Geoprobe® Direct Image®

MP6500
Membrane Interface Probe(MIP) Controller

User Manual

Document No.: MK3083

Revision 1.00 10-12-2004

Equipment and tool specifications, including weights, dimensions, and operating specifications listed in this publication are subject to change without notice.

Where specifications are critical to your application, please consult Geoprobe Systems® at 1-800-GEOPROBE (436-7762).

Section 1.0 General Information

Section 1.1 Introduction

The purpose of this manual is to address aspects of Direct Image® safety, hardware, and general system setup as it pertains to the MP6500 Membrane Interface Probe (MIP) controller. This manual is not intended to be a complete field manual for Direct Image® equipment, but rather a tool to assist the user in general Direct Image® practices. This manual assumes the reader has completed the Geoprobe® Systems MIP training and is familiar with good MIP logging practices. The reader is encouraged to read and follow the practices outlined in the MIP SOP in Appendix B of this document.

Section 1.2 Manual Contents

Section 2.0 discusses the general inputs and outputs of the MP6500 MIP controller made by Geoprobe® Systems. Topics covered include: General use, front and rear panel component identification, connections to the FC4000 field instrument, carrier gas controls indicators, safety concerns and necessary schematics.
Section 3.0 is a quick start section designed to provide the experienced MIP user up and running quickly with the MP6500 system by pointing out key differences and operating points.

Section 2.0 MP6500 MIP Controller

Section 2.1 Introduction

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

The MP6500 series controller is the main operating component for the MIP contaminant detection system. The MP6500 series controller regulates gas flow and probe temperature in the MIP system, and provides digital conversion of analog detector signals as well as other internal devices used with the MIP system. The MP6500 series controller is only compatible with Geoprobe® MP6510 series probes.

The MP6500 consists of the following main components:

- Isolation transformer to condition the 110 VAC for MIP probe heating
- Gas flow regulation systems to provide a constant carrier gas flow to the probe.
- Temperature measurement and control system to regulate MIP probe temperature.
- Analog to digital conversion system to output digital data via serial cable to a Geoprobe® FC4000 Field Instrument.

There are two separate models of the MP6500 MIP controller available differing only in their input voltages. The two models and their respective input voltages are shown in Table 2.1. Both models are 50/60Hz compatible.

Table 2.1
Available MP6500 Controller models

Model	Area of Use	Input Voltages
MP6500	U.S. and Canada	110 VAC (nominal)
MP6503	International	230 VAC (nominal)

The MP6500 is an electrical device, which controls the gas flow to, and the temperature of, the MIP probe. The MIP system also measures soil electrical conductivity via the dipole electrode on the probe. The conductivity feature is controlled and monitored by the FC4000 field instrument directly. The MP6500 controller has inputs for analog signal (differential inputs 5VDC or less) from gas phase chemical detectors that are used in conjunction with the MIP system.

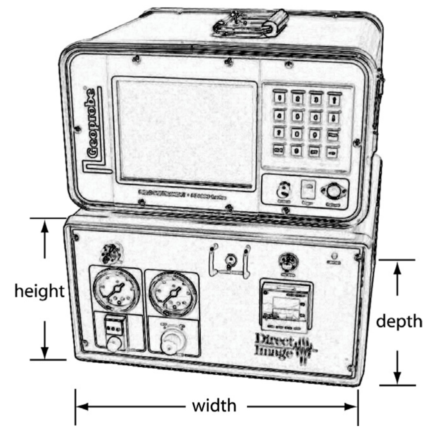
Trunkline pressure and probe temperature are electronically monitored inside the MP6500 controller. All MIP data is collected, displayed and logged by the FC4000 field instrument.

Section 2.2 Mechanical

Proper mounting of the MP6500 controller is essential for reliable and successful use of the MIP system.

