

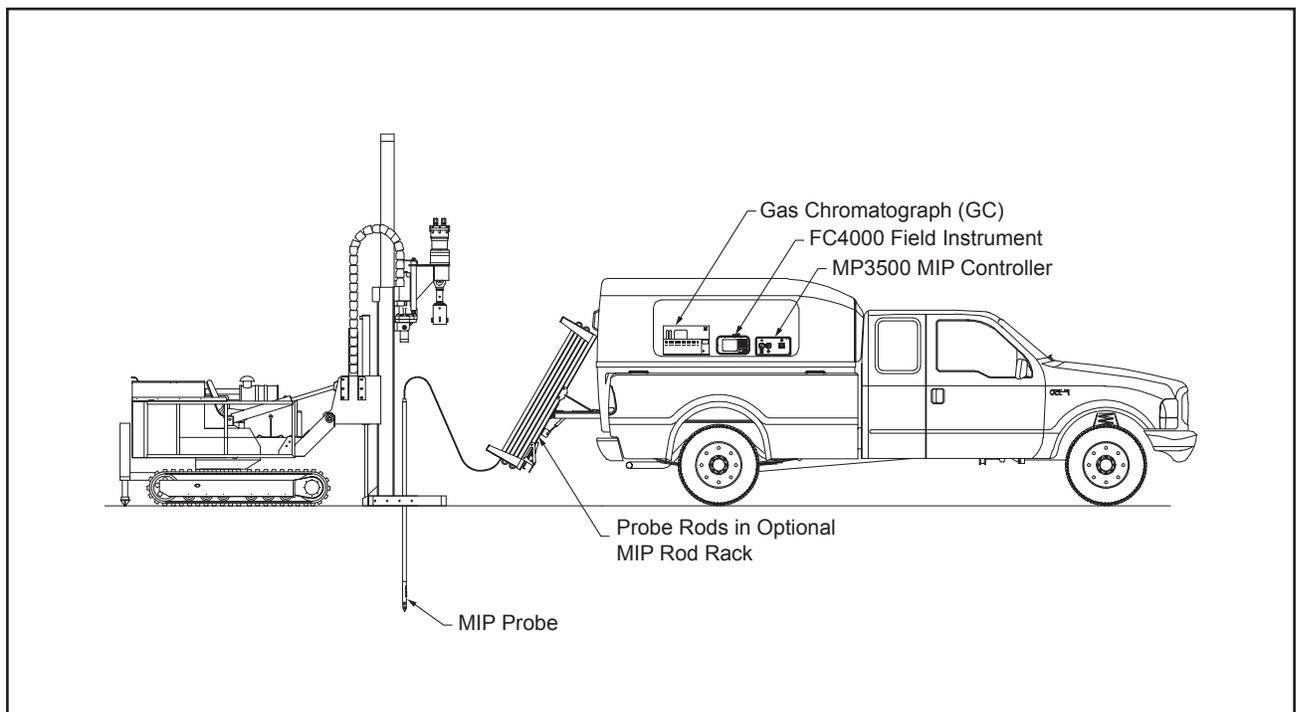
GEOPROBE® MEMBRANE INTERFACE PROBE (MIP)

STANDARD OPERATING PROCEDURE

Technical Bulletin No. MK3010

PREPARED: May, 2003

REVISED: August, 2006



THE MIP SYSTEM MAY BE DEDICATED TO A SINGLE CARRIER VEHICLE FOR USE IN TANDEM WITH MULTIPLE GEOPROBE® DIRECT PUSH MACHINE MODELS

Geoprobe Systems®

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1.0 OBJECTIVE

This document serves as the standard operating procedure for use of the Geoprobe Systems® Membrane Interface Probe (MIP) to detect volatile organic compounds (VOCs) at depth in the subsurface.

