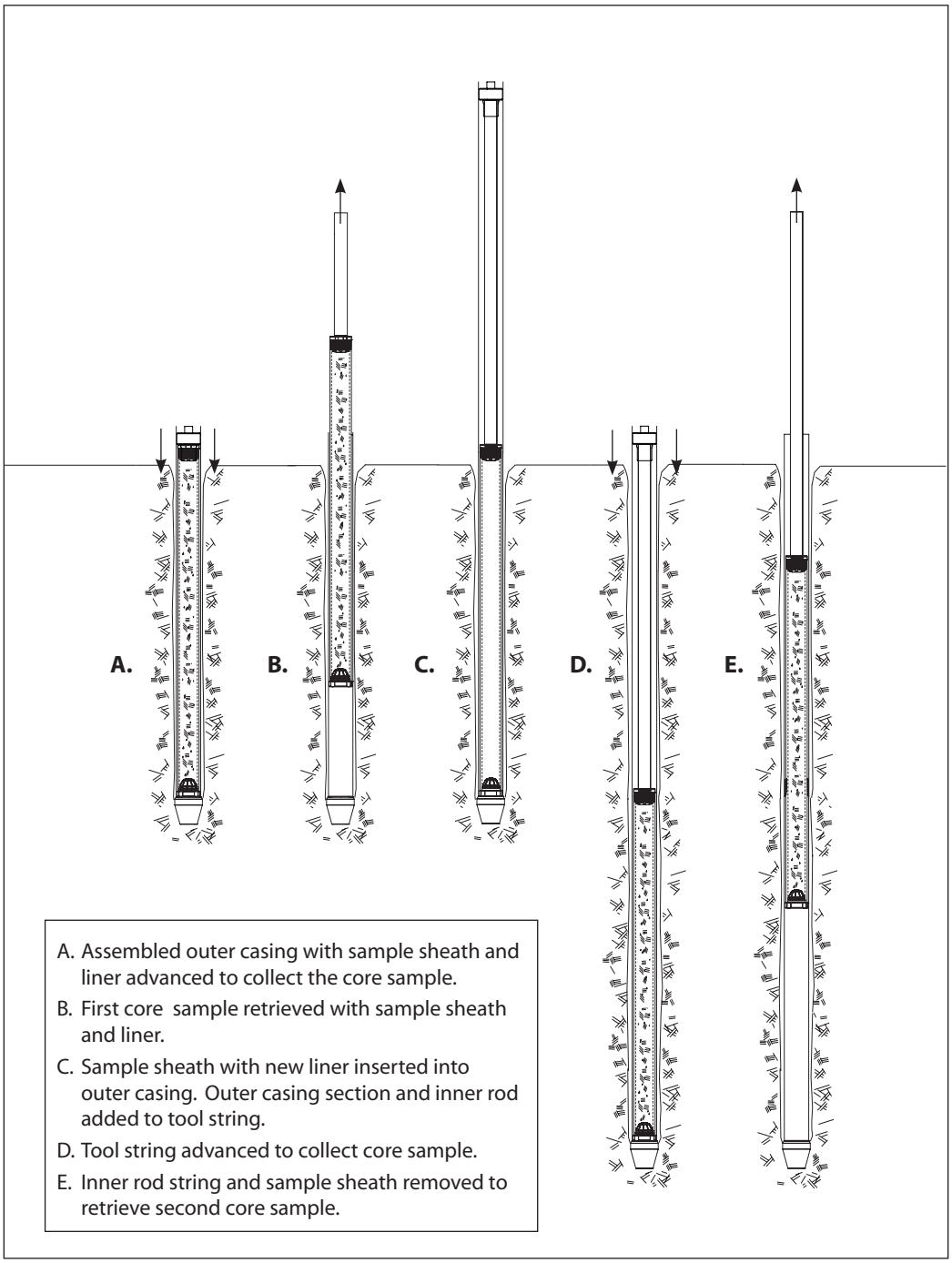
GEOPROBE® SDT45 SONIC DUAL TUBE SAMPLING SYSTEM

STANDARD OPERATING PROCEDURE

Technical Bulletin No. MK3189

PREPARED: January, 2012



Collecting core samples with the SDT45 Sonic Dual Tube Sampling System.

1.0 Objective

The objective of this procedure is to collect a representative core sample at depth through an enclosed casing and recover it for visual inspection and/or chemical analysis.

2.0 Background

2.1 Definitions

Geoprobe®*: A brand name of high quality, hydraulically-powered machines that utilize static force, percussion, rotation and/or vibration to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform core and soil gas sampling, groundwater sampling and testing, soil conductivity and contaminant logging, grouting, and materials injection.

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SDT45 Sonic Dual Tube Sampling System: A system for collecting continuous core samples of consolidated, and unconsolidated materials from within a sealed casing of Geoprobe® 4.5-inch (114 mm) OD sonic casing. Samples are collected and retrieved within a sample sheath and liner that is threaded onto the leading end of a string of Geoprobe® 2.25-inch (57 mm) OD rods, and inserted to the bottom of the outer casing. Collected samples measure up to approximately 7 liters in volume in the form of a 3-inch x 60-inch (76 mm x 1524 mm) core when using common equipment options.

Liner: A 3.0-inch (76 mm) ID , PVC tube that is inserted into the outer casing on the leading end of the inner rod string for the purpose of containing and retrieving core samples. Liners are available in a simple open tube. Nominal liner lengths are 72, 60, or 48 inches and 1 meter.