Dimensions and weight of the MP6500 controller:

Depth: 15 in. (381 mm)
Additional 1.5 in. (38 mm) front panel clearance required
Additional 3.0 in. (127 mm) rear panel clearance required
Width: 15 in. (381 mm)
Additional 1 in. (25 mm) clearance recommended
Height: 7.75 in (197 mm)
Additional 4.0 in. (102 mm) clearance recommended
Weight: 41.05 lb (14.0 kb) (does not include shipping case)



Section 2.3 Safety Precautions

Operator safety is essential when adjusting, testing or handling the MP6500 controller. Although measures have been taken to protect and guard against operator injury, care should be used whenever working with the MP6500 controller. This section describes some of the electrical guarding and protection devices that are used, as well as lists some safety precautions.

CAUTION: NEVER override the **circuit breaker**.

NOTE: This device is intended to trip or 'interrupt current flow' when the circuit is overloaded or a short circuit has occurred on the output device (MIP probe). This device will protect the user and equipment from line-to-line contact hazards.

CAUTION: NEVER override the **GFCI** (Ground Fault Circuit Interrupter).

NOTE: The GFCI is an industry-accepted device that provides protection for personnel and equipment when electrical leakage levels have a potentially dangerous ground current in excess of six milli-amperes. A GFCI is simply a fast-acting circuit breaker that senses small imbalances in the circuit caused by current leakage to ground. In a fraction of a second, the GFCI trips and interrupts the current flow to the MIP probe. This device protects the operator against the most common shock hazard – the ground fault.

The MP6500 controller supplies a nominal 110VAC @5.5 Amperes power to the MIP probe. This level of power is required for the correct operation of the MP6510 series MIP probes. Power supplies of this magnitude pose a clear and present danger to the operator if not treated with respect. Warning labels and the previously discussed electrical safety devices are provided on the instrument to keep the operator aware of and reasonably protected from the dangers.

Caution and respect for the MIP probe power circuit is a must when using the MP6500.

Do not disassemble or modify the MP6500 instrument.

- Use the MP6500 for the purpose for which it is intended
- For repairs contact the Technical Service staff at Geoprobe® Systems.
- Never remove the top cover of the MP6500 instrument case with the power ON.
- Be aware of the 110VAC supply voltage on the heater output.
- Never have power ON when connecting to the 110VAC output.
- Be aware of the weight of the instrument before lifting.
- Be aware of the weight distribution inside the instrument to avoid mishandling or dropping.
- Be aware of static discharge when troubleshooting or working on the MP6500 with the top cover off. Work on a static mat or use a static discharge wristband whenever possible.

Section 2.4 MP6500 Front Panel

The front panel of the MP6500 is shown in Figure 2. The front panel is divided into the following sections:

> Right Section: System power, probe heater control and indication.
> Left Section: Probe gas flow regulation.

Figure 2: MP6500 Front Panel

Power: The power pilot light will indicate when the MP6500 has been connected to the line power and the power switch on the rear panel of the instrument has been turned on. This indicator does not report the status of the probe heater circuit.

Probe Heater and Temperature Controls: The right hand side of the front panel contains the MIP probe heater controls. Again, refer to Figure 2.

Heater Pilot Light: The heater pilot light is on when the MP6500 closes the probe heater relay and power is being supplied to the rear panel probe heater connector. This pilot light does not indicate that the probe is connected to, or receiving current from, the controller. The set point for the probe temperature is pre-set at the factory to 121 °C. The MP6500 controller uses an 'on/off' control scheme for temperature control. The heater will be on until the probe reaches the set point, then it shuts off. With the heater off, the temperature will momentarily continue to rise and then begin to fall. When the temperature falls to less than the set point, the MP6500 again provides power to the probe heater to continue heating the probe.

Heater ON/OFF Switch: The heater ON/OFF switch is on when in the UP position and off when in the DOWN position. The intent of this switch is to be used as the main ON/OFF control for the probe heater. This switch is NOT the heater circuit breaker.

