the sampling tube for stress cracks.

STANDARD PREPARATION AND CLEANING PROCEDURES Cont'

- Inspect the drive head for thread impressions from the sampling tube by—
  - Screwing the drive head onto the sampling tube until flush.
  - Inspecting the bottom half of the drive head for thread impressions. These impressions are caused by not keeping the extension rods tight and by not preprobing the sampling points. The operator must always check that the extension rods are at least hand tight; this will in turn tighten the drive head. Remember to **never** tighten during sampling operations, only after adding new probe rods.
  - Using the Dremel tool with the thick-edged grinding attachment to remove the impressions.
- Inspect the top of the drive head for mushrooming/burring. Use the Dremel tool with the thick-edged grinding attachment to remove the mushroom/bur. This mushrooming/burring is caused by repeated use.

STANDARD PREPARATION AND CLEANING PROCEDURES Cont'

- Inspect the piston rods by rolling them on a flat surface. This will ensure that they are not bent. Not screwing the stop pin in all the way will bend the piston rods.

- Inspect the piston tip to see if it has become flattened. Assemble the piston tip and piston rod. If flattened, use the Dremel tool with the thick-edged grinding attachment to bring it back to a point.

- Check to see if the piston tip slides freely in and out of the cutting shoe by—

  - Inspecting the inside of the cutting shoe for soil/rust and/or debris.

  - Making sure the piston tip's flat side is exposed approximately 1/8 inch, and the cone is fully exposed. If this is not the case, grind the cutting shoe's tapered edge to remove any burs.

STANDARD PREPARATION AND CLEANING PROCEDURES Cont'

- Inspecting the cutting shoe for bends or damage from rocky or clayey soil. If there is damage, the piston tip/rod and drive point will not sit in the cutting shoe completely. Use the Dremel tool with the thick-edged grinding attachment to grind the inside of the tapered end of the cutting shoe. Grind until the inside edge is smooth.

- Dropping the cutting shoe, with the piston tip down, about a ½ inch from the ground. The core piston should pop out easily.

- Inspect the non threaded end of the piston rod for mushrooming by—

  - Removing the drive head from the sample tube.

  - Placing a liner on the cutting shoe and sliding the piston tip/rod into the cutting shoe.

  - Screwing the cutting shoe, liner, and piston tip/rod onto the sampling tube.

STANDARD PREPARATION AND CLEANING PROCEDURES Cont'

- Screwing on the drive head with the cutting shoe facing downward.
- Turning the sampler upside down so that the piston rod will come out of the hole in the drive head. If it does not come out, mushrooming has occurred or the piston rod has been bent. Mushrooming is sometimes caused by not preprobing or by not screwing the stop pin in the entire way.
- Grinding to remove the mushrooms/burs.

OPERATIONS

Onsite Set Up

The operator of the DPSS must follow these step-by-step directions to properly set the DPSS on the exact sampling spot.

- Place vehicle in "PARK" and set the parking brake.
- Turn motor off. Make sure to park vehicle on level ground, because the vehicle does not have a leveling device.
- Go to back of vehicle and open the doors.
- Insert the key in the ignition switch on the DPSS control panel. (See Figure 1.)
- Turn the key clockwise to the "run" position for 10 seconds. This allows the glowplug module (diesel-powered vehicles only) to complete its cycle.
- Move the **Speed Control Switch** to the "OFF" position.

OPERATIONS Cont'

- Start the motor by turning ignition key clockwise.
- Move the **Speed Control Switch** to the "SLOW" position; wait until there is a change in the motor's revolutions per minute. This change indicates that the hydraulic pump is running.
- Pull the **Extend Lever** until the slidebase stops. (See Figures 1 and 2.)
- Pull the **Foot Lever** until the foot is ¾ of the way out. Use the measuring scale on the foot to determine ¾ distance.
- Pull the **Probe Lever** to ensure hammer is in the full down position.
- Pull **Fold Lever** to rotate unit (hammer and foot) into a vertical position.

OPERATIONS Cont'

- Check to see that no equipment is blocking the slidebase before retracting.
- Push the **Extend Lever** up to retract the slidebase, try to avoid striking the rear bumper of the vehicle.
- Pull the **Foot Lever** to lower foot over a predetermined sampling point and to add downpressure, which stabilizes the unit.

Pre-Probing

Pre-probing is mandatory for macro and water sampling. The macro bit should not be driven. Pre-probing also can be used for sampling through roadbeds, asphalt, and cement.

- Always pre-probe to the depth at which sampling begins.
- Attach a pre-probe to a probe rod. (See Figures 3 and 4.) Sampling equipment determines the size of the pre-probe. A 12-inch rod is needed to drive the pre-probe. Total length of the pre-probe and probe rod is approximately 3 feet.

OPERATIONS Cont'

- Attach drive cap to the top of the probe rod. The drive cap must come in contact with the hammer.
- Place probe rod directly under the hammer and anvil. (See Figure 2.)
- Push **Probe Lever** down to carefully lower the hammer onto the top of the probe rod. Ensure the rod is vertically aligned with the foot.
- Mark the probe rod to show the specific depth of the sample. Do not use a permanent marker or paint sticks; use a crayon or carpenter's chalk.
- Turn the **speed control switch** to fast. The engine's revolutions per minute will increase.
- Depress **Probe Lever** to maintain a continuous downpressure and simultaneously depress **Hammer Lever** to activate the hammer. Additional probe rods may be needed to reach sampling depth.

OPERATIONS Cont'

- Pull **Probe Lever** up to withdraw the hammer from the ground.
- Remove drive cap and install pull cap (see Figure 5).
- Use **Probe Lever** to lower hammer; center the pull cap.
- Lower the hammer latch (see Figure 2) so that the latch is below the flange on the pull cap.
- Use **Probe Lever** to raise the probe rods until clear of the ground.

Concrete Drilling

To use the DPSS when sampling through concrete--

- Remove anvil retainer ring assembly and the anvil from the hammer. (See Figure 6.)
- Insert the hexed end of the concrete bit into the bottom of the hammer. (See Figure 7.)
- Lower hammer using **Foot Lever** on the control panel.

OPERATIONS Cont'

- Turn the hammer rotation lever to rotate the hammer so drilling may begin. (See Figure 6.)

- To remove the concrete bit from the borehole, lower the hammer latch around the collar on the concrete bit's steel shank.

Stowing the Unit

To stow the DPSS after sampling, complete the following (see Figure 2)--

- Put hammer in the down position.

- Raise foot about 6 inches.

- Ensure slidebase is extended completely and is aligned centrally to the door opening.

- Raise the **Fold Lever** to fold the unit in a horizontal position.

- Raise **Extend Lever** to slide the slidebase into the truck. Ensure control panel will clear the door panel.

OPERATIONS Cont'

- Raise **Foot Lever** to slide foot into truck.
- Turn **Speed Control Switch** to "OFF".
- Turn ignition off.
- Clean area and fill holes with dirt.

SAMPLING PROCEDURES

Soil Sampling

To prepare the large-bore sampler for sampling, gather the following specific pieces of equipment and tools (see Figure 8) along with the standard tools and equipment (see page 12).

- Cutting shoes
- Liners: plastic, brass, stainless steel, or Teflon® (Always maintain at least 50)
- Liner caps (red and black)
- Sample tubes
- Piston stop-pins
- Drive heads
- Piston rods
- Piston tips
- Sampler kit (Includes tubes, drive heads, piston stop-pins (reversed threaded), piston rods, piston points, cutting shoes, and extension rods to release the piston stop-pin
- Nylon brush
- Extension rods (at least one more than the total number of probe rods in feet) and one T-handle

Teflon® is a registered trademark of E. I. Du Pont de Nemours and Company, Wilmington, DE.

SAMPLING PROCEDURES Cont'

Before leaving for the sampling site, standard preparation and cleaning procedures must be performed. (See page 14.) The following preparation and cleaning procedures are specific to the large-bore sampler.

Soil Sampling

- Clean the sample tubes with a 1.5 x 4 inch nylon brush on a 4-foot stainless steel braid with detergent and water. Rinse and dry thoroughly.

- Clean the cutting shoes, piston rods, and piston tips with a toilet brush and detergent and water. Rinse and dry thoroughly.

- Screw the piston stop-pin into the drive head. This forces water out of the drive head. Repeat this action until all water is forced out. Dry with paper towels and allow for a period of air-drying.

- Inspect the "O" rings in the piston stop-pin for damage.

Large-Bore Sampler

Follow these procedures when using the large-bore sampler--

- Assemble the sampler (see Figure 8) after thoroughly cleaning and decontaminating all parts. All parts must fit together tightly.

SAMPLING PROCEDURES Cont'

- If a liner is used, attach the cutting shoe to the belled-end of the liner.

- Tighten the piston stop-pin using a 3/8-inch open wrench to the point where pressure is exerted against the piston rod. Damage could occur if the piston stop-pin is not tight.

TIP: The pistin stop-pin uses an "O" ring to prevent vibration and loosening. Carefully inspect the "O" ring before assembly, replace if needed.

- Attach the large-bore sampler to the leading probe rod to drive to the desired sample depth. (See Pre-Probing Section on page 22.) Use a 12-inch rod when driving the sampler. Total length of the sampler and probe rod should be approximately 3 feet.

- Drive sampler into the ground to the desired sampling interval. The piston tip will keep the sampler sealed or closed while being driven. A reverse-threaded piston stop-pin holds the piston tip in place.

SAMPLING PROCEDURES Cont'

TIP: Obtain information about the subsurface and depth to bedrock before driving the sampler.

- Attach additional probe rods if needed. (See Pre-Probing Section.) In some soil conditions, pre-probing to the diameter of a solid drive point and to the desired depth may be needed.

- Remove the piston stop-pin by—
  - Raising the foot and retracting the slidebase of the DPSS.
  - Sliding the DPSS in approximately 12 inches from the top of the probe rods. Allow enough room to work under the hammer.
  - Removing the drive cap.
  - Lowering a series of extension rods coupled together into the center of the probe rods, stopping when they reach the top.