***Nominal liner length identifies the length of tools with which the liner is used. The actual end-to-end lengths of the various SDT45 liners will differ from the specified nominal lengths.*

Core Catcher: A dome-shaped device positioned at the leading end of a liner to prevent loss of collected cores during retrieval of the liner and core. Flexible fingers at the top of the core catcher are pushed outward by core samples entering the liner during advancement of the tool string. As the filled liner is subsequently retrieved, the fingers of the core catcher move back inward, effectively closing off the end of the liner and limiting core loss.

2.2 Discussion

Dual tube sampling gets its name from the fact that two sets of rods are used to retrieve continuous core samples from the subsurface. One set of rods is advanced into the ground as an outer casing (Fig. 2.1). These rods receive the driving force from the Geoprobe® Sonic Head and provide a sealed casing through which core samples may be recovered.
The second, smaller set of rods are placed inside the outer casing with a sample liner attached to the leading end of the rod string (Fig. 2.1). These smaller rods hold the liner in place as the outer casing is advanced to fill the liner with core samples. The inner rods are then retracted to retrieve the full liner.

Geoprobe® 4.5-inch OD LHSL sonic casing provide the outer casing for the SDT45 Dual Tube Sonic Sampling System. A cutting shoe is threaded into the leading end of the rod string. When advanced into the subsurface, the cutting shoe shears a 3-inch (76 mm) OD core which is collected inside the casing in a clear plastic liner.

The second set of rods in the SDT45 Sonic Dual Tube System are Geoprobe® 2.25-inch OD rods. A sample sheath with PVC liner is attached to the end of these smaller rods and then inserted into the casing. The inner rods hold the sample sheath tight against the cutting shoe as the outer casing is advanced to collect the core. Once filled, the sample sheath and liner are removed from the bottom of the outer casing by lifting out the inner rod string.

The outer, 4.5-inch sonic casing provide a cased hole through which to sample. The main advantage of sampling through a cased hole is that there is no side slough to contend with. In addition, the outer casing effectively seals the bore hole when sampling through perched water tables. These factors mean that sample cross-contamination is minimized. The SDT45 sampling system is therefore ideal for continuous coring in both saturated and unsaturated zones.

Grouting

The SDT45 system allows bottom-up grouting through the primary tool string. This means that a cement or bentonite grout mix can be pumped through the outer casing as it is withdrawn from the ground. This is in contrast to most other core samplers which require driving a second set of tools back down the bore hole in order to deliver the grout mix.

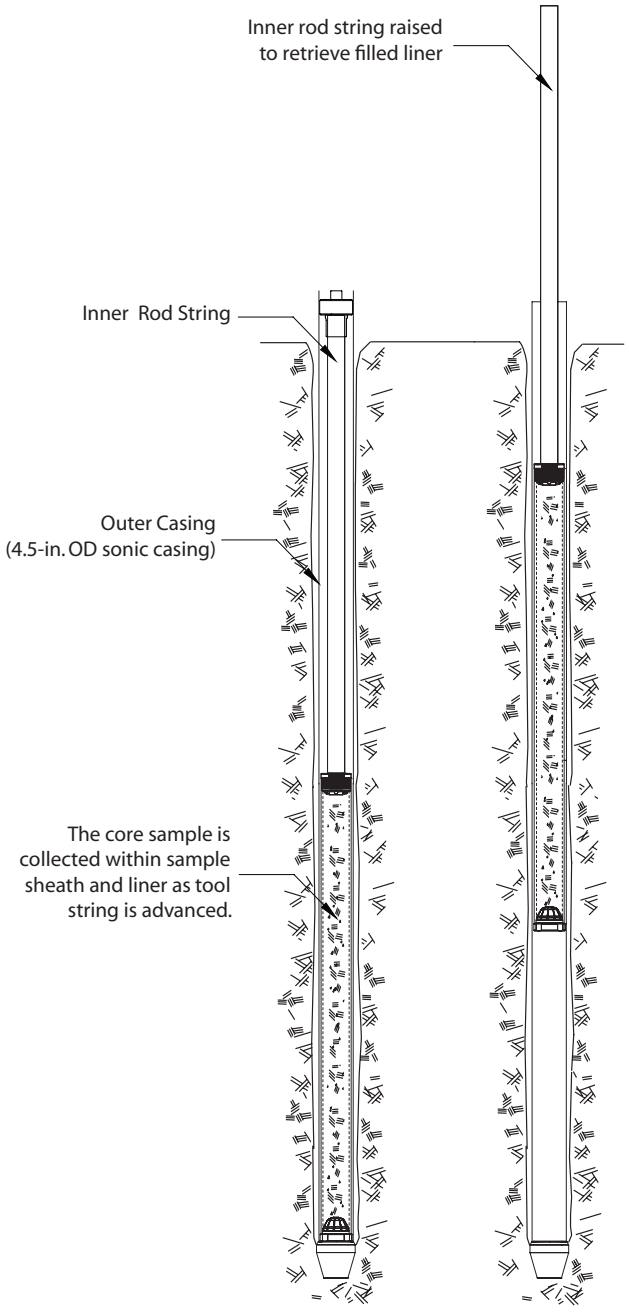


Figure 2.1
Outer casing advanced with sample sheath and liner.