Temperature Controller: This modular controller displays two temperatures: The top display is the actual temperature of the probe displayed in °C, the bottom display is the temperature set point in °C. The set point is pre-set at the factory to 121 °C and should not be adjusted. This modular control is a proportional type controller and provides close tolerance regulation of the probe temperature. If the thermocouple goes open, the temperature controller will display a flashing error message (r5t,op5n) and the MP6500 will not allow current flow to the probe heater. The temperature controller also outputs a proportional analog signal that is sent to the FC4000 field instrument for logging.

Gas Flow Controls: These controls are located on the left side of the front panel

Gas flow controls and their functions are as follows:

Primary Pressure Regulator: Carrier gas connected to the MP6500 first passes through the primary regulator. The purpose of this regulator is the supply of gas at a constant pressure to the mass flow controller. Besides being a pressure regulator, this device is also an on/off valve for the carrier gas. Carrier gas (nitrogen, helium, hydrogen, argon, or compressed air depending upon the detector used with the system) should be supplied to the rear panel of the controller at 30 to 60 psi (2 to 4 bars). The primary regulator should be adjusted to 20 psi (1.4 bars).
Rotating the black knob all the way to the right (clockwise) opens the regulator. With the regulator open, the output pressure is adjusted by using a flat blade screwdriver in the stem embedded in the center of the knob. Output pressure for this regulator is indicated on the pressure gauge located immediately above the regulator.

Be sure to use only light finger pressure to open or close the regulator value.

It is good practice to shut this valve off at the end of each working day. To do this, rotate the black knob all the way to the left (counterclockwise). By opening the valve all the way to the right, the regulator will return to its previously adjusted pressure setting.

Mass Flow Controller: The purpose of this controller is to provide a constant flow of carrier gas through the trunkline. The mass flow controller is an important control to understand for successful MIP usage. This device works by opening or closing a feed valve in response to changes in downstream friction losses or restrictions. Clockwise rotation of the controller knob will increase carrier flow and counterclockwise rotation will decrease carrier gas flow. The numerical counter on the controller is a unitless indicator of controller position only.

The pressure gauge immediately above the mass flow controller indicates the gas pressure on the downstream (probe) side of the mass flow controller. The mass flow controller is normally set so that the output pressure will be between 7 and 10 psi (0.47 to 0.68 bar) for a normal, clean, 100 ft (30 M) trunkline and probe. Mass flow controller settings in this range will yield carrier gas flow rates of 25 to 40 mL/min and result in butane (FID detector) return time of 20 to 50 seconds. A graph of typical gas flow rates, mass flow controller pressures, and butane trip times is show in Figure 3.