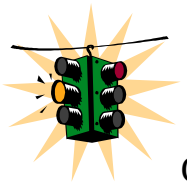
SAMPLING PROCEDURES Cont'

- Attaching the T-handle to the last section of extension rods, then rotating the handle clockwise. The male threads on the leading end will thread into the female threads on the piston stop-pin. The piston stop-pin threads are counterclockwise, thus they will unscrew.
- Continuing to rotate the handle until the resistance stops and the piston stop-pin is free.
- Lifting the handle to check if the piston stop-pin is completely unscrewed.
- Removing the extension rods from the probe rods. The piston stop-pin should be attached to the end.

- After removing the piston stop-pin, place the drive cap on the probe rod. If the probe rod is too close to the ground, attach another probe rod.
- Mark the probe rod to indicate where the operator should stop when hammering. The mark should be approximately 24 inches from the ground.

SAMPLING PROCEDURES Cont'

TIP: Always use carpenter's chalk or tape.



Guide, with your hand or lock-grip pliers, the probe rod out of the borehole so that it does not slide back into the hole.

- Drive sampler to marked distance. Do not overdrive, this compacts the soil sample making extrusion difficult.
- Attach the pull cap and retract the probe rods to recover the sampler.
- Unscrew sampler.
- Extrude the sample by—

SAMPLING PROCEDURES Cont'

- Unscrewing the cutting shoe by hand or with a small pipe wrench and pulling the liner out. In some cases, the drive head, piston rod, and piston tip may need to be removed to extract the liner and sample.

TIP: Longnose pliers can be used to remove the liner and sample.

- Cutting the clear plastic liners, if used, with a utility knife. The large-bore sampler can also be used with brass, stainless steel, or Teflon liners.

Use extreme care when using the large-bore manual extruder. Excessive force can result in injury or damage to equipment.

Macro-Core Sampler

Follow these procedures when using the macro-core sampler (see Figure 9) for open-tube sampling.

- Assemble the sampler after thoroughly cleaning and decontaminating all parts.
- Attach a new core catcher to the top of the cutting shoe if needed.
- Slide the liner over the core catcher and onto the cutting shoe.
- Insert the liner and core catcher into the sample tube.
- Attach a drive head to the sample tube.
- Securely tighten the cutting shoe to the sample tube by hand or by using the macro-core shoe wrench.

SAMPLING PROCEDURES Cont'

NOTE: Remember to always pre-probe.

- Raise the hammer on the DPSS to the highest position.
- Raise the foot if needed to allow room to place the sampler below the hammer. Make sure the DPSS is kept straight.
- Place the macro-core sampler in a vertical position under the hammer.
- Use the **Probe Lever** to apply downpressure until resistance is encountered. Simultaneously, activate the hammer to begin sampling.
- Add more probe rods as needed.
- When using a macro-core core catcher, complete the following--
  - Attach the core catcher to the cutting shoe with the cup side up and away from the cutting shoe.

SAMPLING PROCEDURES Cont'

- Trim approximately ½ inch from the pre-flared end of the liner. DO NOT trim liner when used without the core catcher.

NOTE: A macro-core core catcher is not necessary when sampling in cohesive soils, because it may interfere with sample recovery. The macro-core core catcher should be used for non-cohesive sands.

- Slide liner over the core catcher, with the cup side in, onto the cutting shoe.

- If the core catcher is not used, attach the cutting shoe to the pre-flared end of the liner.

SAMPLING PROCEDURES Cont'

- Add a probe rod if needed.
- Drive the sampler until the drive head reaches the ground surface. Do not overdrive the sampler.
- When sampling at consecutive intervals, lower the sampler in the previously made hole by connecting probe rods until the bottom of the sampler reaches the next sampling interval. Some soil conditions may warrant using a solid drive point to pre-probe to the desired sampling depth. Damage will occur if the sampler is driven into rocks or other impenetrable layers.

SAMPLING PROCEDURES Cont'

- When using the heavy-duty macro-core soil sampler liner, always use a spacer ring. Attach the spacer ring to the cutting shoe in the same manner as the core catcher. The heavy-duty liners are shorter and do not have a flared end.

- Complete the following steps when removing the macro-core soil sampler--

  - Attach the pull cap to the probe rods.

  - Lower the hammer.

  - Close the latch over the pull cap.

SAMPLING PROCEDURES Cont'

- Using the **Probe Lever**, lift probe rods and remove.
- Continue lifting until the drive head is above the ground.
- Attach the pull cap and pull the sampler out.

- If the sampler becomes lodged, follow these procedures--
  - Lower the hammer.
  - Disengage the hammer latch from the pull cap.
  - Raise the foot approximately 12 inches and place wooden blocking (must be larger than the foot) under the foot.
  - Lower the foot unto the blocking.

SAMPLING PROCEDURES Cont'

- Lower the hammer and close the latch over the pull cap. A 12-inch probe rod may be needed to lift the sampler high enough for the latch to close over the pull cap.
- Pull the **Probe Lever** to lift the sampler out of the hole.

- To remove the sample--
  - Unscrew the cutting shoe.
  - Pull the liner out of the sample tube.

Bright Idea!

A few hard taps on the cutting shoe will often loosen the threads and allow the parts to be unscrewed by hand.

SAMPLING PROCEDURES Cont'

Water Sampling

Follow these procedures when using the screen-point ground water sampler (see Figure 10)--

- Clean and decontaminate all parts thoroughly.
- Use a decontaminated screen insert between each sample.
- Inspect "O" rings; replace if needed.
- Push the screen insert and plug into the screen sleeve from the bottom. The bottom end has one drain hole.
- Push the screen connector over the top end of the screen sleeve.
- Push the screen connector pin into place. If it is loose, hold with your thumb and forefinger.
- Insert the screen connector with the screen sleeve inside halfway into the sampler sheath.

SAMPLING PROCEDURES Cont'

Water Sampling

- Slide the drive point seat over the end of the screen assembly (screen sleeve and connector) that protrudes from the screen point sampler sheath.
- Tighten the drive point seat with a 7/8-inch opened wrench or a medium adjustable wrench.
- Push the screen assembly into the screen point sampler sheath until flush with the end.
- Insert an expendable drive point into the drive point seat.
- Screw the drive head (a 1-foot section of probe rod with couplers and "O" rings at both ends), "O" ring end first, into the open end of the sampler sheath.
- Assemble all parts to allow free movement of the screen inside the sampler sheath. There should be no internal binding.

SAMPLING PROCEDURES Cont'

Water Sampling

TIP: Wet the "O" rings with a small amount of distilled water or pure olive oil to provide free movement.

- Probe and expose the screen by--
  - Placing the drive cap on the assembled sampler and driving into the subsurface. Add probe rods until the desired sampling depth is reached.
  - Driving the tip of the sampler approximately 12 to 16 additional inches.
  - Placing the pull cap on the probe rod and lifting the drive head about 24 inches to expose the screen.

SAMPLING PROCEDURES Cont

- Lowering 3/8-inch tubing attached to a post-run tubing adapter.

- Connecting the adapter to the top of the screen assembly. Turn tubing and adapter counterclockwise. Push downward gently.

- Probe and expose the soil.

- In stable formations, the screen assembly and tubing can be lowered into the open bore hole, and the samples can be collected.

- In unstable formations, the screen assembly may have to be pushed out of the screen sheath with the extension rods coupled together and inserted in the probe rods. Protect the connector by attaching an extension rod coupler to the leading end of the extension rod.

SAMPLING PROCEDURES Cont'

Excessive hammering on the rods will result in damage to the screen assembly.

- Collect water samples by--
  - Inserting 3/8-inch tubing with a stainless steel post-run tubing adapter into the probe rods.
  - Turning the tubing and adapter counterclockwise and attaching to the top of the screen connector.
  - Attaching a peristalic or vacuum pump, if needed, to the tubing to purge and extract the water samples.
  - Using the tubing bottom check valve. This valve oscillates the tubing up and down, thus pushing the water upward into the tube as the ball repeatedly lifts and seats. The tubing will feel heavier as it fills with several feet of water.

SAMPLING PROCEDURES Cont'

- Remove the tubing by using the post-run tubing system. Pull the tubing up firmly until it disconnects from the adapter down-hole. The post-run tubing adapter will remain attached to the screen connector.
- Remove all probe rods and water sampler.
- Examine all parts for wear, damage, or contamination.
- Clean all parts thoroughly.
- Replace all "O" rings.
- Prepare for the next sample.

Screened Implant

Follow these procedures when using the screened implant installation--

- Drive to the desired depth by using the probe rods, an expendable point holder and an implant anchor/drive point. Do not pull up when disengaging the drive point at the desired depth.

SAMPLING PROCEDURES Cont'

- Attach appropriate tubing to the implant anchor/point holder. The implant has one end for the tubing and another threaded end for the drive point.
- Remove the drive cap.
- Lower the implant and tubing inside the probe rods until they strike the anchor/drive holder.
- Measure and mark the tubing with tape at the depth the probe rods were driven. This ensures the implant anchor/drive holder did not disengage and that the probe rod is filled with soil.
- Grasp the excess tubing and rotate counterclockwise while applying pressure downward to engage the post-run tubing threads on the implant anchor/drive holder.

SAMPLING PROCEDURES Cont'

- Pull upward lightly to assure connection.
- Extend 2 to 3 feet of tubing out of the probe rods before cutting.
- Thread tubing through the split pull cap and attach to the probe rods. Exert pressure downward on the tubing while pulling up on the probe rods. Pull up approximately 12 inches.

TIP: To pull the probe rod up, you may also use the probe plate pull plate or the manual probe rod jack.

- Pour filter media down the center of the probe rods. If using the 1/4-inch OD polytubing, a funnel will be needed. Make sure to slide the funnel down around the tubing and position over the probe rod.

SAMPLING PROCEDURES Cont'

- Slowly pour glass beads or number 2 silica sand filter media into the funnel. Make sure the glass beads or media go down the inside of the probe rods and around the outside of the tubing. Less than 150 to 200 milliliters of media will fill the space around the implant.

- Stir the media into place around the implant with the tubing.