3.0 Tools and Equipment

The following equipment is required to operate the SDT45 Sonic Dual Tube Sampling System. Refer to Figure 3.1 for identification of the specified parts.

SDT45 Sampler Parts*	Quantity	Part Number
SDT45 Drive Head, 2.25-in. box	-1-	32335
SDT45 Sonic Centering Drive Cap	-1-	43345
SDT45 Sample Sheath, 72-in. length	-1-	30252
SDT45 Sample Sheath, 60-in. length	-1-	30250
SDT45 Sample Sheath, 48-in. length	-1-	30248
SDT45 Sonic Cutting Shoe, Carbide	-1-	44796
SDT45 Sonic Long Snout Cutting Shoe	-1-	44917
SDT45 Expendable Cutting Shoe Holder	-1-	32940
SDT45 Expendable Cutting Shoe	-1-	34887
SDT45 Liner Retainer	-1-	32349
SDT45 Liner Retainer Wrench	-1-	30302

SDT45 Liners and Accessories	Quantity	Part Number
SDT45 PVC Liner, 72-in. length, box of 18	Variable	46066
SDT45 PVC Liner, 60-in. length, box of 18	Variable	46065
SDT45 PVC Liner, 48-in. length, box of 18	Variable	46125
SDT45 Core Catcher	-1-	34454
SDT45 Liner Cutter	-1-	34340
Universal Liner Holder	-1-	22734

Sonic Casing, Probe Rods and Accessories*	Quantity	Part Number
GV4 Spindle 6.0-in. RHSL/4.5-in. LHSL/3.5-in. LHSL	-1-	46937
4.5-in. LHSL Swivel Pull Cap (pin down)	-1-	44883
Sonic Casing, 4.5-in. OD x 60-in. length	Variable	44533
Sonic Casing, 4.5-in. OD x 24-in. length	Variable	44790
Sonic Casing, 4.5-in. OD x 12-in. length	Variable	44877
Sonic Casing, 4.5-in. OD x 24-in. length	-1-	31865
2.25-in. Swivel Pull Cap (pin down)	-1-	35621
Probe Rod, 2.25-in. OD x 60-in. length	Variable	25301
Probe Rod, 2.25-in. OD x 12-in. length	Variable	25351
Probe Rod, 2.25-in. OD x 1-m length	Variable	25352

Optional Accessories	Quantity	Part Number
Rod Wiper Donuts, 4.5-in. Rods	-1-	29976
Rod Wip[er Weldment	-1-	23633
SDT45 Liner Spacer	-1-	32526
DT 45 Liner Spacer Connector	-1-	30436

* Select SDT45 Sample Sheath and liner lengths to match length of sonic casing.