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® is a registered trademark of Kejr, Inc., Salina, Kansas.*

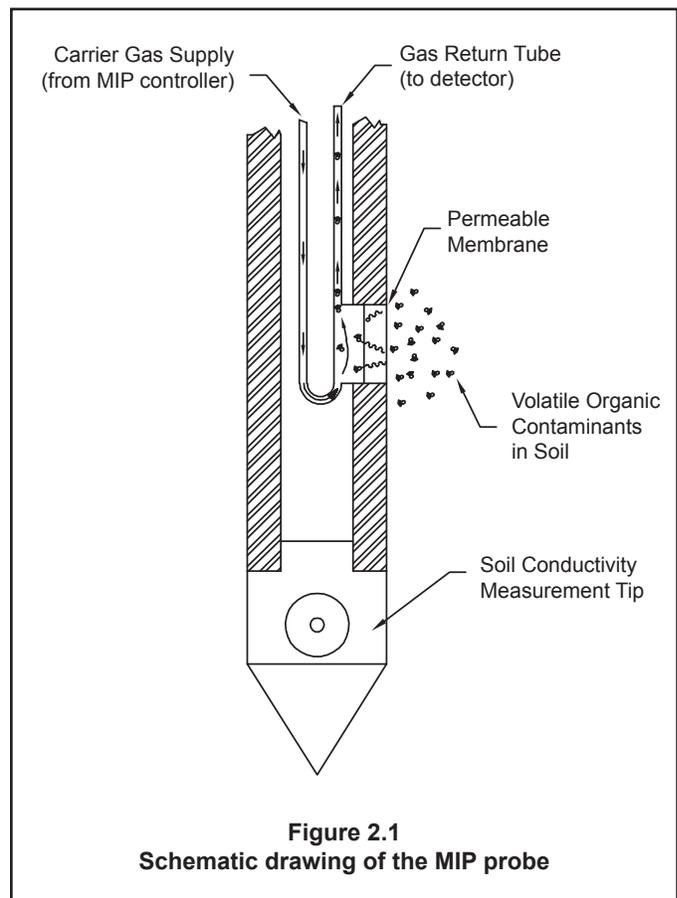
Membrane Interface Probe (MIP): A system manufactured by Geoprobe Systems® for the detection and measurement of volatile organic compounds (VOCs) in the subsurface. A heated probe carrying a permeable membrane is advanced to depth in the soil. VOCs in the subsurface cross the membrane, enter into a carrier gas stream, and are swept to gas phase detectors at ground surface for measurement.

2.2 Discussion

The MIP is an interface between contaminants in the soil and the detectors at ground surface. It is a screening tool used to find the depth at which the contamination is located, but is not used to determine concentration of the compound. Two advantages of using the MIP are that it detects contamination in situ and can be used in all types of soil conditions.

Refer to Figure 2.1. The MIP is a logging tool used to make continuous measurements of VOCs in soil. Volatile compounds outside the probe diffuse across a membrane and are swept from the probe to a gas phase detector at ground surface. A log is made of detector response with probe depth. In order to speed diffusion, the probe membrane is heated to approximately 100° C (212° F).

Along with the detection of VOCs in the soil, the MIP also measures the electrical conductivity of the soil to give a probable lithology of the subsurface. This is accomplished by using a dipole measurement arrangement at the end of the MIP probe so that both conductivity and detector readings may be taken simultaneously. A simultaneous log of soil conductivity is recorded with the detector response.



3.0 Tools and Equipment

The following equipment is needed to perform and record an MIP log. Basic MIP system components are listed in this section and illustrated in Figure 3.1. Refer also to Appendix I for more required tools as determined by your specific model of Geoprobe® direct push machine.