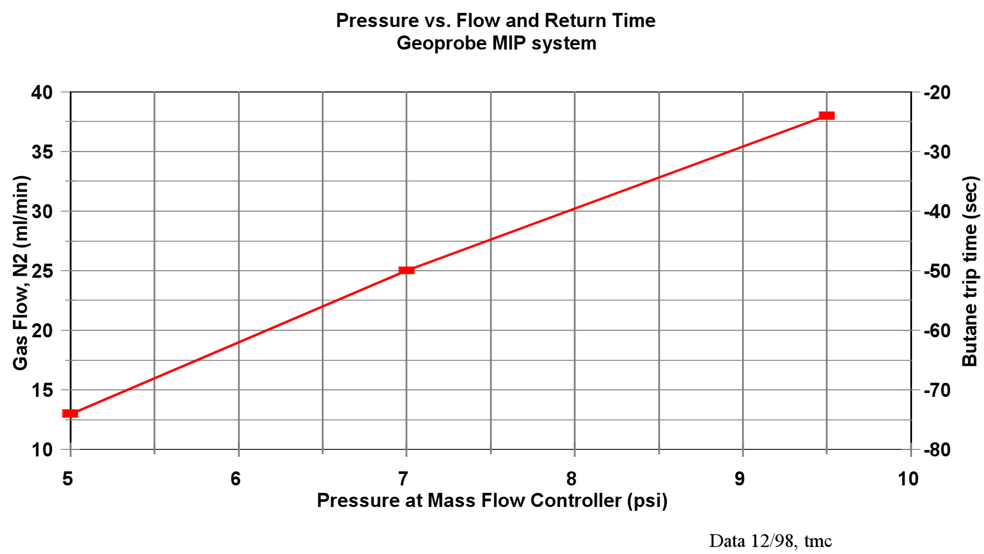


FIGURE 3: Trunkline Pressure vs. Flow and Return Time

The mass flow controller gauge is very important during field operations and should be checked at least once per rod. An increase in this pressure indicates that some downstream blockage has occurred (particulate or water in the line) and the mass flow controller is increasing pressure in order to maintain flow. A decrease in pressure at the mass flow controller indicates that a leak has occurred in the system.

In general, the mass flow controller pressure gauge will not change by more than one psi (0.068 bar) during MIP logging. If it does change by more than one psi, there is a problem in the system. Logging should be halted, the probe removed, and the system should be examined. If the mass flow controller pressure rises to match the primary pressure, then it is safe to assume that the system has a complete blockage and must be examined and corrected.

The MP6500 controller has an internal electronic pressure sensor that monitors the probe side trunkline pressure. The pressure data is sent to the FC4000 field instrument, and displayed as a digital readout on the Real Time detector graph within the FC4000 MIP software. Pressure data is also saved while logging to the .DAT file on a 0.05ft (0.015 meter) increment.

Injection Port: This is a septum-type injection port, which is placed in the carrier gas line before it leaves the control box. Gas phase standards can be injected in this port using needle syringes. A standard injected in this port would travel in the carrier gas stream to the MIP probe and back to the detector. It is important that the injection port nut not be tightened too tight, as this will damage the septum and block carrier gas flow. When replacing the nut simply screw it on finger tight and check the installation for leaks using soap bubbles.

Section 2.5 Rear Panel

The layout of the MP6500 rear panel is shown in Figure 4. The rear panel is used for connection to line power, trunkline connections, detector connections and carrier gas connections.

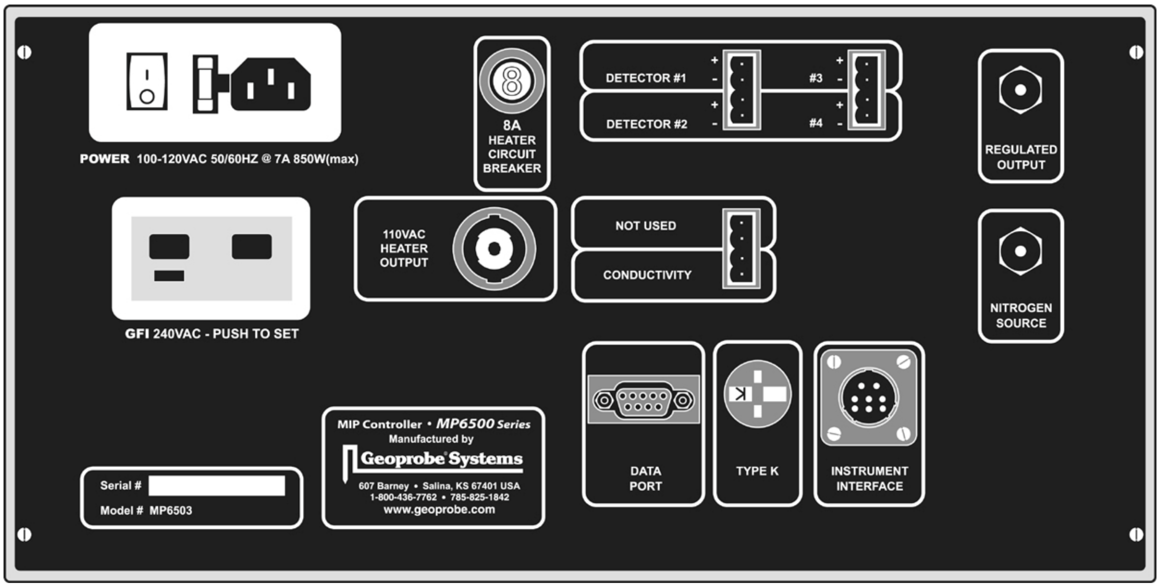


Figure 4: MP6500 Rear Panel

Power: The line voltage required for the MP6500 controller is clearly shown on this label. Do not attempt to connect the MP6500 to line voltages other than the voltage indicated on this label. Use of improper input line voltage could result in damage to the equipment.