TIP: Backfilling can only be done above the water table. Backfilling is completed through the probe rods with either number 2 silica sand or glass beads mixed with granular bentonite. When the mixture comes in contact with water, it becomes sticky and will bridge inside the probe rods around the tubing. The tubing can thus become disconnected from the screen implant when pulling out of the ground.

SAMPLING PROCEDURES Cont'

- Lift up an additional 18 to 24 inches and pour the bentonite seal mixture into place. Fill with a volume of 154 milliliters per foot.
- Pour distilled water on the mixture to begin the sealing process.
- Pull the remaining probe rods out of the ground. At the same time, backfill with a cement/sand or bentonite/sand combination.
- Cut the tubing (approximately 36 inches long) only when the implant anchor and screen are in place and the following steps have been completed to the surface.
- Plug the tube with a carburetor vacuum line cap.

SAMPLING PROCEDURES Cont'

- Mark the location with a stake, plastic pin flag, or a 4-inch protective casing. The casing prevents vandalism.

- Begin sampling.

Mill-Slotted Well Point

When using the mill-slotted well point (see Figure 11), follow these procedures--

- Thread the well point onto the probe rod. It will equal 36 inches by 1 inch OD.

TIP: The slotted section is 24 inches long by .76 inches wide ID and has 15 mill-cut slots. Each slot is 2 inches long by 0.020 inches wide.

- Drive the open-slotted section into the water table from the ground surface.

SAMPLING PROCEDURES Cont'

- Insert an inner tubing or smaller diameter bailer into the probe rods to collect the water samples.
- Couple the 24-inch slotted section to the mill-slotted rod couplers to increase the sampling area.

TIP: The mill-slotted section works best in sandy soil aquifers. Do not use in silty or clayey soils.

- Clean the mill slots with a safety razor blade. To minimize clogging of the slots, drive a larger diameter pre-probe ahead of the slotted section and attach to the slotted section.

SAMPLING PROCEDURES Cont'

Screen Point 15 Ground Water Sampler

Follow these procedures when using the screen point 15 ground water sampler (see Figure 12)--

- Assemble the sampler. When completely assembled, it should measure 1.5 inches by 52 inches. The exposed screen length is 41 inches.
- Use a stainless steel or polyvinyl chloride screen with the sampler.
- Insert the expendable drive point into the lower end of the sampler sheath.
- Attach the drive head to the top. Four "O" rings keep the drive head, expendable point, and sample sheath watertight and free of contaminants when driven to various depths through potentially contaminated zones.

SAMPLING PROCEDURES Cont'

- Insert the extension rods with a screen push adapter into the probe rods once the desired sampling depth is obtained.
- Pull the probe rods up approximately 44 inches while holding the extension rod down.
- Begin sampling.
- After sampling remove the plug in the bottom of the screen to allow for grouting below the sampler and the water table as the probe rods and sampler are removed.
- Disassemble the sampler and scrub with a stiff brush in tap water and Alconox® soap. Steam cleaning may be required in certain cases where fuels and oils are encountered.

Alconox® is a registered trademark of Alconox, Inc., New York, New York 10016.

SAMPLING PROCEDURES Cont'

- Rinse with distilled water and air dry.
- Install an "O" ring on an expendable point.
- To seat the point, moisten the "O" ring with distilled water and twist the ring into the tapered end of the sampler sheath.
- Insert a grout plug in the lower end of the stainless steel or polyvinyl chloride screen.
- When using a stainless steel screen, insert an "O" ring into the groove on the upper end.
- Slide the screen into the sampler sheath; grout plug end first. Do not drop the screen.
- Insert an "O" ring into the groove on the large section of the drive head.
- Thread the drive head into the sampler sheath.

SAMPLING PROCEDURES Cont'

TIP: To avoid damage, assemble the sampler together fully.

- Attach a drive cap to the top.
- Extend the slidebase of the DPSS completely and place the sampler under the hammer.
- Drive the sampler slowly for the first several feet to ensure the sampler is being driven straight.
- Raise the hammer completely and remove the drive cap.
- Place an "O" ring in the top groove of the drive head. Lubricate the "O" ring with distilled water if needed.
- Add a section of probe rod and attach the drive cap.

SAMPLING PROCEDURES Cont'

- Drive the sampler the entire length of the new probe rod.
- Continue adding probe rods until the desired sampling interval is reached. Leave approximately 12 inches of the last probe rod above the ground to allow the attachment of the puller assembly. A 12-inch probe rod may be added if the rods are overdriven.
- Remove the drive cap.
- Slide the carriage halfway back towards the vehicle to attach the puller assembly.
- Attach the pull cap and install the tubing to develop and sample.
- Thread the screen push adapter onto an extension rod.

SAMPLING PROCEDURES Cont'

- Attach a female quick link adapter to the other end of the extension rod.
- Lower the extension rod inside the probe rod. Do not drop it inside the probe rod.
- Attach a male quick link adapter to one end of the extension rod and a female quick link adapter to the other end.
- Add additional extension rods so that the adapter will contact the bottom of the screen. Maintain 48 inches of extension rod above the probe rod.
- Attach the extension rod handle to the top of the extension rod.
- Install the casing pull bracket to the bottom of the probe hammer.

SAMPLING PROCEDURES Cont'

- Lower the hammer and pull bracket until the bracket is below the top of the probe rod.
- Place the casing pull plate over the probe rod and across the pull bracket.
- Install the pull cap.
- Pull probe rods and sampler up while holding the screen in place with the extension rods. If the extension rods rise with the probe rod, pull the extension rods up 6 inches and then drop them to dislodge the expendable point and to allow the screen to slide out of the sampler sheath.

SAMPLING PROCEDURES Cont'

- Raise the hammer and pull bracket assembly about 44 inches. At this point, the screen head will contact the tapered portion of the sampler and the extension rods will rise slightly with the probe rods.

TIP: If the sample hole sides are wet, the sampler and probe rods may slide down the hole. Use a large pair of vise grips to hold the sampler and rods. Lay the vise grips on top of the slidebase and raise the hammer to clear the work area.

SAMPLING PROCEDURES Cont'

Be careful when sliding the polyvinyl chloride screen out of the sampler sheath. It may break when contacting the tapered portion of the sheath.

- Remove the following--
  - Top extension rods and handle.
  - Pull cap.
  - Casing plate puller.
  - If needed, the top probe rod.
- Remove remaining extension rods.

SAMPLING PROCEDURES Cont'

TIP: The tubing will sometimes catch on the edge of the funnel opening of the screen head. Pull up and down and turn the tubing to move past the lip and into the screen.

- To retrieve the screen point 15 ground water sampler--
  - Position the slidebase and hammer above the probe rod.
  - Attach the pull cap to the probe rod.
  - Lower the hammer latch over the pull cap and retract the probe rod.

SAMPLING PROCEDURES Cont'

STOP! Don't bend the screen when removing from the hole.

- Remove the pull cap and probe rod.
- Continue retracting probe rods until at ground surface. Use vise grips if sampler and probe rods slide down the hole.
- Disassemble and decontaminate completely before sampling next probe hole.
- To abandon environmental wells or borings, (see American Society for Testing and Materials D 5299-92 requirements and state regulations)--
  - Remove the grout plug to deploy tubing through the bottom of the screen.

SAMPLING PROCEDURES Cont'

- Pump grout into the open probe hole, as the sampler is withdrawn.
- Position casing pull bracket and pull plate over the probe rods and place the split pull cap on the top probe rod.
- Pull the sampler and rods with the hammer latch while grouting.
- Use the casing puller to manipulate the grout tube and probe rods.
- Use a split pull cap to pull the probe rods without disconnecting the grout tube from the pump.
- Raise the probe rods about 4 to 6 inches to remove the grout plug.

SAMPLING PROCEDURES Cont'

- Remove the pull cap.
- Thread the grout plug push adapter onto an extension rod.
- Insert the adapter and extension rod inside the probe rods.
- Add more rods until the adapter places the grout plug at the bottom of the screen. A relatively soft rebound should be felt when the adapter contacts the grout plug, especially when using a polyvinyl chloride screen.
- Apply pressure to the extension rods and push the grout plug out of the screen.
- If working with a stainless steel screen, raise and quickly lower the extension rods to jar the plug free. A metal-on-metal sensation should be felt.

SAMPLING PROCEDURES Cont'

- If working with a polyvinyl chloride screen, do not attempt to hammer on the grout plug. A steady downward force should dislodge the plug.
- Remove all extension rods when the plug is removed.
- Connect the grout nozzle to polyethylene tubing and insert in the probe rods through the bottom of the screen.

TIP: Maintain a flow of water during deployment to prevent plugging with sediment.

- Pass the grout nozzle through the drive head. Resistance will be felt.
- Continue until the nozzle exits the screen, about 92 inches. Mark the tubing as desired.

SAMPLING PROCEDURES Cont'

- Gently pull up on the tubing to ensure the two spring-like tongues at the end have expanded.
- Keep all probe rods on the tubing as the rods are pulled. Extra tubing may be needed to lay the rods on the ground, as they are removed, about 30 percent more.
- Attach a split pull cap to the top probe rod.
- Position the tubing in the pull cap slot; taking care not to pinch or bind the tubing.
- Operate the grout pump while pulling the first rod.
- Remove the split pull cap and unscrew the probe rod.
- Slide the rod over the tubing and place on the ground. Always leave room for the remaining rods.

SAMPLING PROCEDURES Cont'

- Continue removing probe rods until the sampler is retrieved. When retrieved, the hole will be filled from the bottom up.

TIP: Do not bend or kink the tubing. Sharp bends create weak spots which may burst when pumping grout.

- Promptly clean all probe rods and sampler parts before the grout sets and clogs the equipment.

Soil Gas Sampling

Follow these procedures when using the post-run tubing system (see Figure 13) for sampling of soil gases--

- Drive the post-run tubing system along with probe rods to the desired sampling depth.
- Insert and seal an internal tubing.