3.1 Basic MIP System Components

Description	Quantity	Part Number
Field Instrument	(1)	FC4000 / FC5000
MIP Controller	(1)	MP3500 / MP6500
MIP/EC Acquisition Software	(1)	MP3517
MIP Probe	(1)	MP4510 / MP6510
Replacement Membrane	(1)	MP3512
Membrane Wrench	(1)	16172
LB Sample Tube	(1)	AT6621
Stringpot (linear position transducer)	(1)	SC160
Stringpot Cordset	(1)	SC161
MIP O-ring and Service Kit	(1)	MP2515
MIP Trunkline, 100-ft (30 m) length	(1)	MP2550
Extension Cord, 25-ft (8 m) length	(1)	SC153
Needle Valve	(1)	13700
24-in. Nafion Dryer Tube	(1)	12457
Drive Cushion*	(1)	23321

3.2 Anchoring Equipment

Description	Quantity	Part Number
Soil Anchor, 4.0-in. OD flight	(3)	10245
Anchor Foot Bridge	(1)	10824
Anchor Plate	(3)	10167
GH60 Hex Adapter (if applicable)	(1)	10809
Chain Vise	(3)	10075

3.3 Optional Accessories

Description	Quantity	Part Number
MIP Trunkline, 150-ft (46 m) length	(1)	13999
MIP Trunkline, 200-ft (61 m) length	(1)	15698
FID Compressed Air System	(1)	AT1004
Hydrogen Gas Regulator	(1)	10344
Nitrogen Gas Regulator	(1)	13940
Cable Rod Rack, for 48-in. rods	(1)	18355
Rod Cart Assembly, for 1.25-in. OD rods	(1)	SC610
Rod Cart Hitch Rack, for SC610	(1)	SC650K
Rod Cart Carrier, for SC610	(1)	SC675
Rod Wiper, for 5400 Series foot	(1)	AT1255
Rod Wiper, for 66 Series foot	(1)	18181
Rod Grip Pull Handle, for GH40 hammer	(1)	GH1255
Rod Grip Pull Handle, for GH60 hammer	(1)	9641
Water Transport System	(1)	19011

*For Geoprobe® 66- and 77-Series Direct Push Machines only.