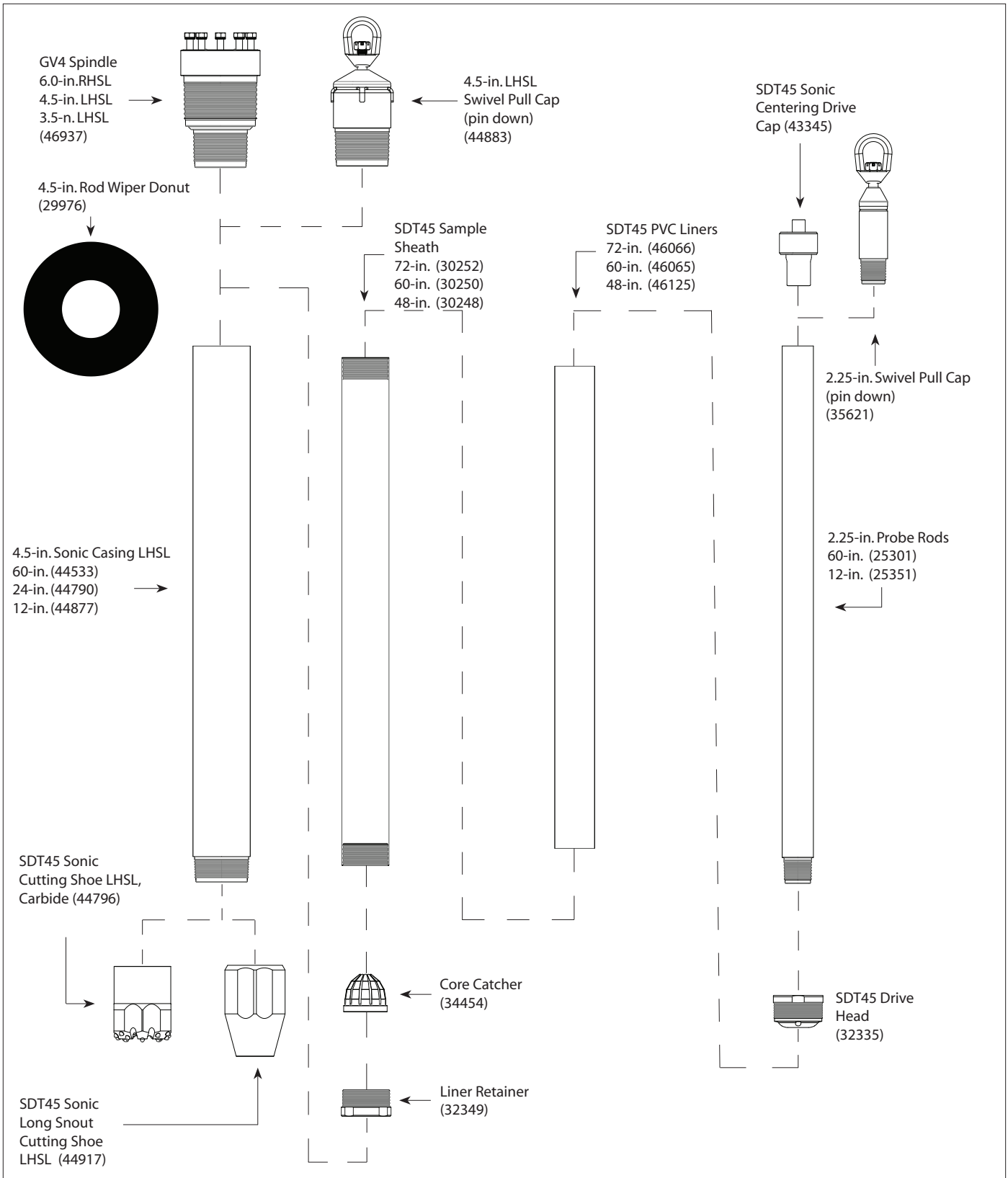


Figure 3.1
SDT45 parts and accessories using 2.25-inch inner rods.

3.1 Tool Options

This section identifies the specific tool options available for use with the SDT45 Sonic Dual Tube System. Refer to Figure 3.1 for illustrations of the specified parts.

Sonic Casing and Probe Rods

Geoprobe® 4.5-inch (114-mm) OD sonic casing is utilized for the outer casing of the SDT45 Sampling System. Nominal rod lengths include, 12 inches, 24 inches, and 60 inches. The specific length of rods may be selected by the operator and will determine the length of tooling for the rest of the SDT45 system.

2.25-inch probe rods

2.25-inch probe rods (2.25-inch / 57-mm OD) are recommended for the inner rod string of the SDT45 system when utilizing an outer casing of 60-inch long rods.

Sample Sheaths

A steel sample sheath supports the weight of the inner rods to protect the sample liner from damage while advancing the SDT45 tool string. The liner is placed within the sample sheath and secured with a drive head at the top of the sheath and a liner retainer at the bottom. The assembled sheath with liner is inserted to the bottom of the outer casing on the leading end of the inner rod string. After advancing the entire tool string one sample interval, the inner rods and sample sheath are retrieved to recover the core sample.

Sample sheaths are available in nominal lengths of 48 inches, 60 inches, and 72 inches. Sample sheath length is generally matched to the length of the sonic casing selected for the outer casing. However, a SDT45 Liner Spacer PVC (32526) and SDT45 Liner Spacer Connector (30436) allow use of 48-inch liners with a 60-inch sample sheath (30250) and 60-inch liners with a 72-inch sample sheath (30252).

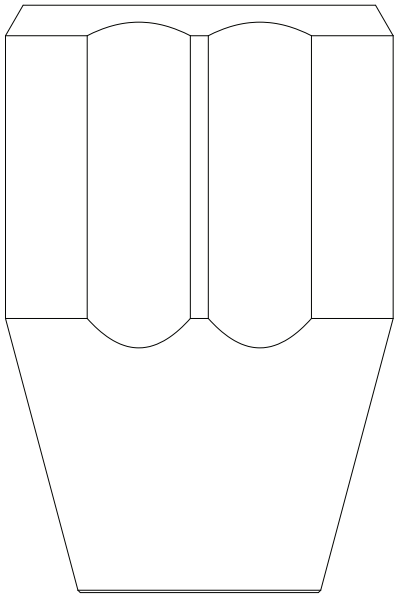
Sample Liners

Sample liners are made of a heavy-duty clear PVC for convenient inspection of the core sample. Liners are available as a simple, open tube. A core catcher can be inserted into the liner. Utilize the core catchers when sampling flowing sands, noncohesive soils, extremely dry soils, or any other materials that fall from the liner during retrieval.

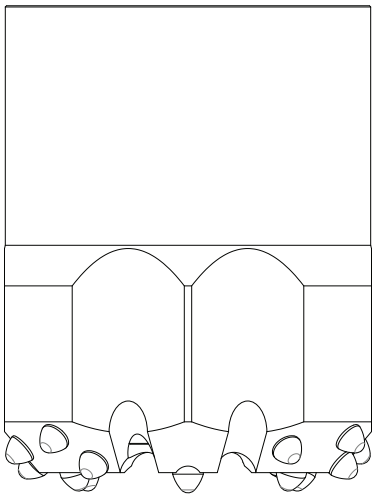
Nominal liner lengths include 48 inches, 60 inches and 72 inches with an OD of 3.0 inches (76 mm). Under "normal" sampling conditions, liner length should correspond to the length of sonic casing used for the outer casing. Certain sampling conditions can cause over-filled liners which may lead to problems removing the liner and core sample from the sample sheath. For these special conditions, utilize a Liner Spacer PVC (32526) and SDT45 Liner Spacer Connector (30436) to provide additional room above the liner for the extruding core sample. The Liner Spacer PVC and Liner Spacer Connector must be used with either a 48-inch liner in a 60-inch sample sheath (30250) or a 60-inch liner in a 72-inch sample sheath (30252). With the tool string only advanced the length of the liner, the Liner Spacer PVC remains free to accept extruding core sample that may otherwise overfill the liner.

