

## APPENDIX H

### GeoProbe Procedures

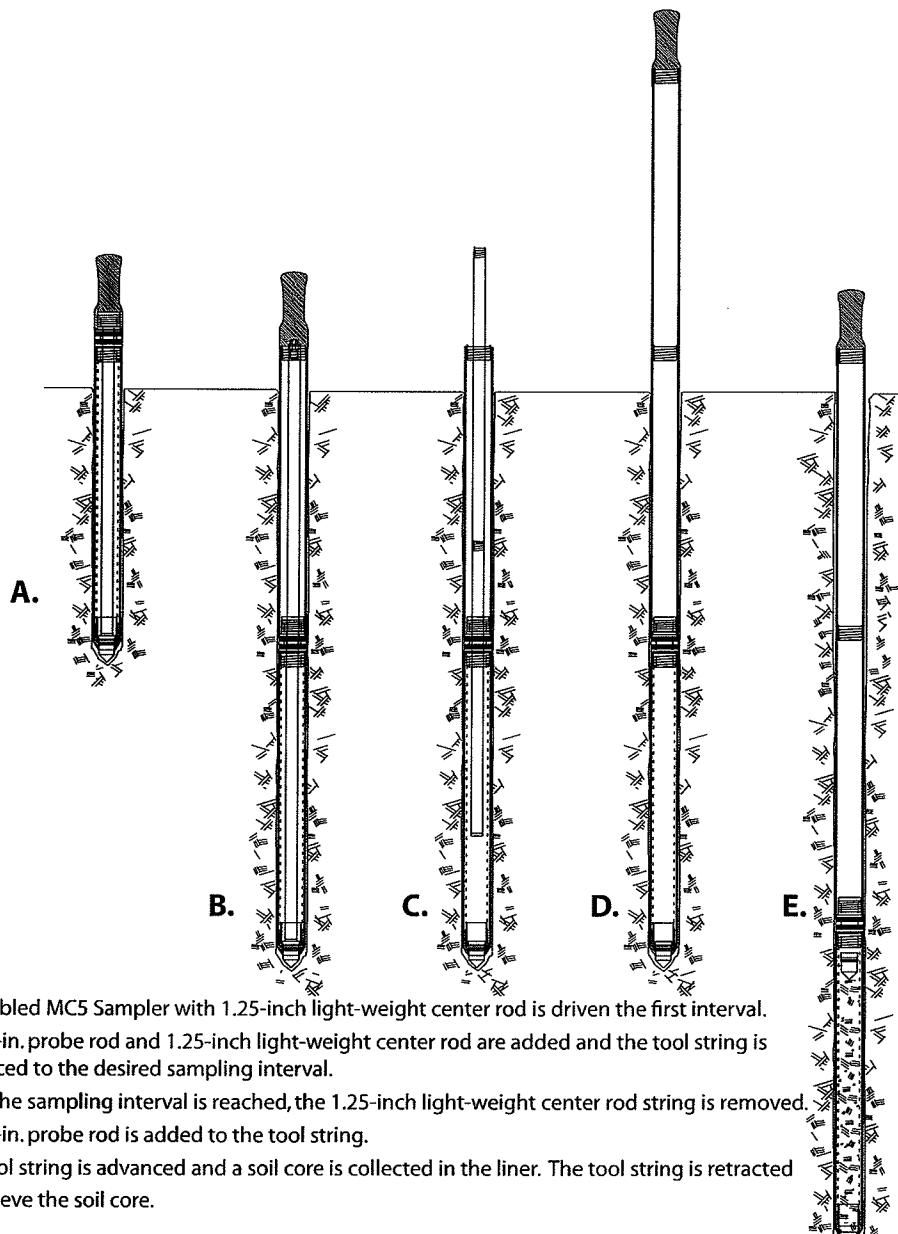
# **GEOPROBE® MACRO-CORE® MC5**

## **1.25-INCH LIGHT-WEIGHT CENTER ROD SOIL SAMPLING SYSTEM**

### **STANDARD OPERATING PROCEDURE**

**Technical Bulletin No. MK3139**

**PREPARED: January, 2011**



### **OPERATION OF THE MACRO-CORE® MC5 SOIL SAMPLING SYSTEM**



**Geoprobe® and Geoprobe Systems®, Macro-Core®, and Direct Image®  
are Registered Trademarks of Kejr, Inc., Salina, Kansas**

**Macro-Core® and Large Bore Soil Samplers  
manufactured under US Patent 5,606,139.**

**Macro-Core® Closed-Piston Drive Point  
manufactured under US Patent 5,542,481**

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## 1.0 OBJECTIVE

The objective of this procedure is to collect a representative soil sample at depth 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 both static force and percussion 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 soil core and soil gas sampling, groundwater sampling and testing, soil conductivity and contaminant logging, grouting, and materials injection.

*\*Geoprobe® and Geoprobe Systems® are registered trademarks of Kejr, Inc., Salina, Kansas.*

**Macro-Core® MC5 Soil Sampler\*\*:** A solid barrel, direct push device for collecting continuous core samples of unconsolidated materials at depth. Although other lengths are available, the standard Macro-Core® MC5 Sample Tubes come in lengths of 48 inches and 60 inches with an outside diameter of 2.25 inches. Samples are collected inside a removable liner. The Macro-Core® MC5 Sampler may be used in an open-tube or closed-point configuration.

*\*\*Macro-Core® is a registered trademarks of Kejr, Inc., Salina, Kansas.*

**Liner:** A removable/replaceable, thin-walled tube inserted inside the Macro-Core® MC5 sample tube for the purpose of containing and storing soil samples. While other lengths are available, the most common Macro-Core® MC5 Liners are 48 inches and 60 inches in length. The liner length should correspond to the length of the sample tube used. Liner materials include stainless steel, Teflon®, and PVC.

**1.25-inch Light-Weight Center Rods:** Used as the inner Rod String for Macro-Core® MC5 sampling. 1.25-inch Light-Weight Center rods come in lengths of 48 inches and 60 inches. They provide a weight reduction of up to 64% over standard 1.25-inch probe rods.

### 2.2 Discussion

In this procedure, an assembled Macro-Core® MC5 Soil Sampler is driven one sampling interval into the subsurface and retrieved using a Geoprobe® direct push machine. The collected soil core is removed from the sampler along with the used liner. After decon, the Macro-Core® sampler is reassembled using a new liner. The clean sampler is then advanced back down the same hole to collect the next soil core. The Macro-Core® Sampler may be used as an open-tube or closed-point sampler.

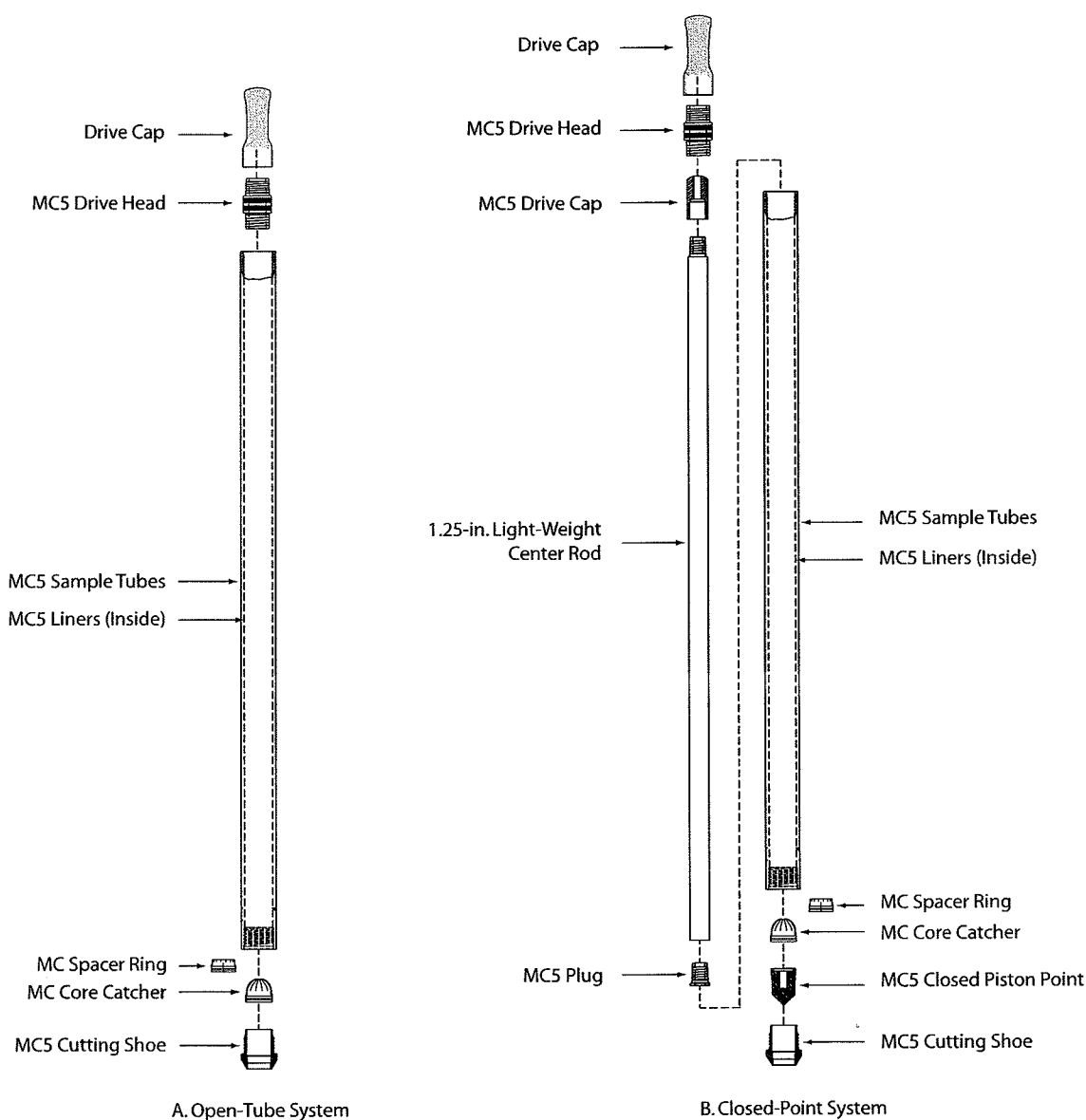
The Macro-Core® MC5 Soil Sampler is commonly used as an open-tube sampler (Fig. 2.1A). In this configuration, coring starts at the ground surface with a sampler that is open at the leading end. The sampler is driven into the subsurface and then pulled from the ground to retrieve the first soil core. In stable soils, an open-tube sampler is advanced back down the same hold to collect the next core.