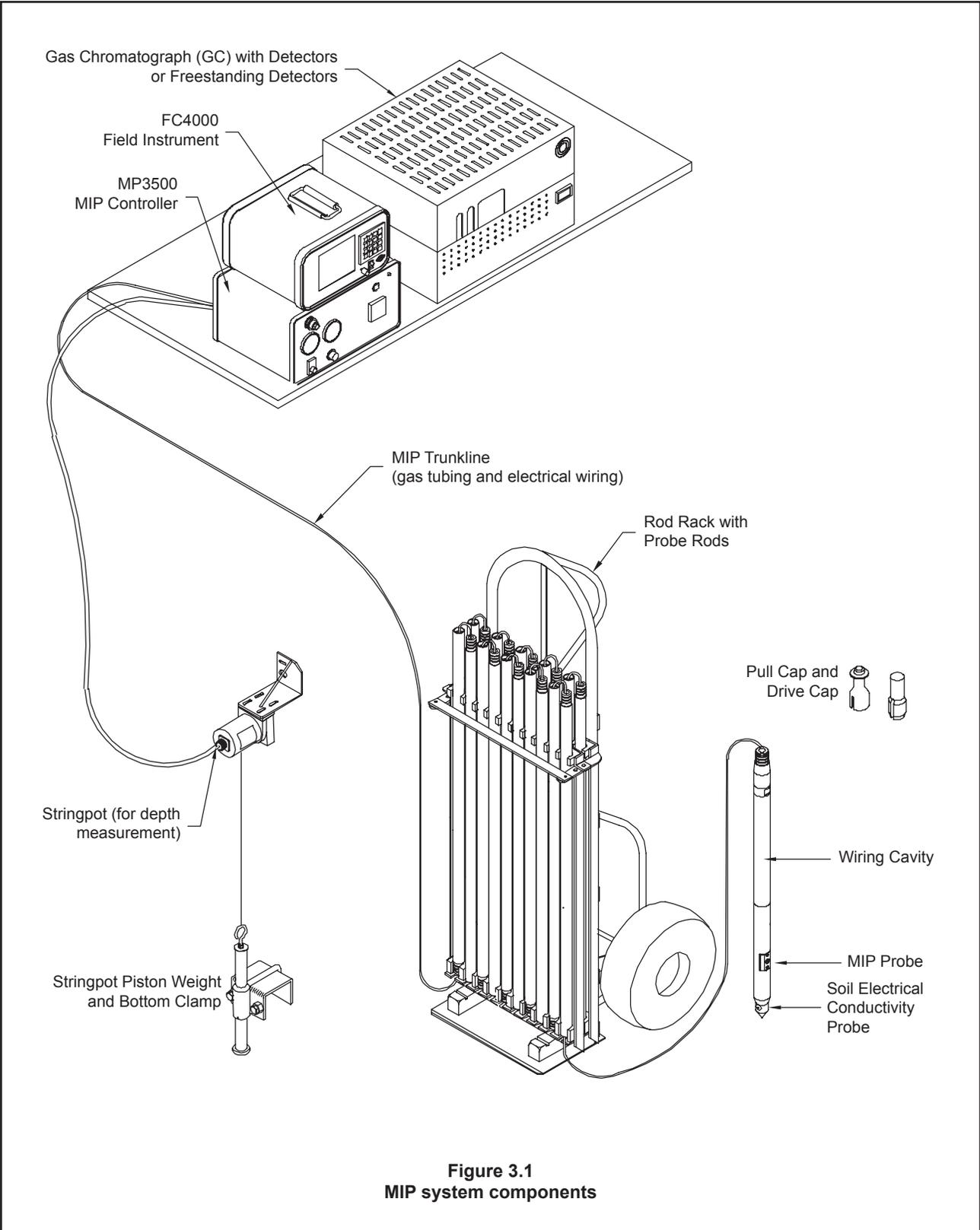


Figure 3.1
MIP system components

4.0: Quality Control - Response Testing

Response testing is an important quality control measure used to validate each log by proving that the integrity of the system is intact. Without running a response test, the operator will not know if the system is detecting the correct compounds or even if the system is working.

4.1 Preparation for Response Testing

Response testing is a necessary part of the MIP logging process because it ensures that the entire system is working correctly and also enables the operator to measure the trip time. Trip time is the time it takes for the contaminant to go from the probe, through the trunk line, and to the detectors. This time will need to be entered into the MIP software for depth calculations as described later in this document.

The following items are required to perform response testing:

- Neat sample of the analyte of interest (i.e.: benzene, TCE, PCE, etc.) purchased from chemical vendor
- Microliter syringes
- 25- or 50-mL Graduated cylinder
- Several 40-mL VOC vials with labels
- Testing cylinder made from a nominal 2-in. PVC pipe with a length of 24 in.
- 0.5 L plastic beaker or pitcher
- 25 mL Methanol
- Supply of fresh water, 0.5 L needed per test
- 5-gallon bucket filled with fine sand and water
- Stopwatch

Preparation of the stock standard is critical to the final outcome of the concentration to be placed into the testing cylinder.

1. Pour methanol into graduated cylinder to the 25 mL mark.
2. Pour 25 mL of methanol from graduated cylinder into 40-mL VOC vial.
3. Mix appropriate volume of desired neat analyte into 40-mL VOC vial containing 25 mL of methanol. The required volume of neat analyte for five common compounds is listed in Column 3 of Table 4.1. Use the equation at the then of this section to calculate the appropriate neat analyte volume for other compounds of interest.
4. Label the vial with name of standard (i.e. TCE, PCE, Benzene), concentration (50 mg/mL), date created, and created by (your name). This is the Stock Standard.

The equation used for making a stock standard is shown on the following page.

Compound	Density (mg/uL)	Volume of Neat Analyte Required to Prepare a Working Standard (uL)
Benzene	0.8765	1426
Toluene	0.8669	1442
Carbon Tetrachloride	1.594	784
PCE	1.6227	770
TCE	1.4642	854

25 mL (methanol) x 50 mg/mL = 1250 mg
1250 mg x 1/density of analyte = amount of neat material to be placed into 25 mL of Methanol

Example: Preparation of 50 mg/mL Benzene standard.

1250 mg x 1/0.8765 mg/uL = 1426 uL

Use 1426 uL of neat Benzene in 25 mL of Methanol to get a 50 mg/mL standard.