SAMPLING PROCEDURES Cont'

- Use the following tools when using probe rods and driving accessories--
  - Expendable drive point.
  - Post-run tubing expendable point holder.
  - Post-run tubing adapter.
  - Selected post-run tubing.
- To prepare the post-run tubing system--
  - Decontaminate and clean all parts before use.
  - Install new "O" rings on the post-run tubing expendable point holder and the post-run tubing adapter.

SAMPLING PROCEDURES Cont'

- Clean and inspect probe rods, making sure there are no obstructions inside the rods.
- Test fit the adapter and the post-run tubing to the expendable point holder to ensure threads are compatible and go together smoothly.

TIP: Always thread the post-run tubing fittings counterclockwise.

- Insert the post-run tubing adapter into the selected tubing.
- Use electrical tape on the outside of the adapter and tubing to prevent the tubing from spinning on the adapter during connection, especially when using Teflon tubing.

SAMPLING PROCEDURES Cont'

The vapors from the tape adhesive could show up in the samples and give false information. This depends on whatever parameters are being sampled.

- To connect the post-run tubing system--
  - Insert the post-run tubing adapter and tubing inside of the probe rods until reaching the expendable point holder.
  - Allow 2 to 3 feet of tubing to extend from the probe rods before cutting.

SAMPLING PROCEDURES Cont'

- Grasp the excess tubing and apply pressure downward while turning clockwise. This is done to engage the post-run tubing adapter threads into the expendable point holder.

- Pull up lightly on the tubing to make sure the post-run tubing adapter is threaded into the expendable point holder.

- To sample using the post-run tubing--

  - Connect the tubing to a Silicone/Tygon® adapter, then to a vacuum hose.

  - Run the vacuum hose to a pelican box and connect to the air-sampling bag inside. Then, connect to the vacuum pump located in the back of the DPSS.

Tygon® is a registered trademark of Norton Company Massachusetts, 1 New Bond Street, Box Number 15138, Worcester, Massachusetts 01615-0138.

SAMPLING PROCEDURES Cont'

- To remove the post-run tubing system--
  - Disconnect the tubing from the vacuum hose.
  - Pull up firmly on the tubing until it releases from the post-run tubing adapter.
  - Remove the tubing from the probe rods and dispose.

Always dispose of properly because of potential hazardous effects.

  - Remove the probe rods and the expendable point holder with the post-run tubing adapter from the ground.

SAMPLING PROCEDURES Cont'

- Inspect the "O" ring at the base of the post-run tubing adapter to verify proper sealing was achieved. The "O" ring should be compressed.

- Test the seal by capping the open end of the point holder and applying vacuum to the post-run tubing adapter.

GLOSSARY

Terms

Backfilling

Refilling the sample hole with the same soil from the existing hole or with a non-contaminated soil to fill the sample hole to the ground surface.

Bedrock

A general term for rock, usually solid, that underlies soil or other unconsolidated material.

Bentonite

A colloidal clay, largely made up of the mineral sodium montmorillonite, a hydrated aluminum silicate.

Biological Agent

Germ warfare chemicals designed and tested during the era from World War I and World War II. The chemical was used to decommission or kill the enemy.

GLOSSARY
Cont'

Terms

Clayey soil

A soil that contains approximately 50 to 75 percent clay. The soil can be molded into a ball or a thread and stays together.

Cohesive soil

A soil that contains some clay and readily sticks together.

Filter Media (Same as Filter Pack)

Sand or gravel that is smooth, uniform, clean, well rounded and siliceous. It is placed in the annulus of the well screen to prevent formation material from entering the well screen.

Health and Safety Plan

A plan written by the Project Officer for the protection of the sampling crew. It describes the type of survey and problems the customer/installation need defined to meet with State/Federal compliance. The plan describes and defines hazards and safety on the job site.

GLOSSARY
Cont'

Terms

Large Bore Sampling

Sampling soil with the large bore sampler.

Macro Sampling

Sampling soil with the macro sampler.

Pre-probing

Advancing the sample hole to the desired depth before using the macro sampler. It can also be used to start a sample hole in crusher run road bedding and black top.

Radiological Agents

Radioactive materials used in training areas and as luminescent coatings on aircraft dials, gauges, and wrist watches.

GLOSSARY
Cont'

Terms

Refusal

When the soil sampler fails to advance deeper in the ground, because sampler encounters rock, dense clay, or very fine dense sand.

Sample Point

The point at which the sample is taken from either the surface or subsurface.

Sampling Area

The general area of concern.

Sampling Interval

The depths in the sample hole designated by the Project Officer where soil samples will be taken.

Sampling Plan

A document written by the Project Officer explaining type, quantity, and test parameters of soil samples to be taken.

GLOSSARY
Cont'

Terms

Sampling Site

Area to be studied and where samples will be taken.

Sample Spot

Location where the DPSS will be set up and where probing will begin.

Sandy Soil Aquifers

Soil containing 50 to 75 percent sand in which the aquifer or water table is located.

Soil Sampling

The method soil samples are taken, either with hand scoops, augers, or with the hydraulic sampler.

Stable Formations

A soil containing clays that when disturbed will hold together and the sidewalls will not sluff off or collapse.

GLOSSARY
Cont'

Terms

Study Area

See sampling area.

Subsurface

Underground zone whose geologic features, principally stratigraphic and structural, are interpreted on the basis of drill records and various kinds of geophysical evidence.

Unexploded Ordnance

Explosives or incendiary devices that have not been detonated.

Water Sampling

Method of obtaining water samples from a sample hole or monitoring well either with a bailer, electric, parstalic, or water pumps.

Water Table

The surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric. It can be measured by installing shallow wells extending a few feet into the zone of saturation and then measuring the water level in those wells.