In unstable soils which tend to collapse into the core hold, the Macro-Core® MC5 Sampler can be equipped with a 1.25-inch Center Rod Closed-Point assembly (Fig 2.1B). The point fits firmly into the cutting shoe and is held in place by the 1.25-inch light-weight center rods. The Macro-Core® MC5 Center Rod System prevents collapsed soil from entering the sampler as it is advanced to the bottom of an existing hole, thus ensuring collection of a representative sample. Once the 1.25-inch light weight center rod system is removed, the point

will be pushed up the liner during the next sampling interval. The point assembly is later retrieved from the sampler with the liner and soil core.

The Macro-Core® MC5 Soil Sampler is a true discrete sampler. It can be driven through undisturbed soil to a desired depth using the 1.25-inch Light Weight Center Rod System. Once the 1.25-inch light-weight center rods are removed, a representative sample is recovered from the desired depth.

Loose soils may fall from the bottom of the sampler as it is retrieved from depth. The MC Core Catcher (Fig. 3.1) alleviates this problem. Excellent results are obtained when the core catcher is used with saturated sands and other non-cohesive soils. A core catcher should not be used with tight soils as it may actually inhibit sample recovery. In that case, a MC Spacer Ring or extended shank cutting shoe can be used. Constructed of PVC, the core catcher is suitable for use with all Geoprobe® liners.



**Figure 2.1**  
**Macro-Core® MC5 Soil Sampler Configurations**

### 3.0 TOOLS AND EQUIPMENT

The following tools and equipment can be used to recover representative soil cores with the MC5 Soil Sampling System. Sample tubes, 1.25-inch light-weight center rods, probe rods, and liners all need to be of equal length in order to obtain a sample. Refer to Figure 3.1 for identification of the specified parts. Additional tooling options are available in Appendix A.

<b>MC5 Sampler Parts</b>	<b>Part Number</b>
MC5 Drive Head, 2.25 in. bored .....	28646
MC5 Drive Head, 2.125 in. bored .....	23640
MC5 Sample Tubes, 60 in.....	22992
MC5 Sample Tubes, 48 in.....	22923
MC5 Sample Tubes, 1 m.....	24239
MC5 Sample Tubes, 36 in.....	24238
MC5 Sample Tubes, 24 in.....	24237
MC5 Cutting Shoe, standard, 2.25 in. OD.....	22922
MC5 Cutting Shoe, undersized, 1.35 in. ID.....	23957
MC5 Cutting Shoe, standard, 2.25 in. OD (extended shank) .....	23978
MC5 Cutting Shoe, undersized, 1.35 in. ID (extended shank).....	28237
MC5 Cutting Shoe, undersized, 1.25 in. ID (extended shank).....	26078
MC5 Cutting Shoe, Heavy Duty, 1.35 in. ID, .....	29552
MC5 Closed Piston Point, standard.....	28113
MC5 Closed Piston Point, undersized .....	26865

<b>Center Rods (1.25 in.) and Center Rod Accessories</b>	<b>Part Number</b>
1.25-in. Center Rod, 60 in. Lightweight.....	27600
1.25-in. Center Rod, 48 in. Lightweight.....	21900
Probe Rod, 1.25 in. x 1 m.....	AT1239
Probe Rod, 1.25 in. x 36 in.....	AT1236
Probe Rod, 1.25 in. x 24 in.....	AT1224
MC5 Drive Cap, 1.25 in. Center Rod, Threadless.....	23639
MC5 Plug Threaded, 1.25 in.....	23641
1.25 in. Pull Cap.....	AT1204

<b>Probe Rods and Probe Rod Accessories</b>	<b>Part Numbers for Specific Probe Rod OD</b>	
	<b>2.25-in. OD</b>	<b>2.125-in. OD</b>
Probe Rod, 60 in.....	25301	AT2160
Probe Rod, 48 in.....	25300	AT2148
Probe Rod, 1 m.....	25352	AT2139
Probe Rod, 2.125 in. x 36 in.....		AT2136
Probe Rod, 2.125 in. x 24 in.....		13072
Drive Cap, GH60 Series, Threadless.....	31530	8397
Drive Cap, GH40 Series, Threadless.....	31405	
Drive Cap, GH40 Series, Threaded.....		AT2101
Pull Cap.....	25298	AT2104

<b>MC5 Liners, Accessories, and Miscellaneous Tools</b>	<b>Part Number</b>
MC Liners, 60 in. (66 liners).....	10074
MC Liners, 48 in. (66 liners).....	AT927K
MC Liners, 1m. (66 liners).....	AT928K
MC Liners, 36 in. (66 liners).....	AT921K
MC Liners, 24 in. (66 liners).....	AT926K
MC Core Catcher .....	AT8531
MC Spacer Ring .....	AT8532
MC Spacer Ring (Bulk Box of 500).....	AT8533K
Vinyl End Caps (Package of 66).....	AT726K
Liner Cutter .....	AT8010
Universal Liner Holder.....	22734
Rod Wiper Weldment .....	23633
Rod Wiper Doughnuts, 2.125-in and 2.25-in.....	26876
Two Pipe Wrenches	



MC5 Drive Cap, 1.25-in.  
Center Rod, Threadless  
(23639)



Light-Weight  
Center Rods, 1.25-in.  
60-in. (27600)  
48-in. (21900)

Probe Rods, 1.25-in.  
1 m. (AT1239)  
36-in. (AT1236)  
24-in. (AT1224)



MC5 Plug Threaded,  
1.25-in. (23641)

Drive Cap, GH40  
Threadless, 2.25-in.  
(31405)



Drive Cap, GH40  
Threaded, 2.125-in.  
(AT2101)



MC5 Drive Head  
2.25-in. (28646)  
2.125-in. (23640)



MC Core Catcher  
(AT8531)



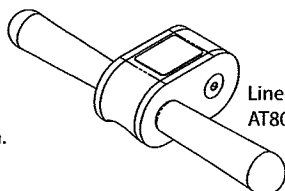
MC5 Closed Piston Point,  
Standard  
(28113)



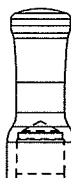
MC5 Cutting Shoe,  
Standard, 1.5-in. ID  
(22922)



MC5 Cutting Shoe,  
Heavy Duty, 1.35-in. ID  
(29552)



Liner Cutter  
AT8010



Drive Cap, GH60  
Threadless, 2.25-in.  
(31530)



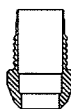
MC Spacer Ring  
(AT8532)



MC5 Closed Piston Point,  
Undersized  
(26865)



MC5 Cutting Shoe,  
Standard, Extended Shank,  
1.5-in. ID  
(23978)



MC5 Cutting Shoe,  
undersized, Extended Shank,  
1.35-in. ID  
(28237)



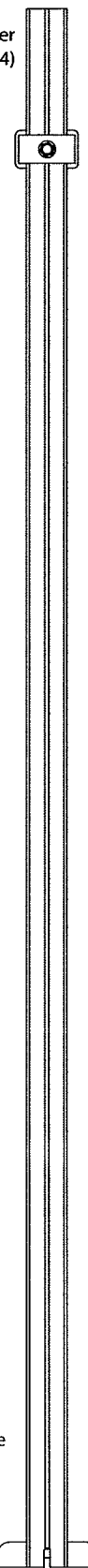
MC5 Cutting Shoe,  
Undersized, Extended  
Shank, 1.25-in. ID  
(26078)

Universal Liner Holder  
(22734)

MC Liners  
60-in. (10074)  
48-in. (AT927K)  
1 m. (AT928K)  
36-in. (AT921K)  
24-in. (AT926K)



MC5 Sample Tube  
60-in. (22992)  
48-in. (22923)  
1 m. (24239)  
36-in. (24238)  
24-in. (24237)



**Figure 3.1**  
**Macro-Core® MC5 Soil Sampler Parts**

### 3.1 Tool Options

Five major components of the MC5 Soil Sampling System are sample tubes, probe rods, 1.25-inch light-weight center rods, sample liners, and cutting shoes. These items are manufactured in a variety of sizes to fit the specific needs of the operator. This section identifies the specific tool options available for use with the MC5 Soil Sampling System.

#### **Sample Tubes**

MC5 Sample tubes come in lengths of 60 inches (1524 mm), 48 inches (1219 mm), 1 meter, 36 inches (914 mm), and 24 inches (610 mm).

#### **Probe Rods**

Standard Geoprobe® 2.125-inch and 2.25-inch OD probe rods are required to operate the MC5 Soil Sampling System. The specific length of rods may be selected by the operator. The most common rod lengths used in MC5 Soil Sampling are the 60-inch and 48-inch rods.

#### **1.25-inch Light-Weight Center Rods**

1.25-inch Light-Weight Center Rods (1.25-inch / 32-mm OD) are recommended for the inner rod string of the MC5 system when utilizing an outer casing of 48- or 60-inch long rods. Choose the light-weight rod length that matches the length of rods used for the outer casing (48-inch light-weight rods with 48-inch outer casing, etc.). Currently, standard Geoprobe® 1.25-inch probe rods must be used with 24-inch, 36-inch, and 1-meter MC5 Sample Tubes.