Cutting Shoes

Two cutting shoes are available for use with the SDT45 Sonic Dual Tube System (Fig. 3.2). The Long Snout Cutting Shoe (44917). The Carbide Cutting Shoe (44796) is used when a flushing medium is required (rocks).



SDT45 Sonic Long Snout Cutting Shoe
(44917)



SDT45 Sonic Cutting Shoe, Carbide
(44796)

Figure 3.2
Cutting shoe options for the SDT45 Sonic Dual Tube Sampling System.

4.0 Operation

4.1 Decontamination

Before and after each use, thoroughly clean all parts of the core sampling system according to project requirements. Parts should also be inspected for wear or damage at this time. During sampling, a clean new liner is used for each core sample.

4.2 Operational Overview

The SDT45 Sonic Sampling System is designed to collect continuous core samples. Once sampling begins, consecutive core samples are removed as the outer casing is advanced to greater depths.

The core sample is collected using a liner with core catcher to maximize sample recovery (Fig. 4.1-A). Upon retrieval of the first liner and core sample (Fig. 4.1-B), a new liner is loaded into the sample sheath and inserted to the bottom of the outer casing on the end of an inner rod. A section of outer casing is added to the tool string (Fig. 4.1-C) and the entire tool string is advanced to fill the liner with core sample (Fig. 4.1-D). The sample sheath and filled liner are removed from the outer casing to retrieve the second core sample (Fig. 4.1-E). A new liner is placed in the sample sheath and the process is repeated for the entire sampling interval.

Specific instructions for assembly and operation of the SDT45 Sampling System are given in the following sections.

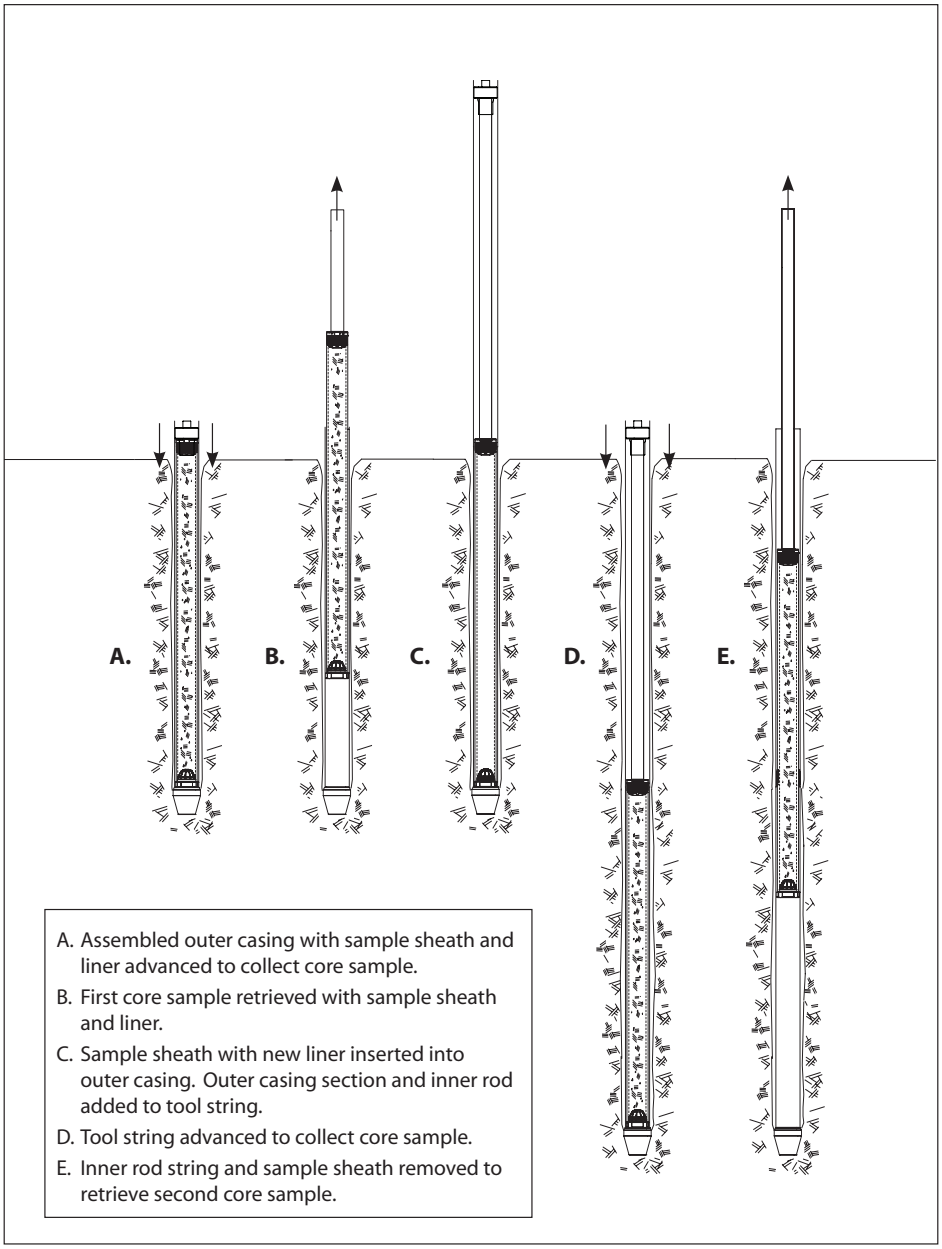


Figure 4.1
Continuous core sampling from ground surface with the SDT45 system.