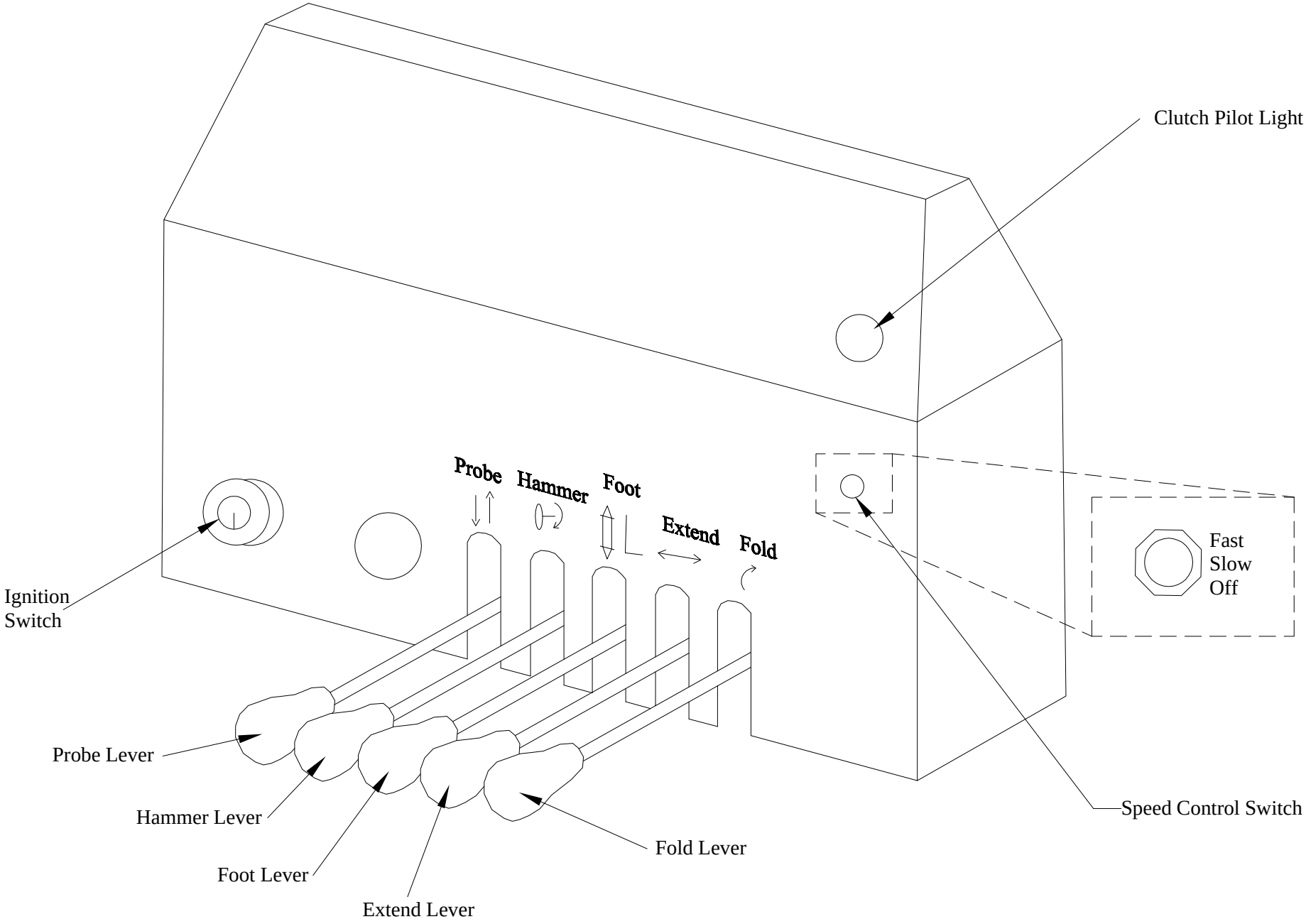


Figure 1. Control Panel on the DPSS

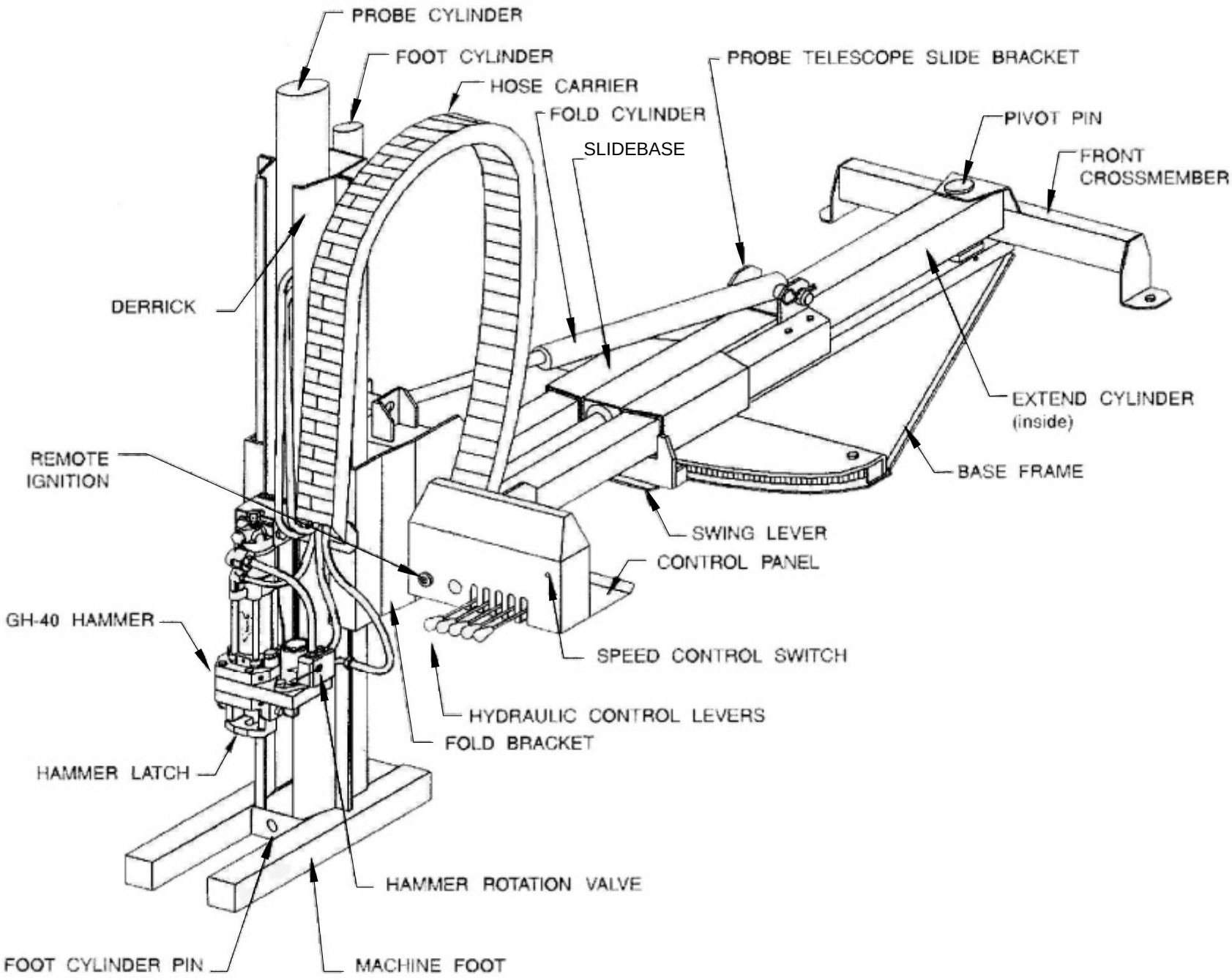


Figure 2. Basic Parts of a Geoprobe Model 5400

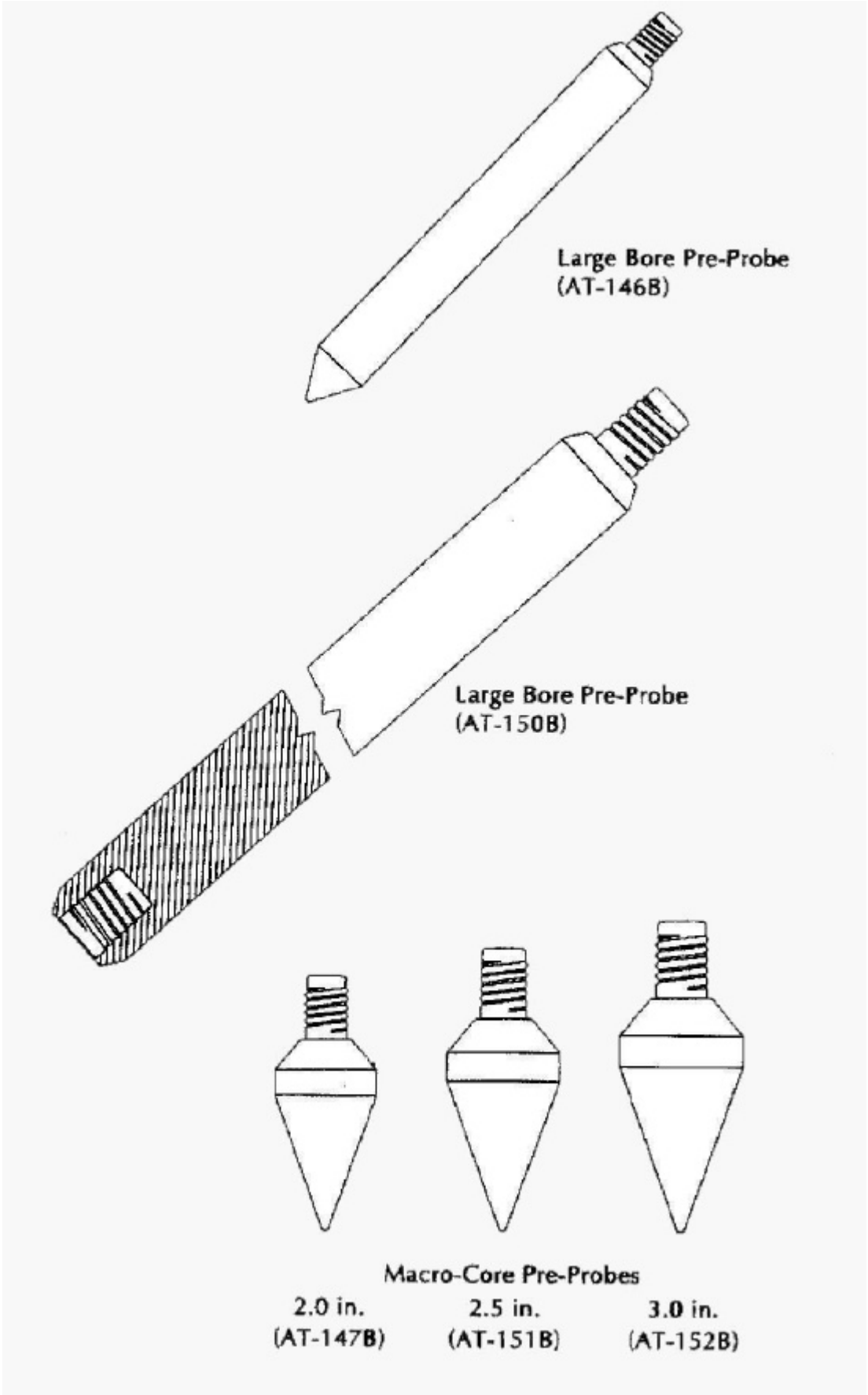


Figure 3. Examples of Pre-Probes