A weight reduction of up to 64% is provided by the 1.25-inch Light-Weight Center Rods over standard 1.25-inch probe rods. As a result, considerably less energy is expended when retrieving the 1.25-inch Light-Weight Center Rods from within the outer casing during operation of the MC5 System.

#### **Sample Liners**

Sample liners are made of heavy-duty clear plastic for convenient inspection of the soil sample. Nominal lengths of 24 inches, 36 inches, 1 meter, 48 inches, and 60 inches are available. Choose the liner length corresponding to the length of the sample tube used (e.g. 60-inch liners with 60-inch sample tubes).

#### **Cutting Shoes**

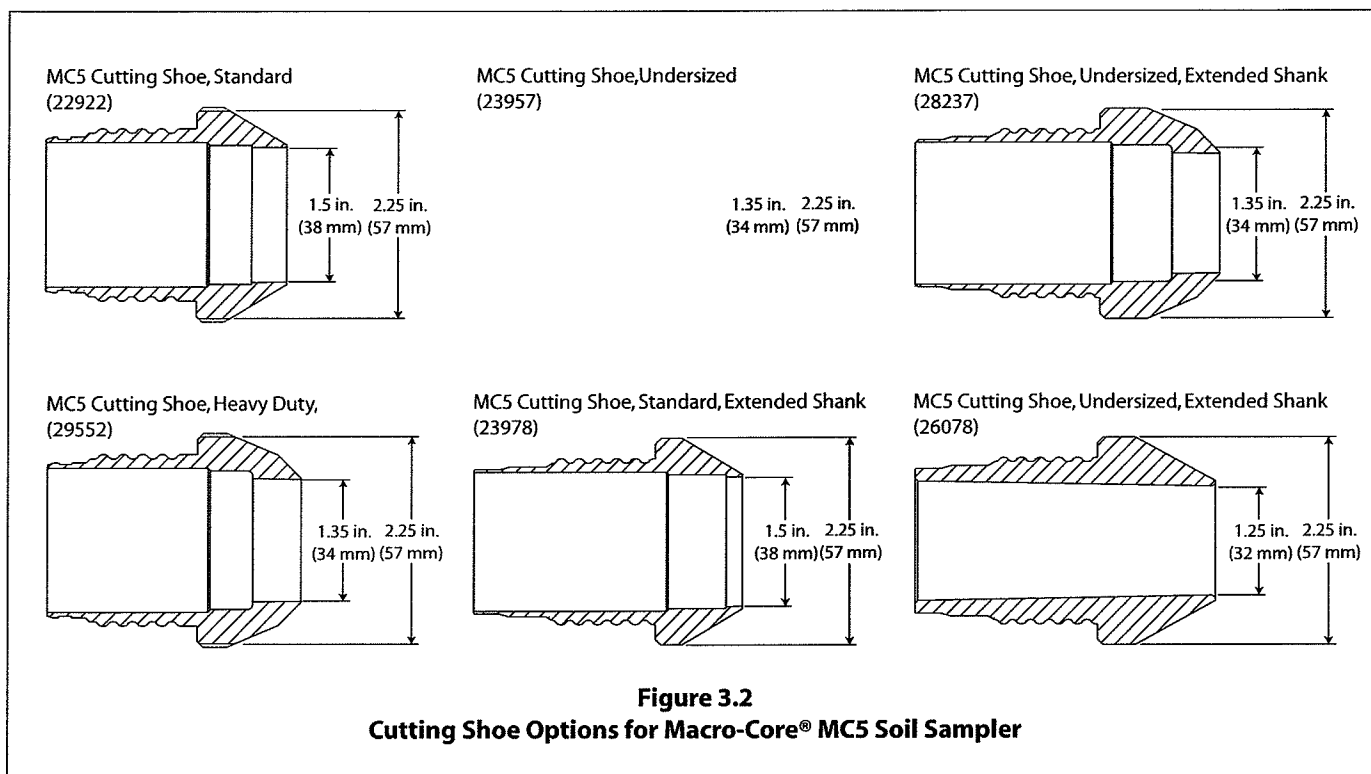
Six cutting shoes are available for use with the MC5 Soil Sampling System (Fig.3.2). The extended shank cutting shoes (23978, 28237, and 26078) fit inside the sample liner and help soil pass freely into the liner. The other three cutting shoes (22922, 23957, 29552) require an MC Core Catcher (AT8531) or MC Spacer Ring (AT8532) in order to properly connect to the sample liners.

The most prominently used cutting shoes are the two “standard” cutting shoes (22922 and 23978). These cutting shoes collect a 1.5-inch (38-mm) diameter soil core.

Undersized cuttings shoes (23957, 28237, and 29552) collect a smaller 1.35-inch (34-mm) soil core and are used in formations with plastic clays or other soil types that lead to overfilling of the sampler liner. Of these, the 29552 and 28237 cutting shoes are also thicker at the leading end for increased durability in harsh conditions where cobbles or large gravel are present.

Soil formations with highly plastic clays may call for an even smaller soil core. In these conditions, a 26078 cutting shoe with its 1.25-inch (32-mm) soil core is most effective.





## 4.0 OPERATION

All parts shown in illustrations are those most commonly used configuration for the MC5 Sampling System. Refer to Section 3.0 for part numbers and additional tooling options.

### 4.1 Decontamination

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

Cleaning inside the probe rods and MC5 sample tubes is accomplished with the nylon brushes and extension rods listed in Appendix A. Thread a nylon brush and handle onto an extension rod of suitable length. Using clean water and phosphate-free soap, cycle the brush inside the probe rod or sample tube to remove contaminants. Rinse with clean water and allow to air dry.

### 4.2 Field Blank

It is suggested that a field blank be taken on a representative sample liner prior to starting a project and at regular intervals during extended projects. Liners can become contaminated in storage. A field blank will prove that the liners do not carry contaminants which can be transferred to soil samples. The following information is offered as an example method which may be used to take a field blank. Make the appropriate modifications for the specific analytes of interest to the investigation.

#### *Example Procedure Required Equipment*

MC Liner .....	(1)	Distilled Water .....	(100 ml)
MC Vinyl End Caps .....	(2)	VOA Vial (or other appropriate sample container) .....	(1)

1. Place a vinyl end cap on one end of the liner.
2. Pour 100 milliliters of distilled water (or other suitable extracting fluid) into the liner.
3. Place a vinyl end cap on the open end of the liner.
4. From the vertical position, repeatedly invert the liner so that the distilled water contacts the entire inner surface. Repeat this step for one minute.
5. Remove one end cap from the liner, empty contents into an appropriate sample container, and cap the container.
6. Perform analysis on the extract water for the analytes of interest to the investigation.

### 4.3 Open-Tube Sampler Assembly

#### 1a. Using the MC Core Catcher

Place the open end of an MC Core Catcher over the threaded end of an MC5 Cutting Shoe (22992, 23957, 29552) as shown in Figure 4.2. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe. The core catcher should be used in loose soils, especially saturated sands (non-cohesive soils). Use of the core catcher is not necessary in tough, cohesive soils or tight clays, and may interfere with sampling especially in soft clays. The "fingers" of the core catcher flex outward to let soil move into the liner while sampling.

#### 1b. Using the MC Spacer Ring



Figure 4.1. The spacer ring fits securely onto the MC5 Cutting Shoe.