4.3 Assembling the Sample Sheath

The sample sheath is used to support the weight of the 2.25-inch probe rods and to protect the liner from damage while advancing the SDT45 tool string. The process of assembling the sheath to collect core samples is given below.

1. Slide the core catcher into the leading end of the liner (Fig. 4.2).
2. Slide the liner retainer over the core catcher and liner (Fig. 4.3).
3. Place the liner into either end of the sample sheath with the liner retainer and core catcher (Fig. 4.4).
4. Thread the liner retainer onto the sample sheath. If the tools are clean, it should easily thread on easily by hand (Fig. 4.5).
5. On the opposite end of the sheath, thread on the SDT45 Drive Head. The drive head will connect the sheath to the 2.25-inch probe rods (Fig. 4.6).

The sample sheath is now ready for core sample collection.

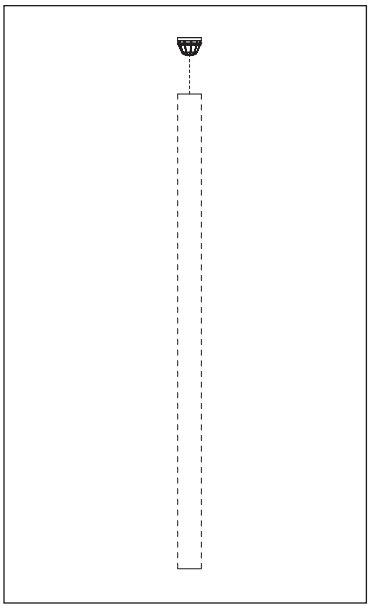


Figure 4.2. The core catcher is placed on the end of the liner.

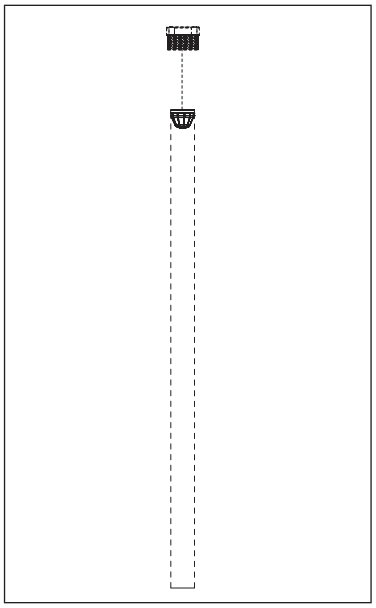


Figure 4.3. The liner retainer is placed over the core catcher and liner.

Figure 4.4. Liner, core catcher, and liner retainer are slid into sample sheath.

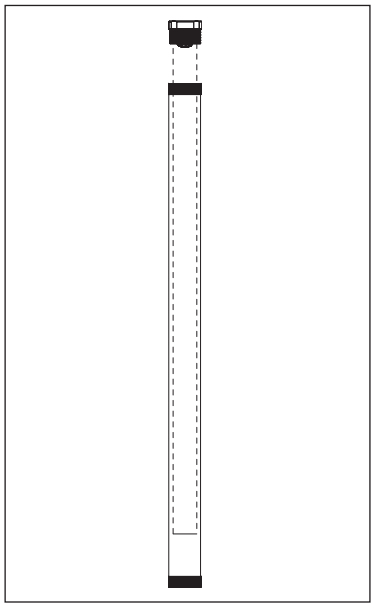


Figure 4.5. Liner, core catcher, and liner retainer are slid into sample sheath.

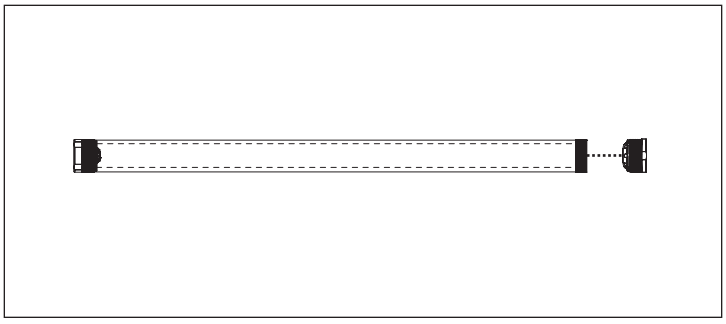


Figure 4.6. Drive head is threaded onto the opposite end of the sample sheath.

4.4 Core sample Collection

This section describes collection of continuous core samples from within the sealed outer casing of the SDT45 Sonic Dual Tube Sampling System. The procedure is written for a sampling series that begins at the ground surface and utilizes 2.25-inch inner rods. Refer to Figure 4.7 for an illustration of the assembled sampler.

1. Thread the SDT45 Cutting Shoe onto the leading end of a 4.5-inch OD Sonic Casing. Completely tighten the cutting shoe. (Fig. 4.8)

2. Insert the sample sheath assembly (see Section 4.4) into the 4.5-inch OD casing.

3. Place a SDT45 Sonic Centering Drive Cap (43345) on top of the SDT45 Drive Head (32335).

4. Using the head rotation, thread GV4 Spindle into casing.

5. Raise the head to its highest position by fully extending the cylinder.

6. Position the SDT45 Sampler directly under the head with the cutting shoe centered (Fig. 4.9). The sampler should now be parallel to the derrick. Step back from the unit and visually check sampler alignment.