Unit Power Connection: Connect only to voltage indicated on the input power label. MP6500 series MIP controllers vary in their input power requirements depending upon the indicated country of service. Input voltage requirements for the various models within the MP6500 series are shown in Table 2.2.

Table 2.2
Available MP6500 Controller models

Model	Area of Use	Input Voltages
MP6500	U.S. and Canada	110 VAC (nominal)
MP6503	International	230 VAC (nominal)

Fuse Holder: Power to the controller is fused at the input point. Fuse size varies with the designated input voltage as shown in Table 2.3. A spare fuse is provided within the power connection block.

Table 2.1
Input Power Fuse Size

Model	Input Voltages	Fuse Size
MP6500	110 VAC (nominal)	10 Amp
MP6503	230 VAC (nominal)	6.3 Amp

GFI: The purpose of this switch is to detect any current leakage to ground that may occur from the probe and automatically disconnect from power if such leakage occurs. To test the operation of the GFI, push the "test" button. This will cut the power to the probe heater circuit only and not the rest of the MP6500 controller. Pressing the "reset" button will restore power to the heater circuit. A green indicator light on the GFI switch indicates that the power is on. See Appendix A for a schematic of the MP6500 probe heater circuit.

Data Port: This port accepts a standard DB-9 male connector and is used to transfer digital data from the MP6500 internal analog to digital (A/D) converter in the controller to the FC4000 Field Instrument. Data transferred via this port includes: probe temperature, detector responses and trunkline carrier gas pressure.

Heater Circuit Breaker: This is a safety circuit breaker on the secondary side of the probe heater transformer. This breaker pops out when the breaker has tripped. Simply press the button to reset the breaker. If the breaker continues to reset, a problem exists in the trunkline or probe portions of the heater circuit and must be addressed before resetting the breaker. Do not attempt to hold the breaker on; doing so will damage the breaker as well as portions of the probe heater circuit.

Detector Inputs: The MP6500 MIP controller is designed to accept analog inputs from up to four gas phase detectors. These inputs accept signals in the range of 0-5VDC. This range is sufficient to work with most all detectors common to the market. Polarity is marked at each input. The MP6500 uses an internal analog to digital (A/D) converter to convert the detector signals to digital data sent to the FC4000 Field Instrument.

Conductivity Connector: The dipole soil conductivity wires (one white and one red) from the MIP trunkline are connected to the bottom two lugs of the connector. Note that the red and white wires are interchangeable in these two lugs. There is a 0.75 VAC potential present between these lugs during logging.

Heater Connector: The trunkline probe heater wires (yellow) are connected to this connector. The potential between these wires is 110 VAC and care should be exercised when working with this connector.

Thermocouple Connection: This is a standard type K thermocouple connection that accepts the male connector attached to the end of the thermocouple wire in the MIP trunkline. When assembling the male thermocouple connector to the trunkline, note that the red wire goes in the negative pole and yellow to positive. Reversing these connections will result in the temperature reading to go down as the probe heats and will result in probe damage if not corrected quickly.

Regulated Out: This fitting is the outlet for the pressure and flow regulated output from the MP6500 controller. This fitting is normally equipped with a 1/16-in. Swagelok® brand fitting for attachment to one of the Teflon® tubes in the MIP trunkline. The MIP trunkline has a 1/8 in., brass, tube-like bulkhead fitting for this connection.

Nitrogen Source: This is the input port for carrier gas to the MIP system. This label is somewhat of a misnomer as any one of a number of carrier gasses may be connected to this port. This is a 1/8 in. Swagelok® fitting. Clean carrier gas should be supplied to this port at a regulated pressure of 30 to 60 psi (2 to 4 bars) through a 1/8 in. brass, tube-like bulkhead fitting.