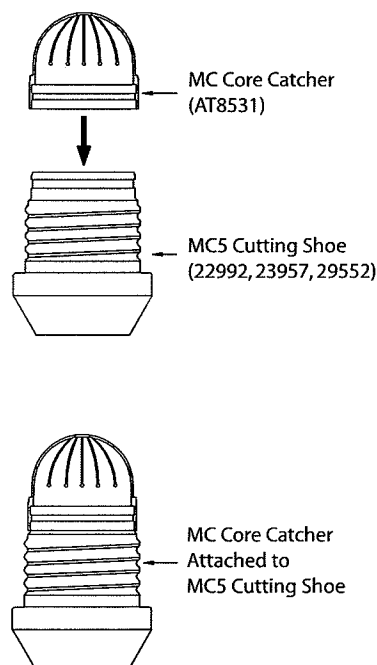


Figure 4.2  
Core Catcher Attachment

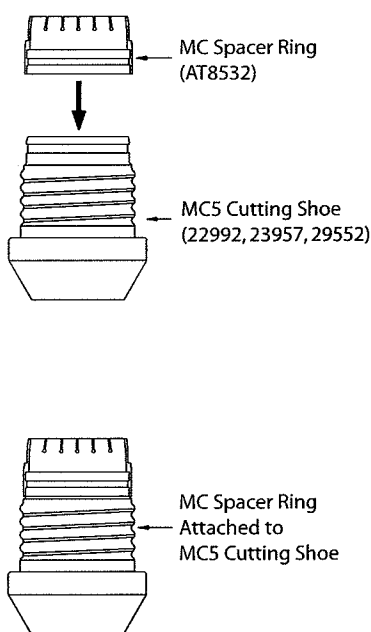


Figure 4.3  
Spacer Ring Attachment

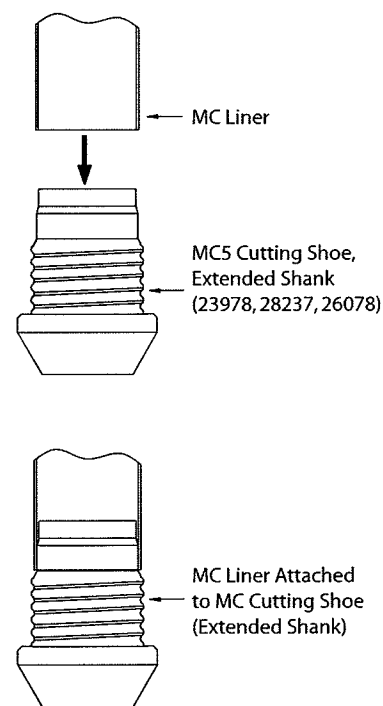


Figure 4.4  
Liner Attachment on  
Extended Shank

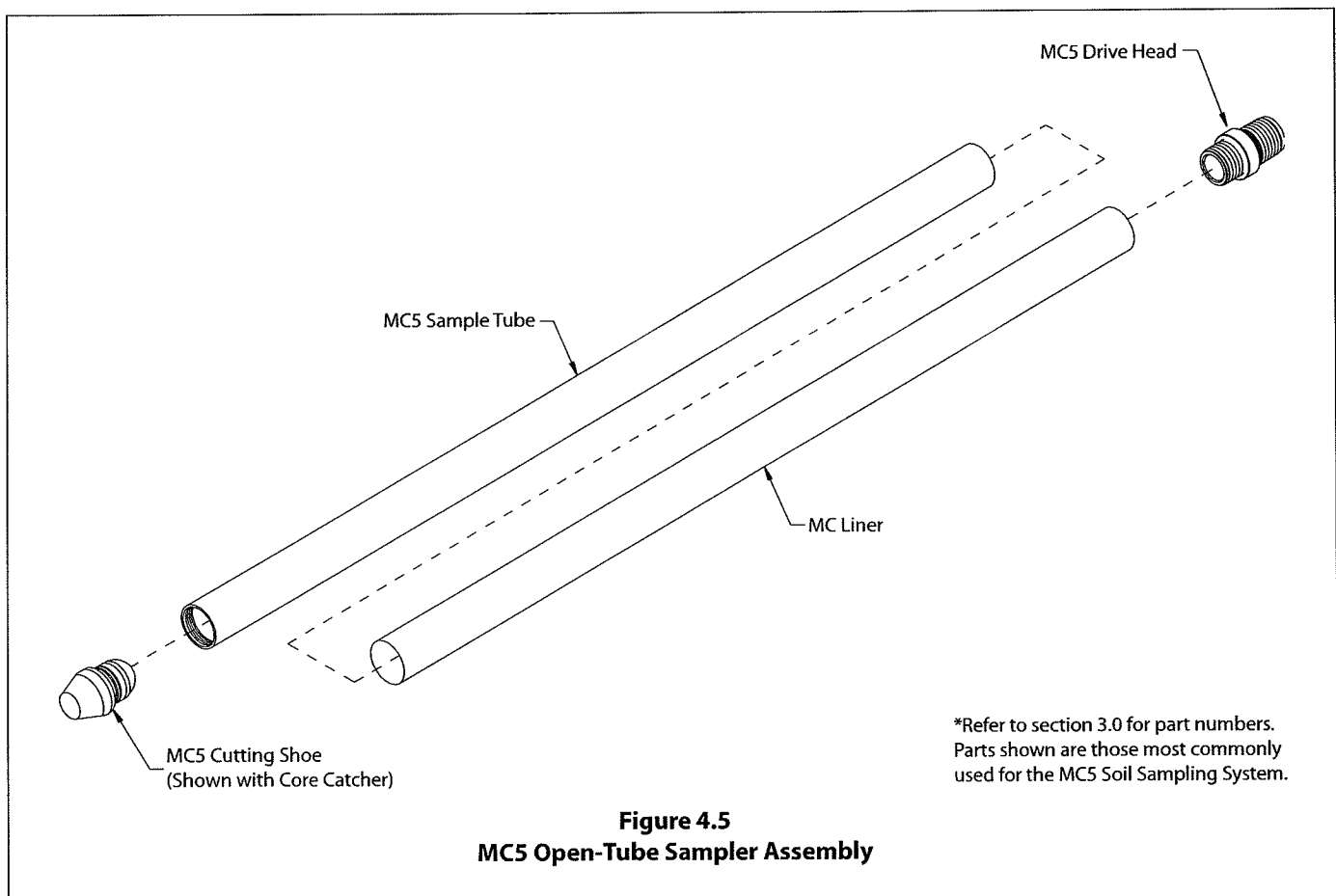
Push the base of an MC Spacer Ring onto the threaded end of an MC5 Cutting Shoe (22992, 23957, 29552) until it snaps into the machined groove on the cutting shoe (Fig. 4.1 and Fig. 4.3). Spacer rings should be used when sampling cohesive soils. It allows soil to pass freely over the junction between the liner and cutting shoe.

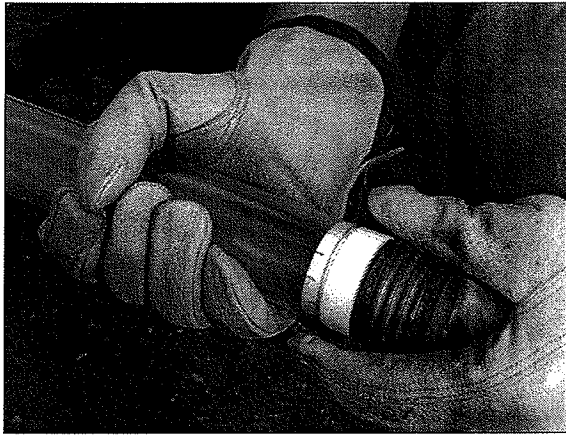
#### 1c. Using the Extended Shank Cutting Shoe

The cutting shoes with extended shanks (23978, 28237, 26078) do not use core catchers or spacer rings. MC5 Liners should securely slide onto the end of these cutting shoes (Fig. 4.4). The extended shank cutting shoes should only be used when sampling cohesive soils. When sampling loose soils, especially saturated sands (non-cohesive soils), a cutting shoe with an MC Core Catcher is recommended.

2. Place either end of the liner onto the spacer ring or core catcher (Fig. 4.6). If you are using a cutting shoe with an extended shank, do not use a spacer ring or core catcher (Fig. 4.7). The liner should fit securely onto the spacer ring, core catcher, or cutting shoe.
3. Slide whole assembly into either end of the sample tube (Fig. 4.8). Thread the cutting shoe onto the sample tube (Fig. 4.9). If the thread is clean, it should easily thread on by hand. In some cases, a wrench may be necessary for tightening. There shouldn't be a gap between the cutting shoe and sample tube.
4. Thread an MC5 Drive Head into the top of the sample tube (Fig. 4.10). Securely tighten the drive head by hand. Ensure that the end of the sample tube contacts the machined shoulder of the drive head.

#### Sampler Assembly is Complete

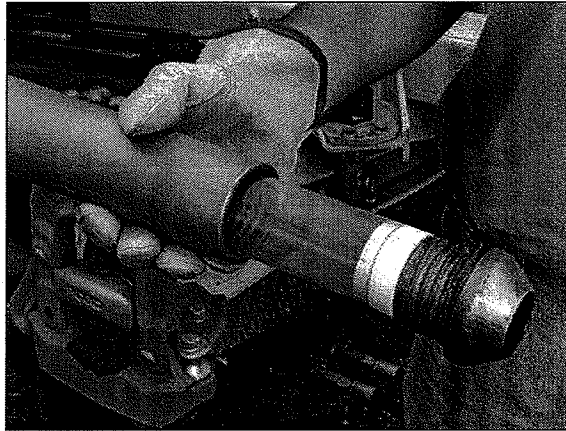




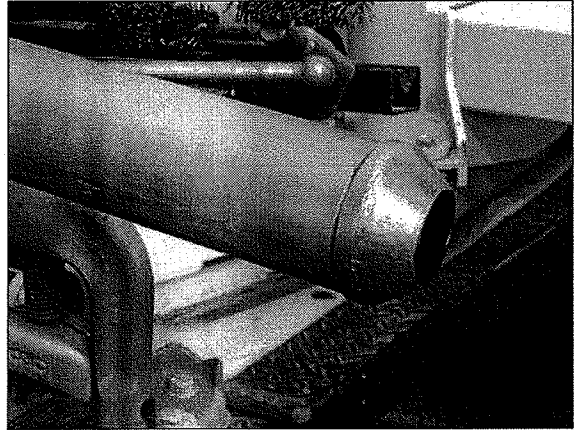
**Figure 4.6.** Place either end of the liner onto the spacer ring or core catcher. The liner should fit securely.



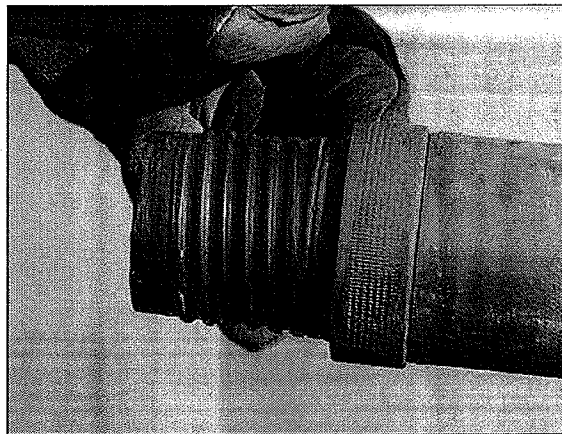
**Figure 4.7.** Place either end of the liner onto the extended shank cutting shoe. (This is used in place of a spacer ring or core catcher)



**Figure 4.8.** Slide whole assembly into either end of the sample tube.



**Figure 4.9.** Thread the cutting shoe onto the sample tube.



**Figure 4.10.** Thread the MC5 Drive Head onto the opposite end of the sample tube. Tighten by hand.

#### 4.4 MC5 Closed-Point Sampler Assembly

The Macro-Core® 1.25-inch Light-Weight Center Rod Sampling System seals the leading end of the sampler with a point (Fig. 4.11) assembly that is held in place with a 1.25-inch light weight center rod. Once advanced to the top of the sampling interval, the 1.25-inch Light-Weight Center Rods are removed from the probe rod string.