4.2 Response Test Procedure

With the standard prepared, the operator is ready to test the response of the probe as described below.

1. Stabilize the baseline by immersing the probe in a container with enough water to fully cover the membrane. This is necessary due to the sensitivity of the photoionization detector (PID) and the electron capture detector (ECD) to oxygen.
2. Access the MIP Time software and view the detector vs. time data. The detector signals should be stable before proceeding.
3. Obtain 500 mL of water (either tap water or distilled) in a suitable measuring container.

Volume of 50 mg/mL Standard	Final Concentration of 0.5 L Sample (mg/L or ppm)
1000 uL	100
100 uL	10
10 uL	1

4. Use a standard volume specified in Table 4.2 to mix the desired test concentration. This is the Working Standard.
5. Pour the working standard into a nominal 2-inch x 24-inch PVC pipe and immediately insert the MIP into the solution (Fig. 4.1). Leave the probe in the test solution for 45 seconds. At the end of 45 seconds, place the probe back in the container of water.
6. From the results on the MIP Time software the trip time and response time can both be measured (Fig. 4.2).



Figure 4.1
The MIP probe is placed in a PVC pipe containing the standard solution.

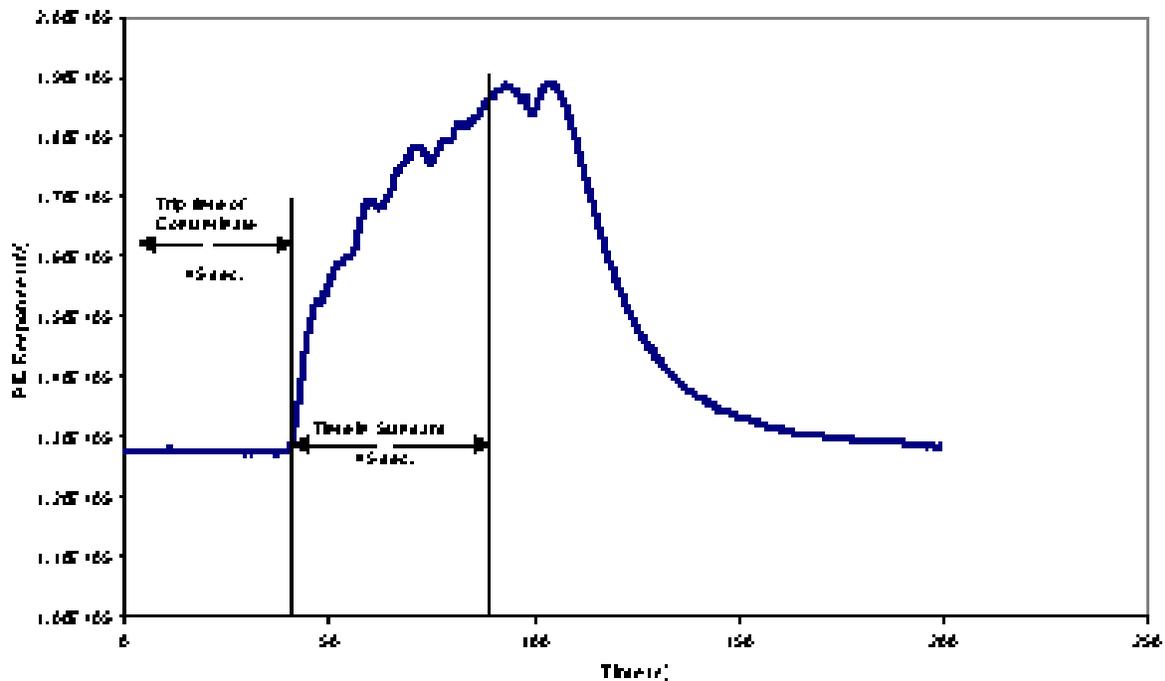


Figure 4.2
SRI PID Response Test - 10 ppm Benzene

5.0 Field Operation

1. Power on the generator.
2. Turn on any gases that will be used for the MIP system (i.e. nitrogen carrier gas, hydrogen for the FID, etc.). Check the flow rate of the system and psi on the mass flow controller. Compare these numbers to previous work.
3. Power on the detector or detectors and allow to warm up to set temperature (approximately 30 minutes).
4. Power on the MIP Controller.
5. Power on the computer or the Field Instrument.
6. Advance a pre-probe 3 to 4 feet into the subsurface at the location to be logged.
7. Remove the pre-probe and raise the probe foot of the direct push machine.
8. If advancing the MIP with percussion, raise the probe foot enough to slide the rod wiper plate underneath.
9. If pushing only, turn the desired amount of anchors into the subsurface and return the probe foot to the position from which the pre-probe was advanced. Leave the probe foot raised sufficiently to allow sliding the rod wiper underneath.
10. Place the rod wiper plate under the foot such that the opening is directly over the pre-probed hole. Lower the foot firmly onto the rod wiper.