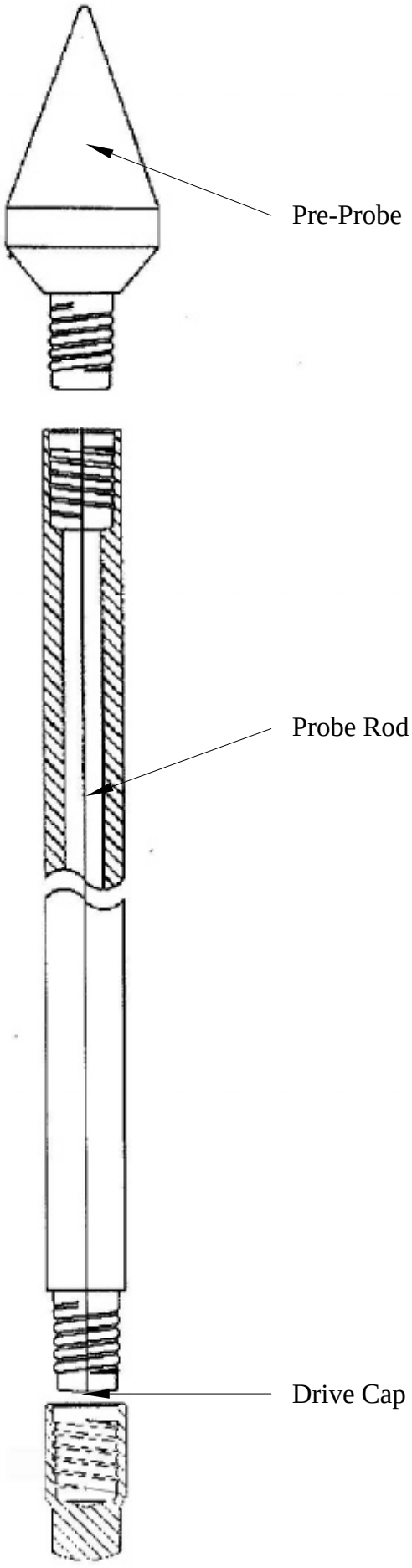


Figure 4. Pre-Probe Assembly

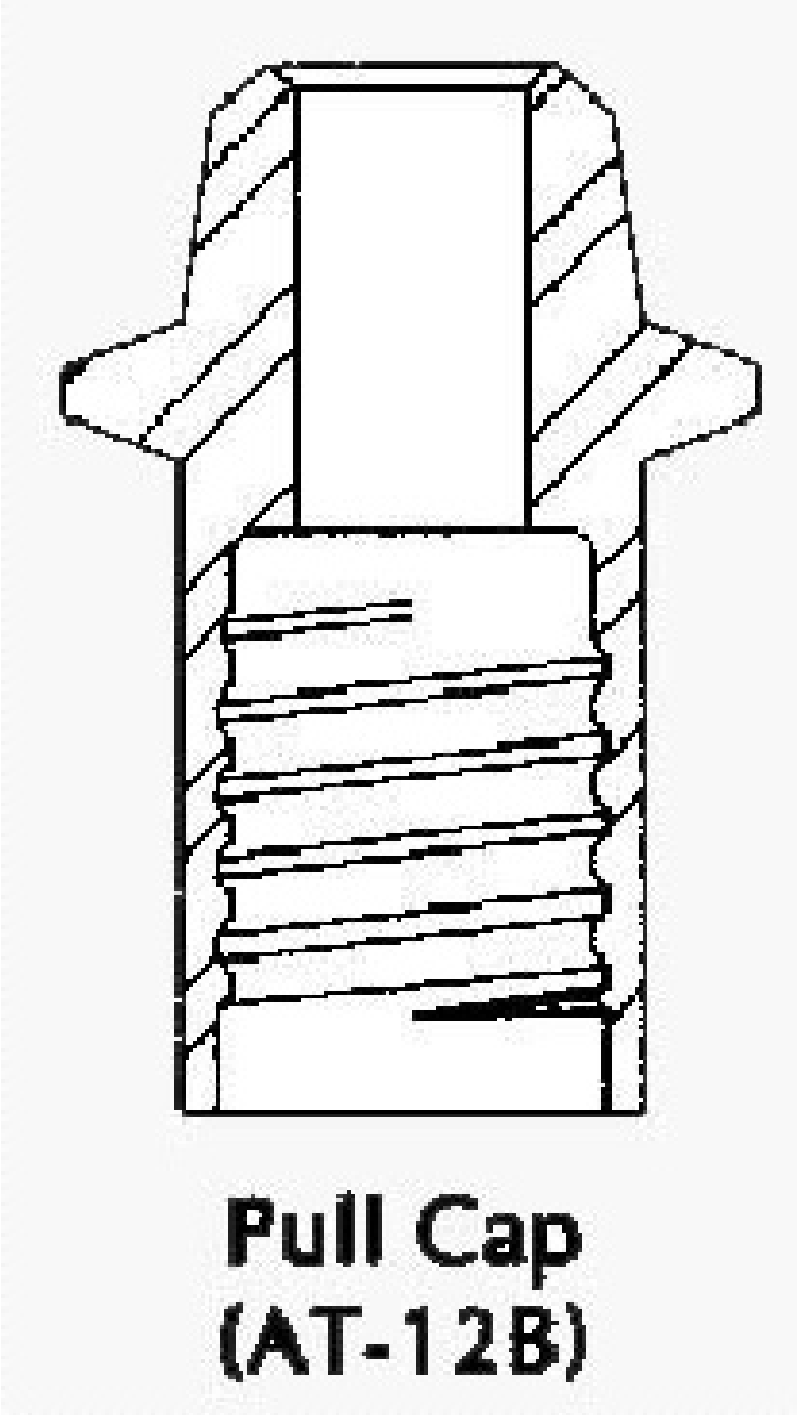


Figure 5. Pull Caps

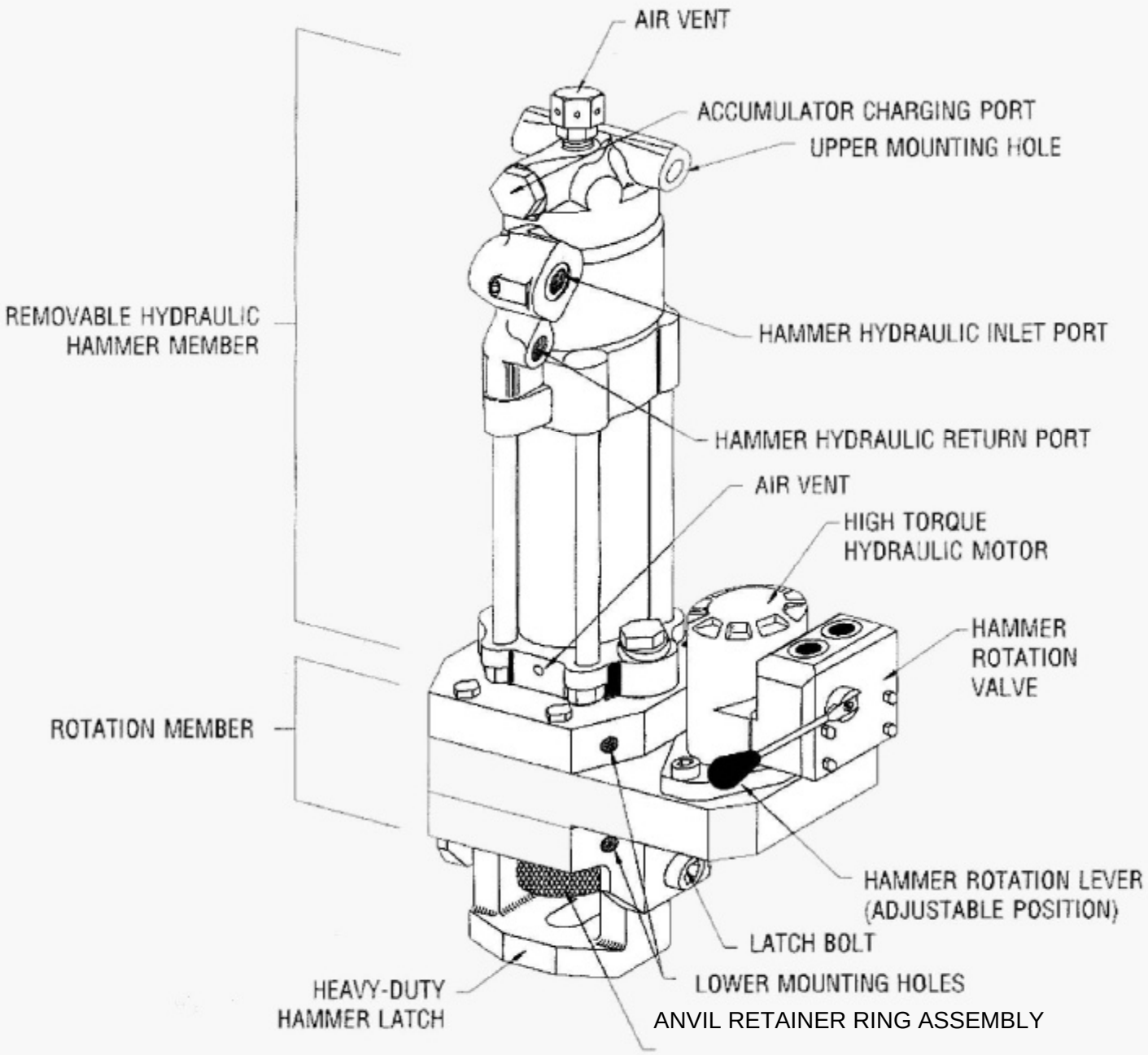
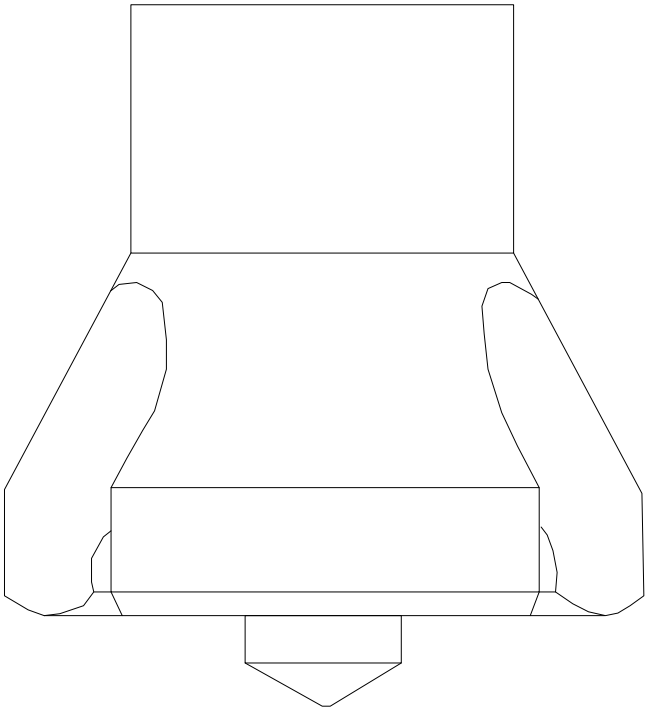