1. Install an O-ring in the machined groove on the piston rod point (Fig. 4.12).
2. Push the MC5 Closed Piston Point (28113 or 26865) completely into the cutting shoe as shown in Figure 4.12. Note that the standard point (28113) is used with 1.5-inch (38-mm) ID cutting shoes and the undersized point (26865) is for cutting shoes with a 1.35-inch (34-mm) ID.

##### 3a. Using the MC Core Catcher

Place the open end of an MC Core Catcher over the threaded end of an MC5 Cutting Shoe (22992, 23957, 29552) as shown in Figure 4.13. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe. The core catcher should be used in loose soils, especially saturated sands (non-cohesive soils). Use of the core catcher is not necessary in tough, cohesive soils or tight clays, and may interfere with sampling especially in soft clays. The “fingers” of the core catcher flex outward to let soil move into the liner while sampling.



Figure 4.11. The MC5 Closed Piston Point slides into the cutting shoe.

##### 3b. Using the MC Spacer Ring

Push the base of an MC Spacer Ring onto the threaded end of an MC5 Cutting Shoe (22992, 23957, 29552) until it snaps into the machined groove on the cutting shoe (Fig. 4.14). Spacer rings should be used when sampling cohesive soils. It allows soil to pass freely over the junction between the liner and cutting shoe.

##### 3c. Using the Extended Shank Cutting Shoe

The cutting shoes with extended shanks (23978, 28237) do not use core catchers or spacer rings. MC5 Liners should securely slide onto the end of these cutting shoes (Fig. 4.15). The extended shank cutting shoes should only be used when sampling cohesive soils. When sampling loose soils, especially saturated sands (non-cohesive soils), a cutting shoe with an MC Core Catcher is recommended.

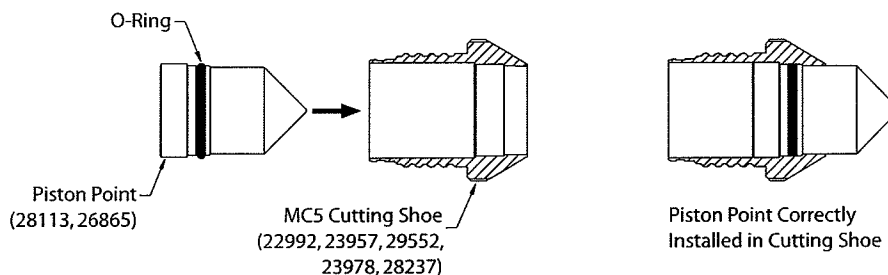
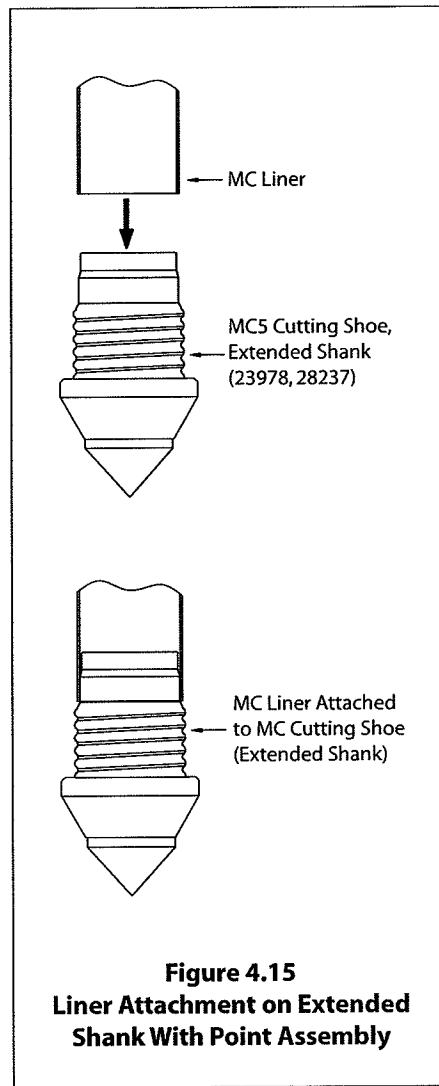
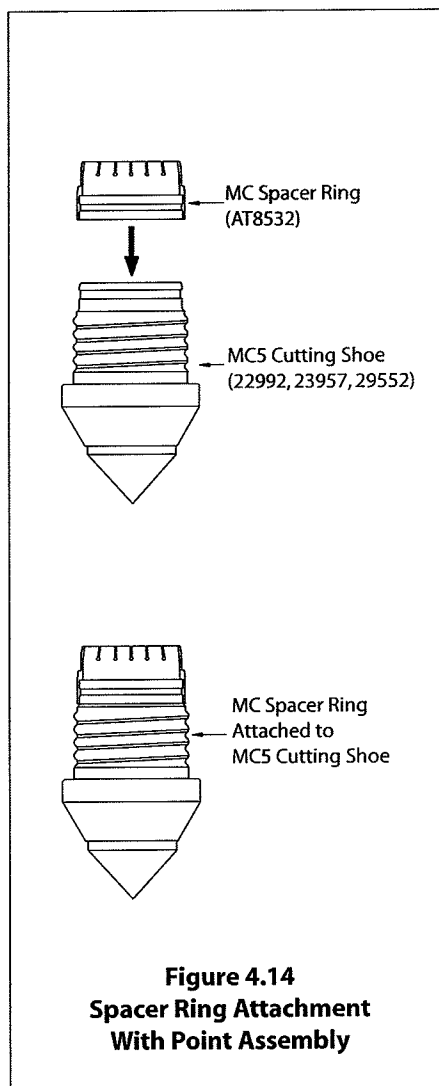
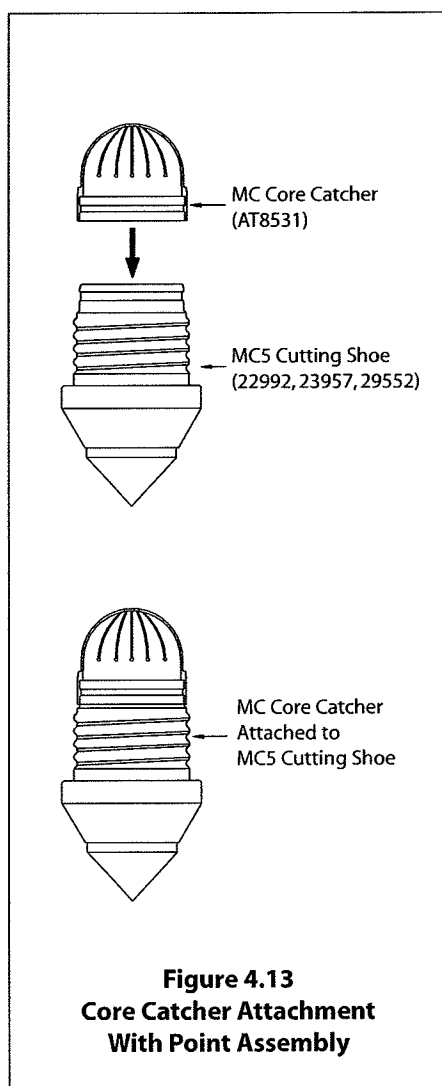


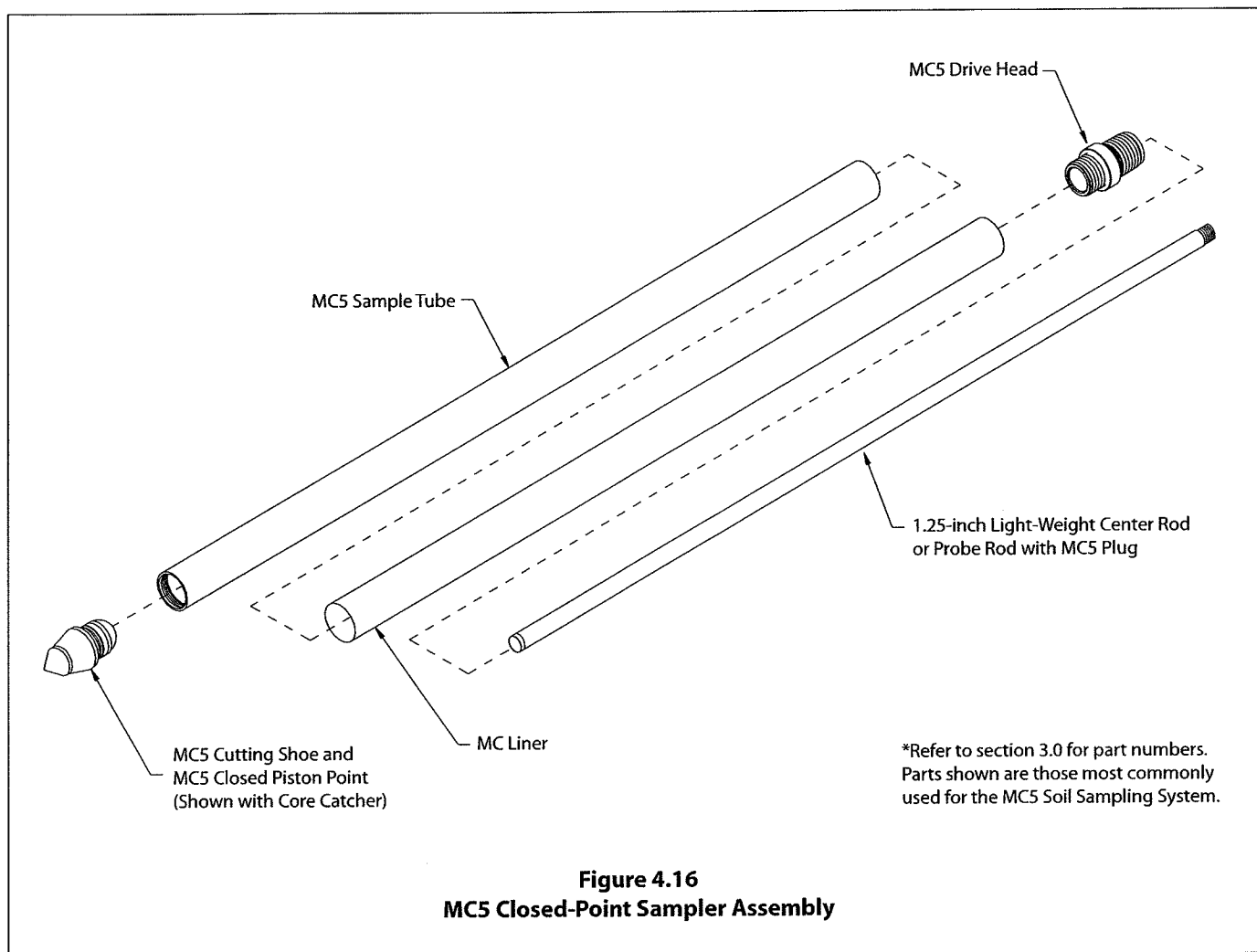
Figure 4.12  
Installation of MC5 Closed Piston Point Assembly in MC5 Cutting Shoe