11. If pushing only, position the anchoring bridge over the foot of the machine such that the anchors extend through the holes in the bridge (fig. 5.1). Install a chain vise at each anchor to secure the bridge.
12. With the software loaded, run a response test (Section 4.0) and record the height of the peak response and the trip time into a field notebook. Refer to Figure 4.2.
13. Enter the trip time obtained during response testing.
14. Attach a slotted drive cap to the MIP drive head.
15. Insert the MIP point into rod wiper opening and drive it into the soil until the membrane of the probe is at ground level.
16. Connect the stringpot cable to the stringpot weight located on the probe foot and pull keeper pin so the weight drops to the ground.

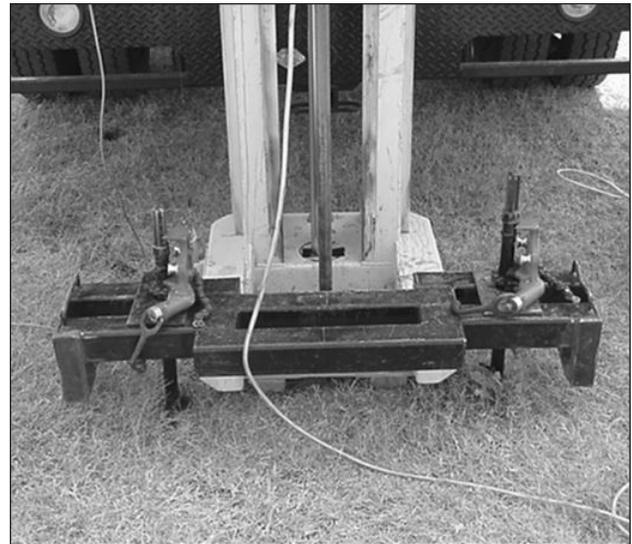


Figure 5.1
Anchor the probe foot to allow advancement of MIP probe by push only (no percussion).

NOTE: Do not allow the stringpot cable to retract into the stringpot housing at a high rate. This will ultimately damage the stringpot.

17. Record the system parameters in a field notebook at this time (i.e.. mass flow, trip time).

NOTE: If the mass flow reading drops or rises more than one psi, turn off the flow at the primary controller and remove the probe from the ground. If the temperature monitor quits heating or gives an error, remove the probe from the ground.

18. Place the trigger switch in the “ON” position.
19. Advance the probe at a rate of 1 ft/min to the predetermined log depth or until refusal is attained.

NOTE: Refusal is attained when it takes longer than 1.5 minutes of continuous hammering to advance the probe one foot. This is the maximum time to reach one foot of probe travel.

20. When the MIP log is complete, turn the trigger off and slowly return the stringpot cable into the stringpot housing.
21. Pull the probe rod string using either the Geoprobe® rod grip pull system or a slotted pull cap.
22. When the MIP reaches the surface, clean the face with water and run a response test. This response test should be written down in the field notes and compared to the initial test. This system check ensures the data for that log is valid.
23. Save the data to a 3.5-inch floppy disk or CompactFlash® card and exit the MIP software.
24. Data from the MIP can now be graphed with Direct Image® MIP Display Log or imported into any spreadsheet for graphing.