Figure 6. Close-up of the Hammer on the DPSS



Geoprobe's 2.5-in.
(64 mm) Concrete Bit
eats through high
density concrete

Figure 7. Concrete Bit

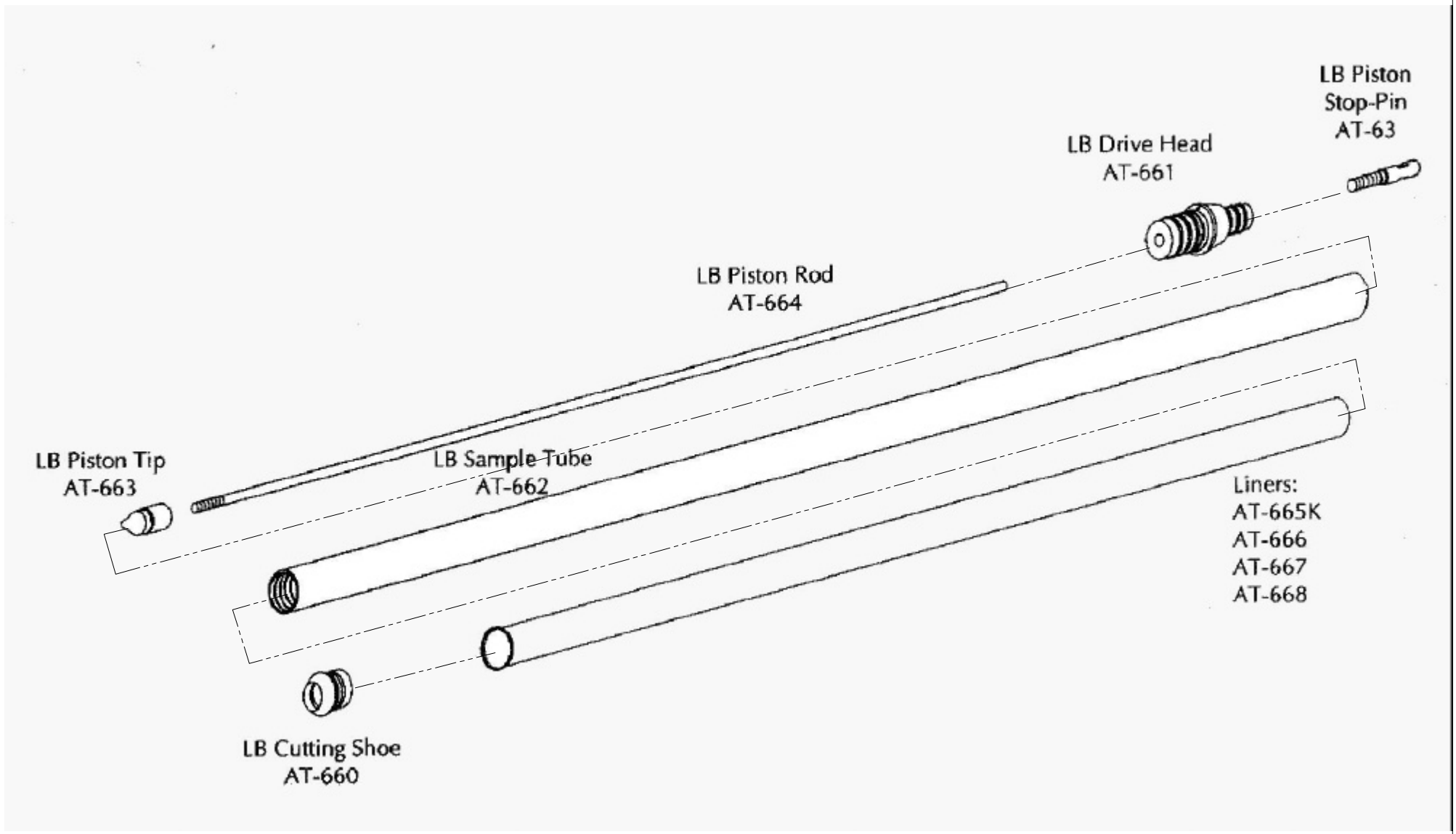


Figure 8. Large-Bore Sampler Assembly

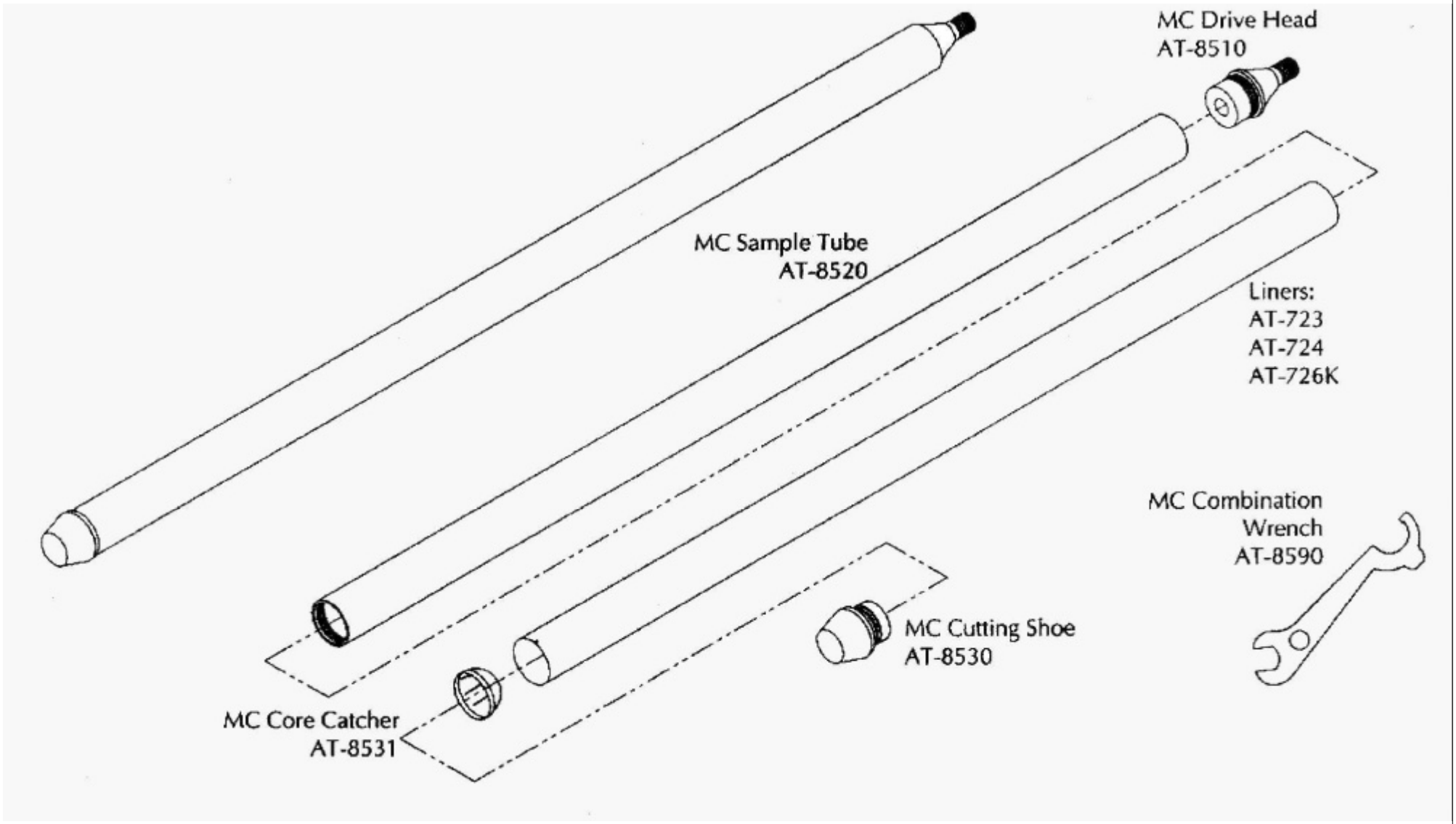


Figure 9. Macro-Core Sampler Assembly

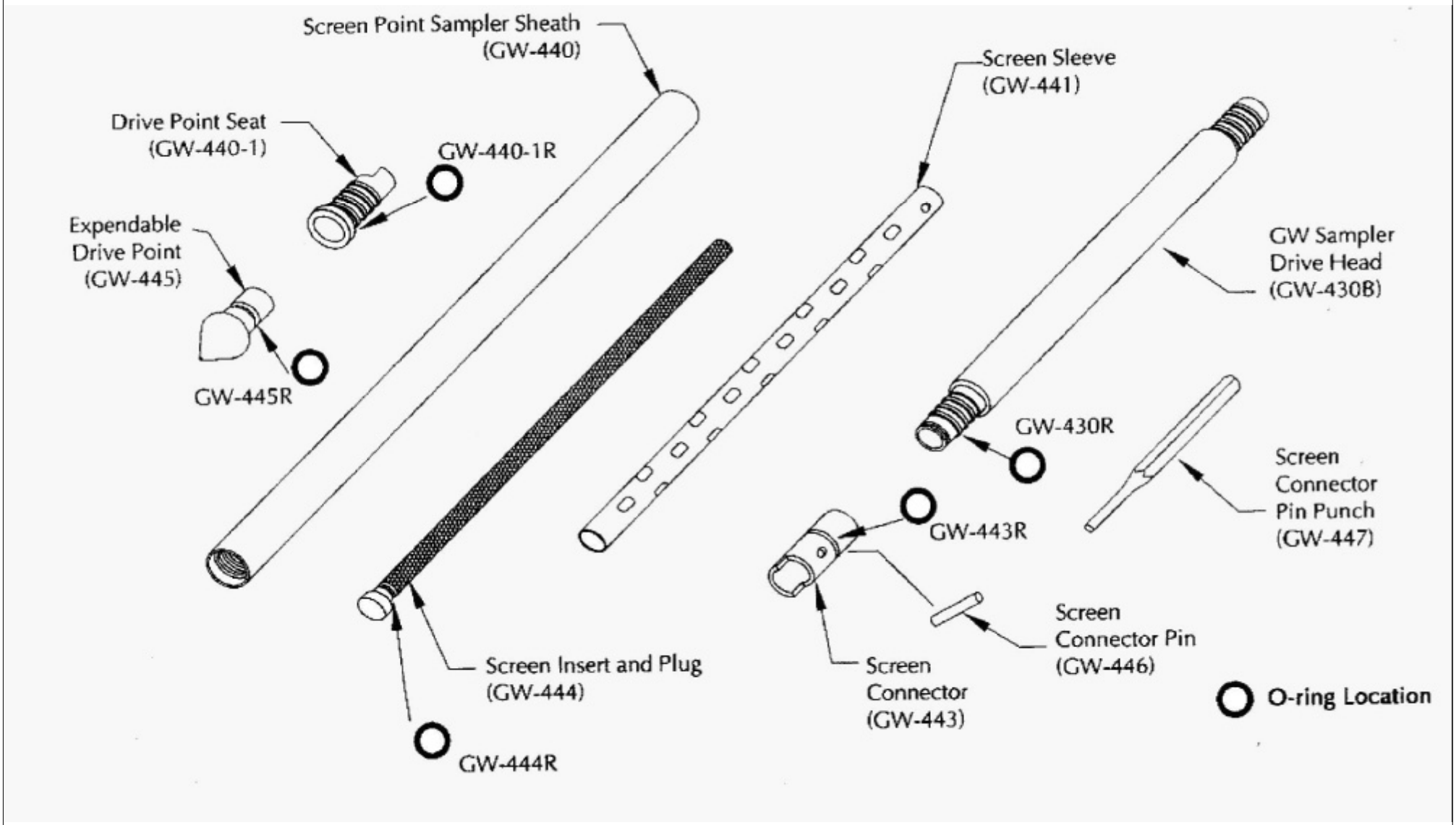