**Refer to Figure 4.16 for MC5 Closed-Point Sampler Assembly**

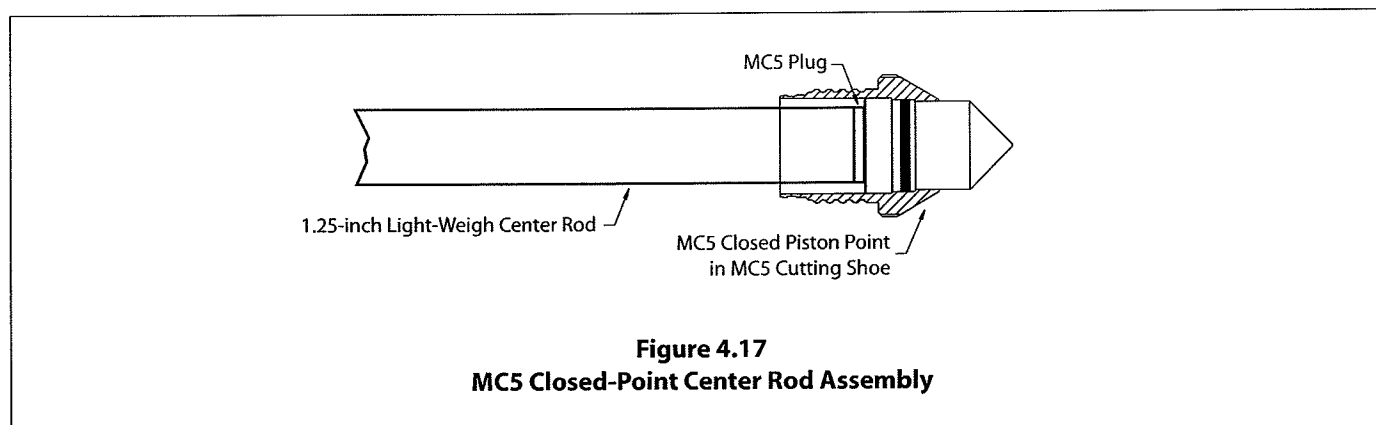
4. Place either end of the liner onto the spacer ring or core catcher (Fig. 4.18). If you are using a cutting shoe with an extended shank, do not use a spacer ring or core catcher (Fig. 4.19). The liner should fit securely onto the spacer ring, core catcher, or cutting shoe.
5. Slide whole assembly into either end of the sample tube (Fig. 4.20). Thread the cutting shoe onto the sample tube (Fig. 4.21). If the thread is clean, it should easily thread on by hand. In some cases, a wrench may be necessary for tightening. There shouldn't be a gap between the cutting shoe and sample tube.
6. Thread an MC5 Drive Head into the top of the sample tube. Securely tighten the drive head by hand. Ensure that the end of the sample tube contacts the machined shoulder of the drive head (Refer to Figure 4.10).

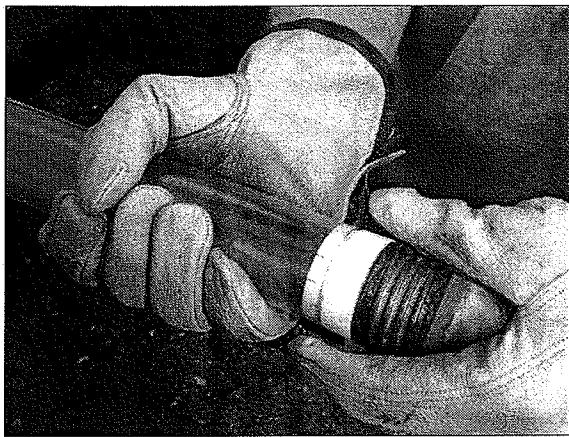
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7. Thread an MC5 Plug (23641) onto 1.25-inch light-weight center rod (Fig.4.22). Note that light-weight center rods are only available in 48-inch and 60-inch lengths. Utilize 1.25-inch probe rods if other lengths are required.
8. Insert the light-weight center rod and MC5 Plug into sample tube assembly (Fig.4.23), sending the plug end in first. Allow it to come in contact with the top of the Piston Point (Fig. 4.17).

#### **Sampler Assembly is Complete**

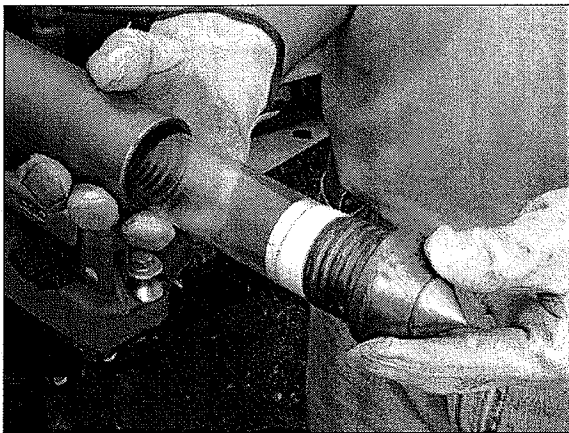




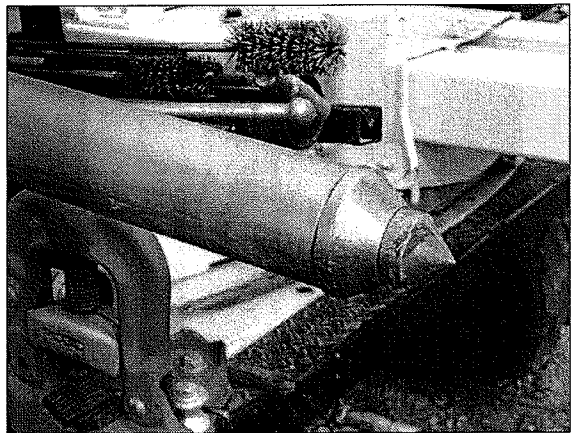
**Figure 4.18.** Place either end of the liner onto the spacer ring or core catcher. The liner should fit securely.



**Figure 4.19.** Place either end of the liner onto the extended shank cutting shoe. (This is used in place of a spacer ring or core catcher)



**Figure 4.20.** Slide whole assembly into either end of the sample tube.



**Figure 4.21.** Thread the cutting shoe and point onto the sample tube.



**Figure 4.22.** The MC5 Plug is threaded onto the end of the 1.25-inch light-weight center rod.



**Figure 4.23.** The MC5 Plug and a 1.25-inch light-weight center rod are inserted into the sample tube.



## 4.7 Open-Tube Sampling

The MC5 Open-Tube Sampler is used to gather continuous soil cores beginning from ground surface. A representative soil sample is obtained by driving the assembled sampler one sampling interval into the subsurface through undisturbed soil. Upon retrieving the sampler, the liner and soil core are removed. The sampler is then properly decontaminated, reassembled with a new liner, and inserted back down the same hole to collect the next soil core.

Instructions for operating the MC5 Open-Tube Sampler are given in this section.

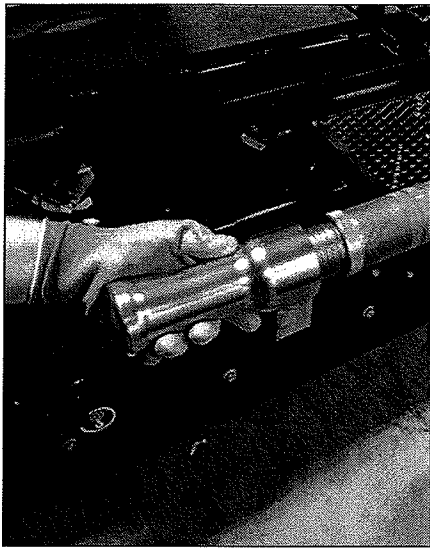
1. Place a drive cap onto the drive head (Fig. 4.24) of an assembled Open-Tube Sampler (Refer to Section 4.3 for sampler assembly).
2. Raise the probe unit hammer assembly to its highest position by fully extending the probe cylinder.
3. Position the MC5 Sampler directly under the hammer with the cutting shoe centered between the toes of the probe foot. The sampler should now be parallel to the probe derrick. Step back from the unit and visually check sampler alignment (Fig. 4.25).
4. Apply static weight and hammer percussion to advance the sampler until the drive head reaches the ground surface. (Fig. 4.27A)

**NOTE: Activate hammer percussion whenever collecting soil. Percussion helps shear the soil at the leading end of the sampler so that it moves into the sample tube for increased recovery.**

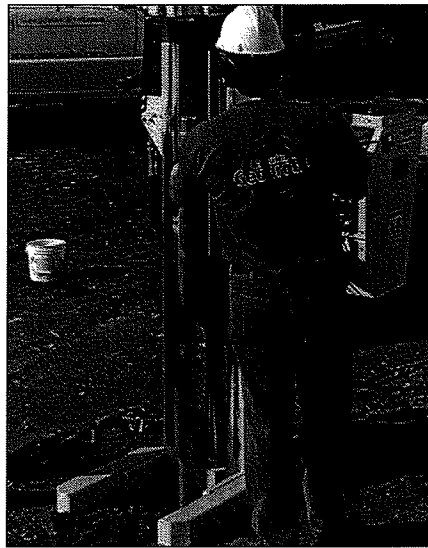
5. Raise the hammer assembly a few inches to provide access to the top of the sampler.
6. Remove the drive cap and thread a pull cap onto the sampler drive head (Fig. 4.26).
7. Lower the hammer assembly and hook the hammer latch over the pull cap. Raise the hammer assembly to pull the sampler completely out of the ground. If a winch is available, it can be used with a pull plate to retract the tool string. A Rod Grip Pull Handle can also be used to retract the tool string.
8. Proceed to Section 4.9 for instructions on recovering the soil core from the MC5 Sampler.