7. Advance the sampler unit until the head reaches the bottom of the stroke.

   NOTE: Activate the sonic head whenever collecting core samples. Vibration helps shear the core at the leading end of the sampler so that it moves into the sample sheath for increased recovery.

8. Raise the assembly a few feet to provide access to the top of the sampler.

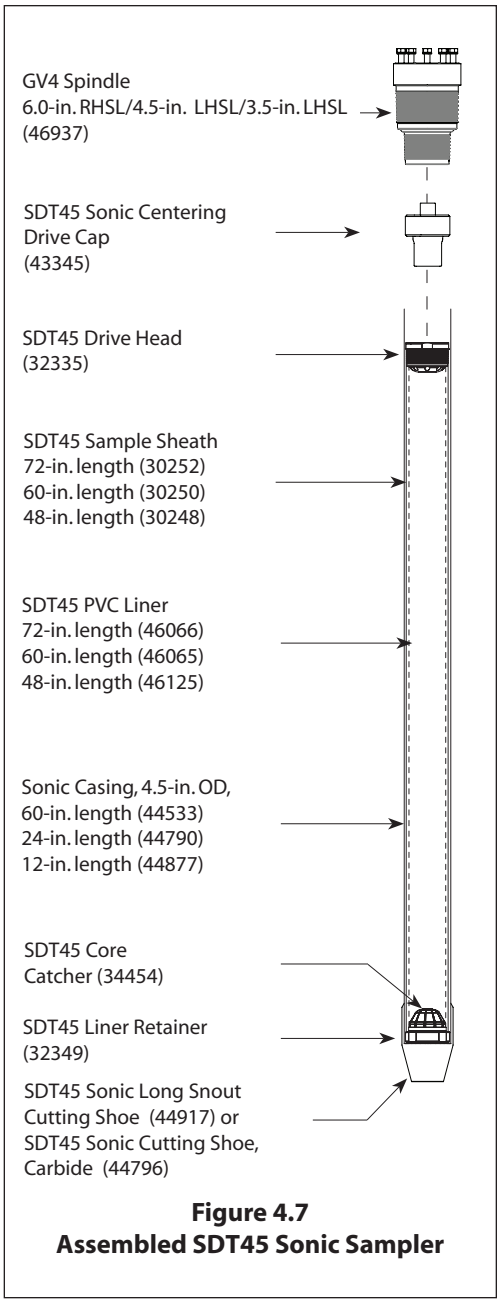


Figure 4.7
Assembled SDT45 Sonic Sampler

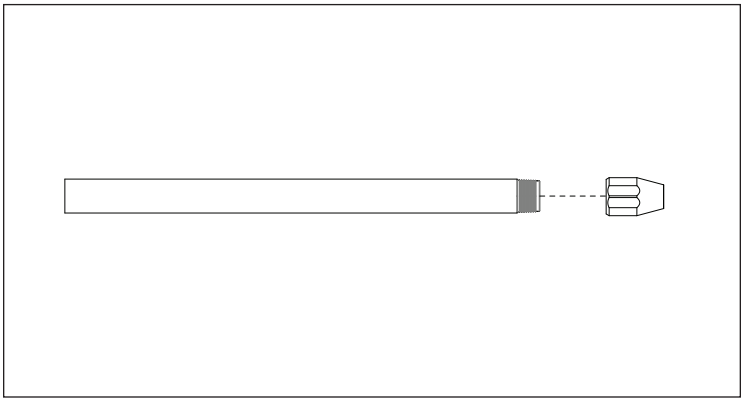


Figure 4.8. The cutting shoe is threaded onto the 4.5-inch casing.

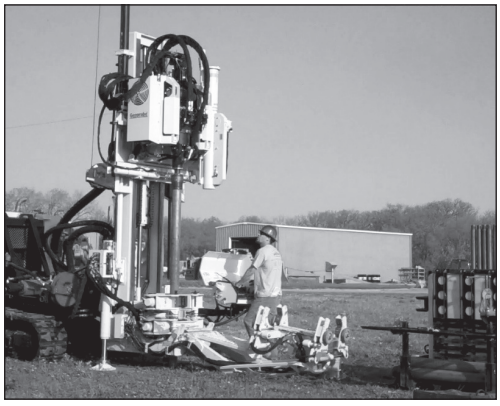


Figure 4.9. SDT45 Sampler is centered before initial advancement.

Figure 4.10. Advancing the SDT45 Sampler

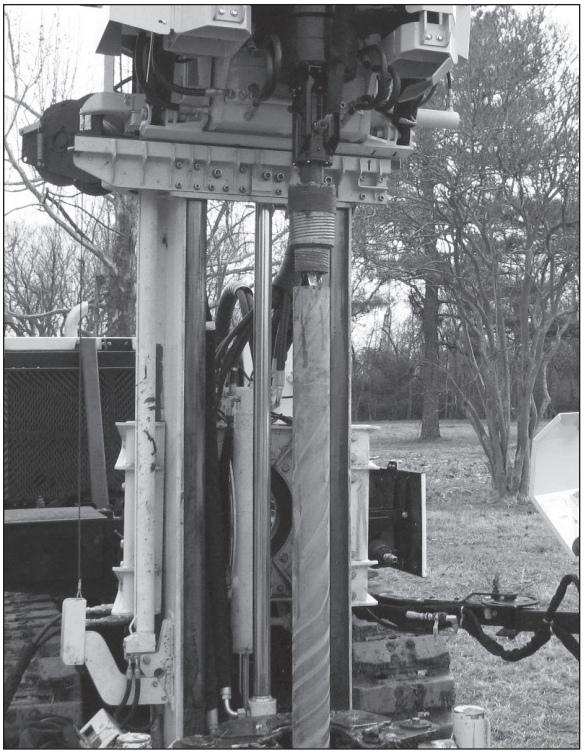


Figure 4.11. Unthread spindle to provide access to inner tool string.