Section 3.0 MP6500 MIP Controller Connections

Section 3.1 Introduction

This section explains making connections to a basic field operation of the MP6500 MIP controller. The first operation task is to make the various gas and electrical connections to the back panel of the controller. With this complete, the MP6500 is turned on, the probe heated, a response test ran and logging operations started.

Section 3.2 Attachment of Gas Supply

Connect a carrier gas supply to the input port labeled “Nitrogen Source” on the rear panel of the MP6500 controller. This input port is a 1/8 in. Swagelok® fitting. One-eighth inch (3.175 mm) OD tubing of either stainless steel or Teflon® should be used from the carrier gas supply to the input port.

The choice of carrier gas used will depend upon the detector connected to the system. Selection of the proper carrier gas is the responsibility of the user and should be based on the requirements of the detector being connected to the system. The following carrier gasses have been used for MIP work:

Nitrogen (most common)
Clean air (used with FID)
Helium
Argon

The carrier gas should be supplied to the “Nitrogen Source” port at a regulated pressure of 30 to 60 psi (200 to 400 kPa). Turn the pressure regulator control knob on the MP6500 front panel to the off position before applying gas pressure to the controller. Apply gas pressure to the MP6500 and check for leaks at this connection using a soap solution.

Section 3.3 Trunkline Connections

The trunkline should be connected to the MP6500 controller in the following manner:

Regulated Out Gas Line

One of the 1/16 in. (1.6 mm) OD Teflon® tubes from the trunkline should be connected to the “Regulated Out” port on the back of the MP6500 controller. A Swagelok® type, 1/16 in. fitting is provided for this purpose. The tubing should be inserted into the connection and tightened with a wrench approximately one-quarter turn. When pressure is applied to the trunkline, this fitting should be checked and, if necessary, re-tightened to stop leakage.

Conductivity Connector

The dipole soil conductivity wires (one white and one red) from the MIP trunkline are connected to the bottom two lugs of the connector. Note that the red and white wires are interchangeable in these two lugs. There is a 0.750 VAC potential present between these lugs during logging.

Instrument Interface

This connection is made with the cable that is loomed with the data serial cable. The other end of this cable is connected to the PROBE connector on the FC4000. The purpose of this interface is to transfer the electrical conductivity voltage (0.750VAC nominal) from the FC4000 field instrument to the MP6500 controller for routing to the MIP trunkline.

Heater Connector

The trunkline probe heater wires (yellow) are connected to this connector. The potential between these wires is 110 VAC and care should be exercised when working with this connector.

Thermocouple Connection

This is a standard type K thermocouple connection that accepts the male connector attached to the end of the thermocouple wire in the MIP trunkline. When assembling the male thermocouple connector to the trunkline, note that the red wire goes in the negative pole and yellow to positive. Reversing these connections will result in the temperature reading to go down as the probe heats and will result in probe damage if not corrected quickly.

Trunkline to Detector

The second gas line in the trunkline must be connected to the detector. The manner of attachment of this tube to the detector is dependent upon the detector configuration and is outside the scope of this manual. Usually this connection is made by inserting a “megabore” size (0.53 mm OD) Silcosteel® stainless steel tube into the detector and then inserting this tube in the bore of the gas line of the trunkline. A standard 1/16 in. size Swagelok® connector is then used to compress the gas line into the stainless steel tube. This connection should, of course, be checked for leaks using a soap solution.

NOTE: Do not connect the gas lines to either the MIP probe of the detectors without first purging this line with carrier gas flow from the MP6500. Failure to do so may introduce particulates into the MIP probe and/or detectors.

Power Supply

A cord is provided with the MP6500 for attachment to the electrical supply. The input voltage for the MP6500 is clearly marked on the back panel of the controller. Do not attempt to connect the MP6500 controller to any voltage other than the input voltage prescribed on the back panel of the controller. Connection to a line voltage other than described on the back panel can result in damage to the controller and the probe, as well as possible injury to the operator.