To sample consecutive soil cores, advance a clean sampler down the previously opened hole (Fig. 4.27B) to the top of the next sampling interval (Fig. 4.27C). Drive the tool string the length of the sampler to collect the next soil core (Fig. 4.27D). Switch to an MC5 Center Rod Sampler if excessive side slough is encountered.

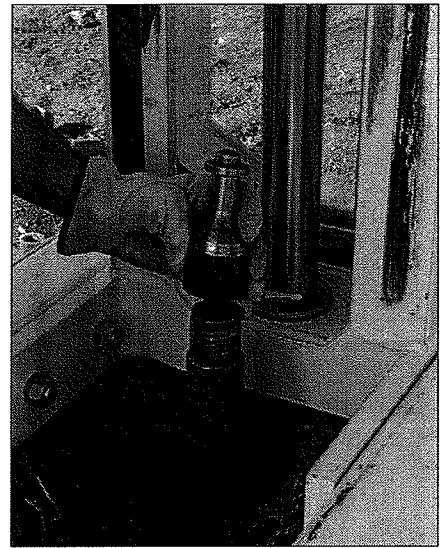
**NOTE: Use caution when advancing or retrieving the sampler within an open hole. Low side friction may allow the sampler and probe rods to drop down the hole when released. To prevent equipment loss, hold onto the tool string with a pipe wrench when needed.**



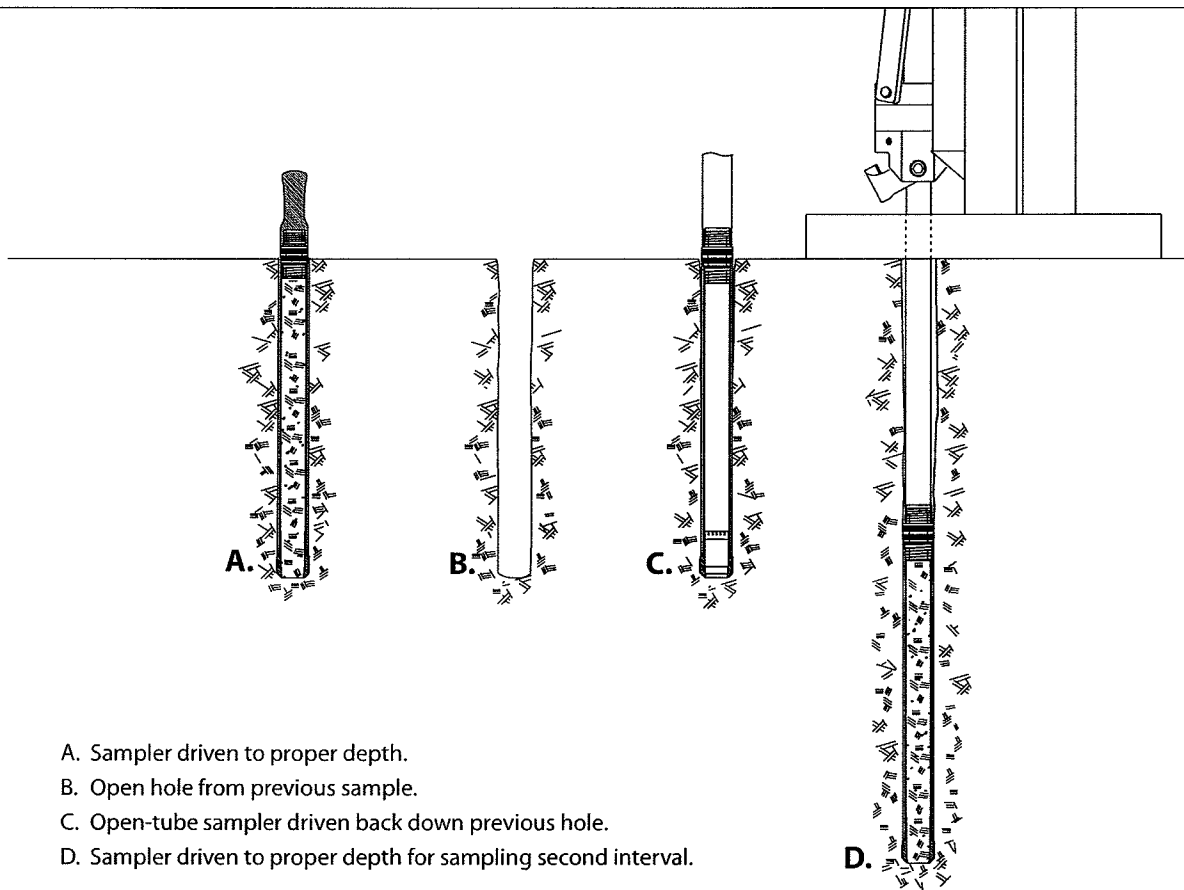
**Figure 4.24.** Place drive cap onto sampler drive head.



**Figure 4.25.** The sampler should be parallel to the probe derrick for driving.



**Figure 4.26.** The pull cap is one way to remove the sampler from the ground.



**Figure 4.27**  
**Phases of MC5 Open-Tube Soil Sampling**

## 4.8 Closed-Point Sampling with the MC5 Center Rod System

Material collapsing from the probe hole sidewall can make it difficult to collect representative soil cores from significant depths with an open-tube sampler. To overcome this problem, the MC5 Sampler can be equipped with a center rod assembly that will hold the piston point in place. This allows the sealed sampler to pass through the slough material and then it can be opened at the appropriate sampling interval.

Instructions for operating the MC5 Closed-Point Sampler are given in this section.

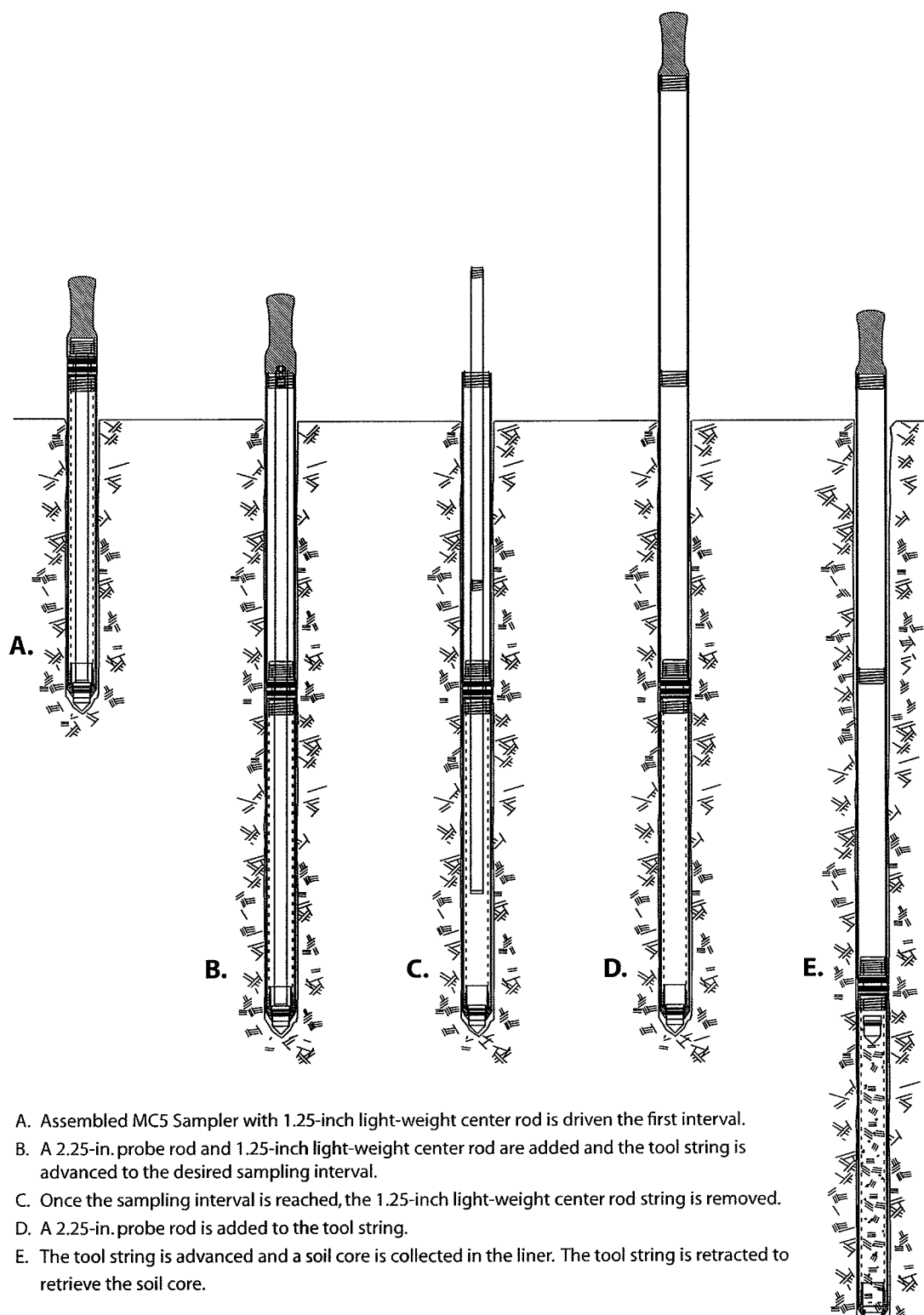
1. Place a drive cap onto the center rod and a drive cap onto the drive head of an assembled Closed-Point Sampler (Refer to Section 4.4 for sampler assembly).
2. Raise the probe unit hammer assembly to its highest position by fully extending the probe cylinder.
3. Position the MC5 Sampler directly under the hammer with the cutting shoe centered between the toes of the probe foot. The sampler should now be parallel to the probe derrick. Step back from the unit and visually check sampler alignment (Fig. 4.25).
4. Apply static weight and hammer percussion to advance the sampler until the drive head reaches the ground surface (Fig. 4.28A).
5. Add additional probe rods and 1.25-inch light-weight center rods to the tool string until the desired sampling interval is reached (Fig. 4.28B).
6. Once the sampling interval is reached, remove the center rod string (Fig. 4.28C).
7. Add an additional probe rod to the string and place a drive cap on the probe rod (Fig. 4.28D).
8. Advance the tool string to collect the soil core in the liner (Fig. 4.28E).