6.0 Replacing a Membrane on the MIP Probe

A probe membrane is considered in good working condition as long as two requirements are met: 1) The butane sanity test result is greater than $1.0E+06$ uV response, 2) Flow of the system has not varied more than 3 mL/min from the original flow of the system (a flow meter or bubble flow meter should be kept with the system at all times). If either one of these requirements are not met, a new face must be installed as follows.

1. Turn the heater off and allow the block to cool to less than 50° C on the control panel readout.
2. Clean the entire heating block with water and a clean rag to remove any debris.
3. Dry the block completely before proceeding.
4. Remove the membrane using the membrane wrench (Fig. 6.1). Keep the wrench parallel to the probe while removing the membrane to ensure proper engagement with socket head cap screw.

NOTE: Do Not leave the membrane cavity open for extended periods. Debris can become lodged in the gas openings in the plug.

5. Remove and discard the copper washer as shown in Figure 6.2. Each new membrane is accompanied by a new copper washer. **Do not reuse the copper washer.**
6. Inspect the open cavity for any foreign objects. Remove any objects present and clean the inside of cavity of any soil that was deposited on the wall of the block.
7. Insert the new copper washer around the brass plug making sure that it sits flat on the surface of the block.
8. Install the new membrane by threading it into the socket. Use the membrane wrench to tighten the membrane to a snug fit. Do not overtighten.
9. Turn the gas on and leave the heater off. Apply water to the membrane and surrounding area to check for leaks. If a leak is detected (bubbles are formed in the water), use the membrane wrench to further tighten the membrane.
10. Use a flow meter/bubble flow meter to check flow to the detectors. Record this value in a field notebook.



Figure 6.1
Unthread the membrane from the probe block.



Figure 6.2
Remove and discard the copper washer.

Appendix I: Tools for Various Direct Push Machines

Model 5400 and 54DT Direct Push Machines

<u>Description</u>	<u>Part Number</u>
Stringpot Mounting Bracket	SC110
Stringpot Bottom Clamp	SC111
Stringpot Piston Weight	SC112
Slotted Drive Cap, for 1.25-in. rods	AT1202
Slotted Pull Cap, for 1.25-in. rods	AT1203
MIP Drive Adapter, for 1.25-in. rods	MP2512
MIP Drive Head	GW1516
Probe Rod, 1.25-in. x 48-in.	AT1248

Model 54LT Direct Push Machine

<u>Description</u>	<u>Part Number</u>
Stringpot Mounting Bracket	11433
Stringpot Bottom Clamp	SC111
Stringpot Piston Weight	SC112
Slotted Drive Cap, for 1.25-in. rods	AT1202
Slotted Pull Cap, for 1.25-in. rods	AT1203
MIP Drive Adapter, for 1.25-in. rods	MP2512
MIP Drive Head	GW1516
Probe Rod, 1.25-in. x 48-in.	AT1248

Model 5410 Direct Push Machine

<u>Description</u>	<u>Part Number</u>
Stringpot Piston Weight	SC112
Slotted Drive Cap, for 1.25-in. rods	AT1202
Slotted Pull Cap, for 1.25-in. rods	AT1203
MIP Drive Adapter, for 1.25-in. rods	MP2512
MIP Drive Head	GW1516
Probe Rod, 1.25-in. x 48-in.	AT1248

Model 6600, 66DT and 6610DT Direct Push Machines

<u>Description</u>	<u>Part Number</u>
Stringpot Mounting Bracket	16971
Stringpot Bottom Clamp	11751
Stringpot Piston Weight	SC112
Slotted Drive Cap, for 1.5-in. rods	15607
Slotted Pull Cap, for 1.5-in. rods	15164
Drive Cap Adapter, for GH60 and 1.25-in. rods	15498
MIP Drive Adapter, for 1.5-in. rods	18563
MIP Friction Reducer	18564
Probe Rod, 1.5-in. x 48-in.	13359



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