Figure 10. Screen-point Groundwater Sampler Assembly

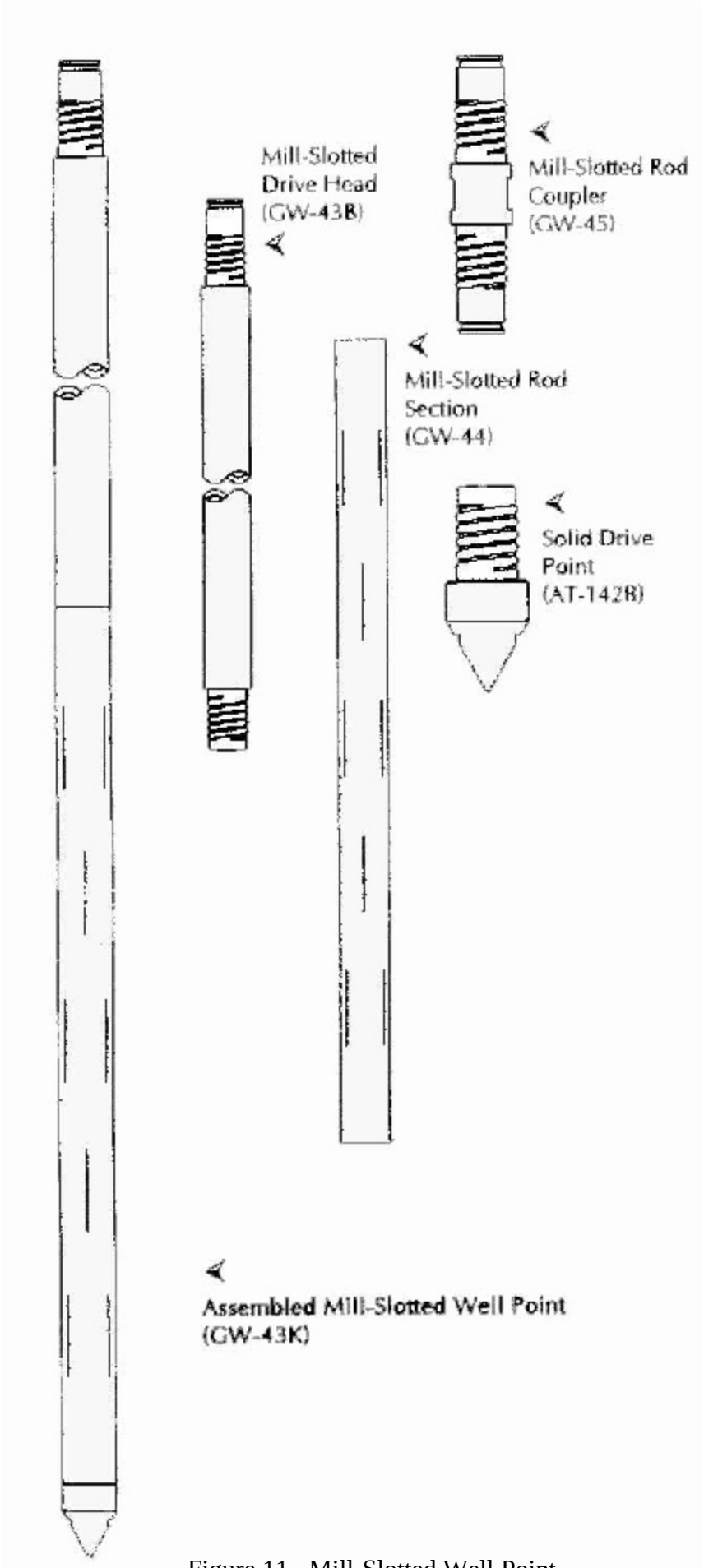
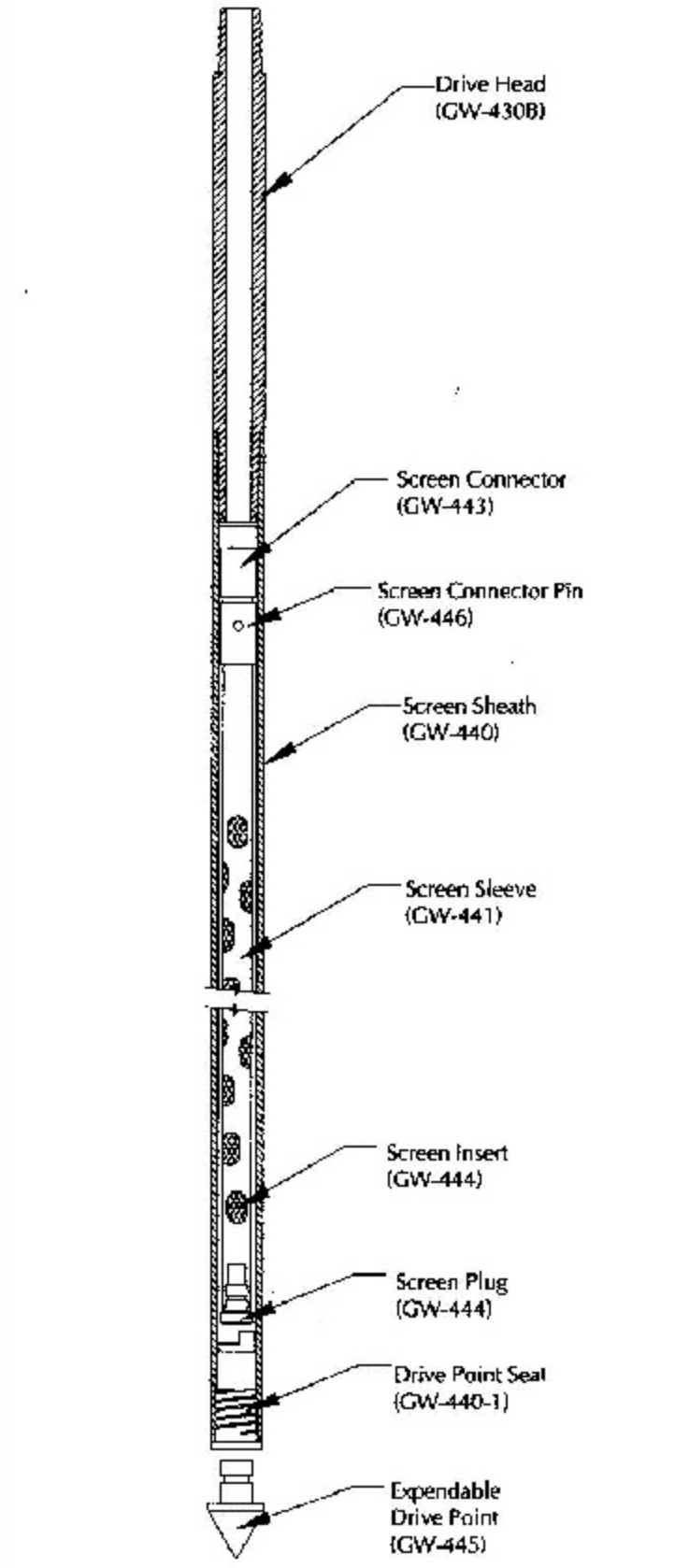


Figure 11. Mill-Slotted Well Point



Cross Section of Assembled Screen Point Sampler (GW-440K)

Figure 12. Screen Point 15 Groundwater Sampler

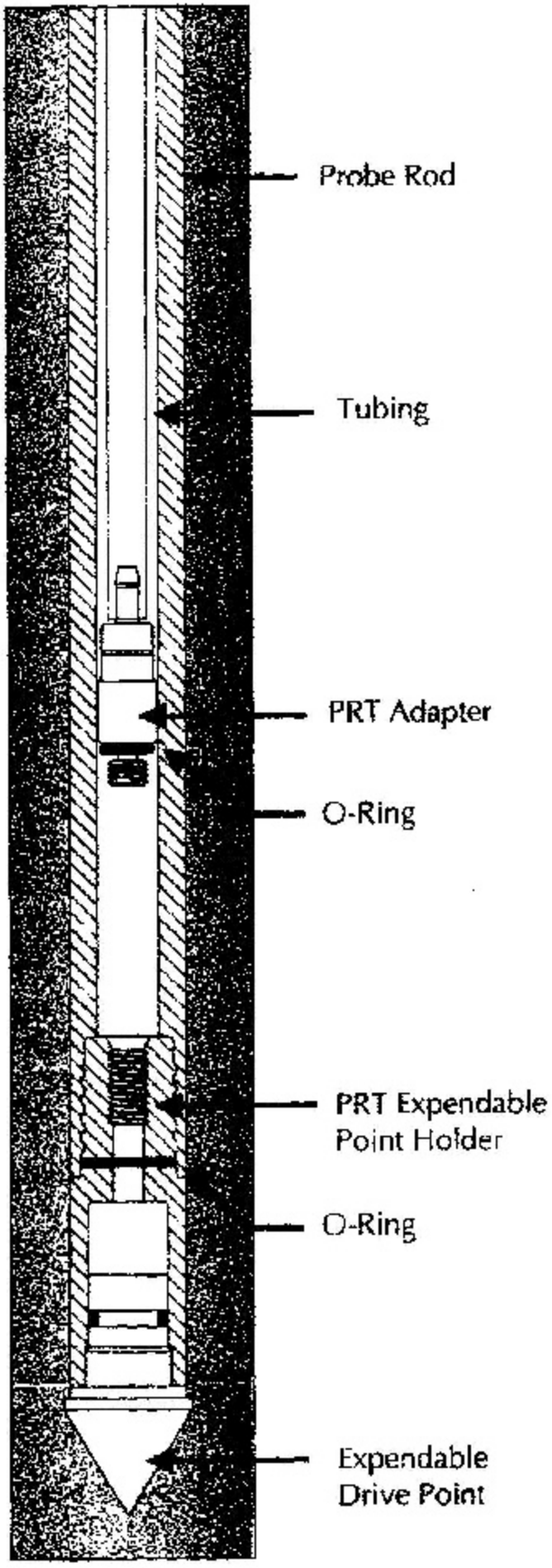


Figure 13. Soil Gas Sampler Using a Post-Run Tubing System