**NOTE: Activate hammer percussion whenever collecting soil. Percussion helps shear the soil at the leading end of the sampler so that it moves into the sample tube for increased recovery.**

9. Lower the hammer assembly and hook the hammer latch over the pull cap. Raise the hammer assembly to pull the first probe rod out of the ground. Remove the rod and place the pull cap on the next rod of the tool string. Continue pulling probe rods until the MC5 Sampler is brought to the ground surface. If a winch is available, it can be used with a pull plate to retract the tool string. An RG Handle is another option to retract the tool string.

**NOTE: Use caution when advancing or retrieving the sampler within an open hole. Low side friction may allow the sampler and probe rods to drop down the hole when released. To prevent equipment loss, hold onto the tool string with a pipe wrench when needed.**

10. Proceed to Section 4.9 for instructions on recovering the soil core from the MC5 Sampler.



**Figure 4.28**  
**Phases of MC5 Closed-Point Center Rod System**

## 4.9 Soil Core Recovery

The soil sample is easily removed from the MC5 Sampler by unthreading the cutting shoe and pulling out the liner (Fig. 4.29). A few sharp taps on the cutting shoe with a pipe wrench will often loosen the threads sufficiently to allow removal by hand. If needed, the exterior of the cutting shoe features wrench flats for attaching a wrench to loosen tight threads. With the cutting shoe removed, simply pull the liner and soil core from the sample tube (Fig. 4.31). A Hydraulic Liner Extruder is also available for mounting on your machine to remove liners (Fig. 4.30).

If the closed-point sampler is used, the piston point is now retrieved from the end of the liner (Fig. 4.32). Secure the soil sampler by placing a vinyl end cap on each end of the liner.

Undisturbed soil samples can be obtained from liners by splitting the liner. The MC Liner (AT8010) is used to make longitudinal cuts along the liner (Fig. 4.33).



Figure 4.29. Remove the MC5 Cutting Shoe and liner from the MC5 Sampler Tube.



Figure 4.30. The Hydraulic Liner Extruder helps remove the liner.



Figure 4.31. MC5 Liner filled with soil core.

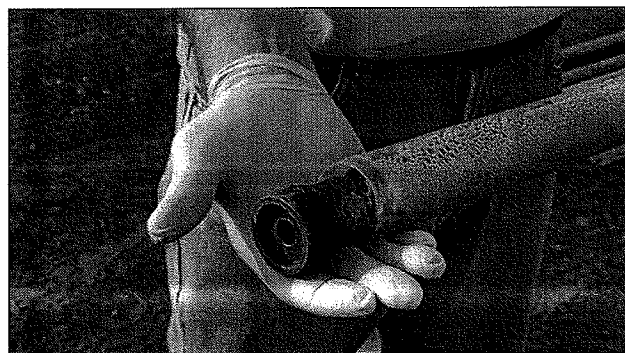


Figure 4.32. MC5 Closed Piston Point is retrieved from the top of the liner.



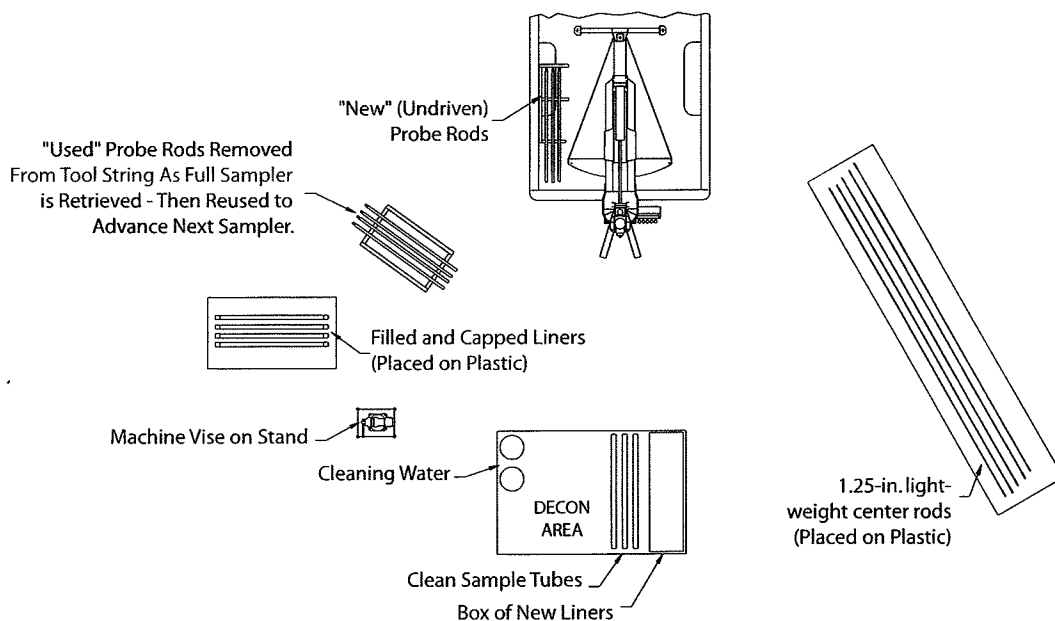
Figure 4.33. MC Liner Cutter makes two longitudinal cuts in PVC Liners.

#### 4.10 Tips to Maximize Sampling Productivity

The following suggestions are based on the collective experiences of Geoprobe® operators:

1. Organize your truck or van. Assign storage areas to all tools and equipment for easy location. Transport sample tubes, probe rods, 1.25-inch light-weight center rods, and liners in racks. Above all, minimize the number of items lying loose in the back of your vehicle.
2. Take three or four samplers to the field. This allows the collection of several samples before stopping to clean and decontaminate the equipment. A system is sometimes used where one individual operates the probe while another marks the soil cores and decontaminates the used samplers.
3. A machine vise is recommended. With the sampler held in a vise, the operator has both hands free to remove the cutting shoe, drive head, and sample liner. Cleanup is also easier with both hands free. Geoprobe® offers an optional machine vise (FA300).
4. Organize your worksite. Practice with the sampler to identify a comfortable setup and then use the layout whenever sampling. A collapsible table or stand is handy to hold decontaminated sampler tubes and liners. Equipment may also be protected from contamination by placing it on a sheet of plastic on the ground.

Instead of counting probe rods for each trip in-and-out of the probe hole, identify separate locations for "new" rods and "used" rods. Collect the first sample from the open hole using "new" rods. As each probe rod is removed during sampler retrieval, place it in the "used" rod location. Now advance a clean sampler back down the same hole using all of the rods from the "used" location. Add one "new" rod to the string and then drive the tools to collect the next soil core. Once again, remove each probe rod and place it in the "used" rod location as the sampler is retrieved. Repeat this cycle using all the "used" rods to reach the bottom of the probe hole, and one "new" rod to fill the sampler.



**Figure 4.36**  
**Equipment Layout Example to Maximize Sampling Productivity**

5. Cleanup is very important from the standpoint of operation as well as decontamination. Remove all dirt and grit from the threads of the drive head, cutting shoe, and sample tube with a nylon brush (BU700). Without sufficient cleaning, the cutting shoe and drive head will not thread completely onto the sample tube and probe rods. The threads may be damaged if the sampler is driven in this condition.

Ensure that all soil is removed from inside the sample tube. Sand particles are especially troublesome as they can bind liners in the sampler. Full liners are difficult to remove under such conditions. In extreme cases, the soil sample must be removed from the liner before it can be freed from the sample tube.

## 5.0 REFERENCES

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

## APPENDIX A ALTERNATIVE PARTS

<b><u>Geoprobe® Tools and Equipment</u></b>	<b><u>Part Number</u></b>
Drive Cap, GH40 Series, Threaded, 2.25 in.....	25362
Drive Cap, GH60 Series, Threaded, 2.25 in.....	25363
Drive Cap, GH60 Series, Threaded, 2.125 in.....	15673
Nylon Brush, Macro-Core® Tool.....	BU700
Nylon Brush, 2.25-in. and 2.125-in. probe rods.....	BU2125
Extension Rod Handle.....	AT69
Extension Rod (60-in.).....	10073
Extension Rod (48-in.).....	AT671
Extension Rod (36-in.).....	AT67