Figure 4.12. Inner rods and sample sheath are retrieved.

9. Unthread the spindle and side shift the head to access. (Fig. 4.11)

10. Pull up the inner rod string along with the sample sheath (Fig. 4.12).

To sample consecutive core samples, advance a clean sample sheath and liner down the previously opened hole to the top of the next sampling interval. Add center rods as the sample sheath is lowered into the opened hole. An additional inner rod and 4.5-inch probe rod should be added. Advance the tool string the length of the sampler to collect the next core sample. Proceed to Section 4.6 for instructions on recovering the core sample from the sample sheath.

4.5 Removing Filled Liner from the Sample Sheath

Place the sample sheath into the vise. The liner retainer wrench can be used to remove the SDT45 Liner Retainer and liner from the sample sheath. If possible, the retainer can be removed by hand (Fig. 4.13). The wrench can be used to gently knock off the retainer if necessary (Fig. 4.14). With the retainer and core catcher removed, the core can be withdrawn from the sample sheath.

Figure 4.13. Remove the liner retainer with liner retainer wrench.

Figure 4.14. The wrench can be used to gently knock off the retainer.

Figure 4.15. Remove liner retainer and core catcher.

4.6 Removing a Section of Liner with a SDT45 Liner Cutter

The liner and core can be placed on the liner holder. Use the SDT45 Liner Cutter to safely expose the sample. Using both hands, smoothly pull the cutter through the liner. (Fig. 4.16) The slit liner can be removed and the core is exposed (Fig. 4.17).

Figure 4.16. Use the SDT45 Liner Cutter to safely expose the sample.

Figure 4.17. Slit liner exposing the sample.

4.7 Dual Tube Core Sampling Tips

Saturated sands are the most difficult formations to sample with the SDT45 system. Saturated conditions place positive pressure on the core outside of the outer casing. When sampling in noncohesive formations (e.g. sands) below the water table, it may be necessary to add water to the outer casing to prevent formation heave. Adding water to the rods puts a positive head on the system and may keep formation material from flowing into the rods as the liner and core sample are retracted. If a small amount of formation material is still drawn into the outer casing as the core sample is retrieved, the material may be displaced by slightly raising the outer casing while lowering the next new liner to depth. Water must be maintained within the outer casing during this process to overcome the hydraulic pressure imparted by the formation fluid. When retrieving, pull back the sample slowly.

SDT45 core catchers will help considerably with sample recovery in non-cohesive soils and other materials that do not fill the liner diameter. Core catchers are not recommended for cohesive or expansive soils as the core catchers may actually inhibit core movement into the liner. Also, using a shorter sample interval may improve sample recovery by minimizing wall friction as the material is sampled.

Certain soils have a tendency to exhibit plastic flow or extrusion characteristics. Allowing additional space for these materials will increase the speed of sampling because less time is spent cleaning overfilled sample sheaths. This will also yield a more representative sample. Using a sheath that is a foot or two longer than the sampling interval or using a shorter sample interval (while advancing) can create a buffer zone. The SDT45 Liner Spacer PVC and Spacer Head were designed for these situations.

Some clay materials will extrude during sampling. Under these conditions, using a shorter sample interval may improve sample recovery by minimizing the wall friction as the material is sampled.

It may be helpful to mark the first 2.25-inch probe rod attached to the sample sheath as an indicator that the sample sheath is next in line.

4.8 Outer Casing Retrieval

The outer casing of the SDT45 Sonic Dual Tube System may be retrieved in one of three ways:

1. Casing pulled then bore hole sealed from ground surface with granular bentonite.

2. Casing pulled with bore hole sealed from bottom-up during retrieval.

   Bottom-up grouting should be performed during casing retrieval in unstable formations where side slough is probable. Such conditions create void spaces in the bore hole if granular bentonite is installed from the ground surface.

   A Geoprobe® grout machine is used to deliver a sealing material (high-solids bentonite slurry or neat cement grout) to the bottom of the outer casing through flexible tubing. The grout mix is pumped through the tubing to seal the void remaining as the outer casing is retrieved. This is an advantage of the SDT45 Dual Tube Sonic Sampling System as other core samplers require a second set of tools to deliver grout to the bottom of the bore hole. Contact Geoprobe Systems® for more information on bottom-up grouting with the Geoprobe® grout machines.

5.0 References

Geoprobe Systems®, 2003. *Tools Catalog, V. 6.*

Geoprobe Systems®, 2005. *Standard Operating Procedure. Geoprobe@ Pneumatic Slug Test Kit. Technical Bulletin No. 19344.*

Geoprobe Systems®, 2006. *Direct Push Installation of Devices for Active Soil Gas Sampling and Monitoring. Technical Bulletin No. MK3098.*

Equipment and tool specifications, including weights, dimensions, materials, and operating specifications included in this brochure are subject to change without notice. Where specifications are critical to your application, please consult Geoprobe Systems®.

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