Detector Inputs

Analog outputs in the 0-5VDC range can be connected to the rear panel of the MP6500 controller. Attach the positive and negative leads from the detector to the appropriate lugs on the rear panel connector. Polarity is marked next to the lug and care should be exercised to follow these markings.

Data Port Connection

Attach the 9-pin serial communications cable (provided) to the Data Port connection on the rear of the MP6500. The opposite end of this cable connects to the FC4000 Field Instrument.

Section 3.4 MP6500 Power up

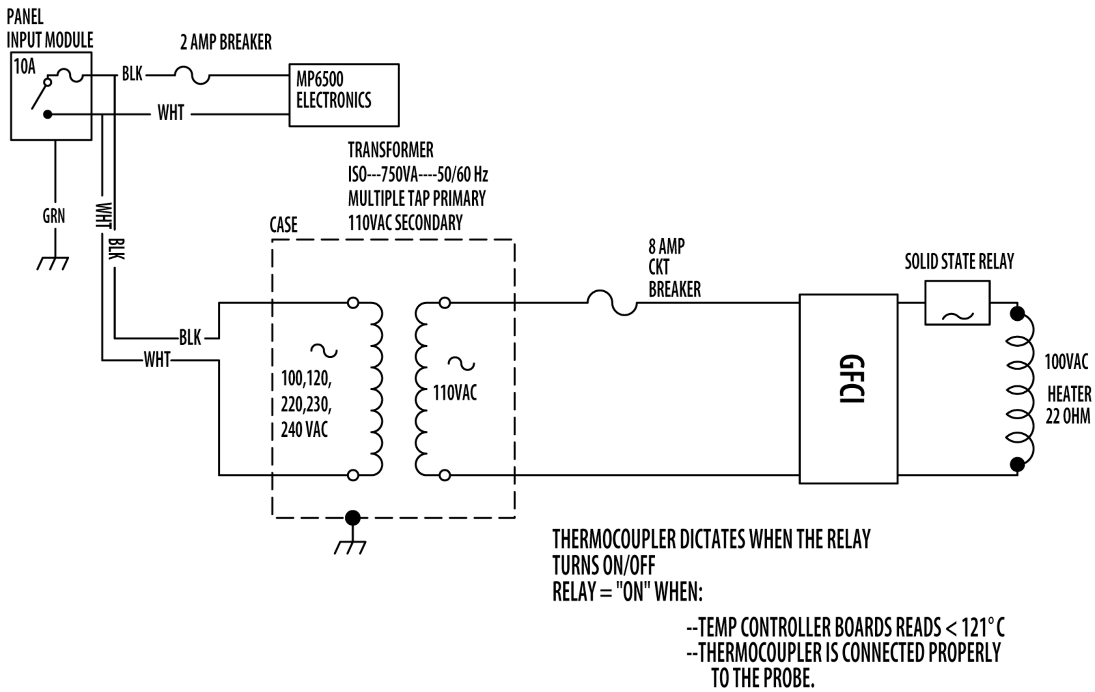
The following steps need to be followed when powering up the MP6500 controller.

1. Open the valve at the carrier gas supply. Make sure that the pressure is adjusted to between 30 and 60 psi (200 to 400 kPa).
2. Open the primary regulator on the MP6500 front panel, making sure that the pressure at this regulator is set to 20 psi (100 kPa).
3. Turn off the heater switch on the front of the MP6500 controller.
4. Turn on the power switch on the MP6500 back panel.

Under the above conditions, the system power pilot light on the front panel should be lit. If no probe thermocouple connection is made to the rear panel, an error message will be shown on the temperature controller on the front of the MP6500. Once the appropriate probe connections are made, the probe temperature will be shown on the temperature controller. At this time, turning on the front panel heater switch will cause the MP6500 to begin heating the MP6510 series probe.

Appendix A

MP6500 Probe Heater Control Schematic



APPENDIX B

Geoprobe® Membrane Interface Probe (MIP)

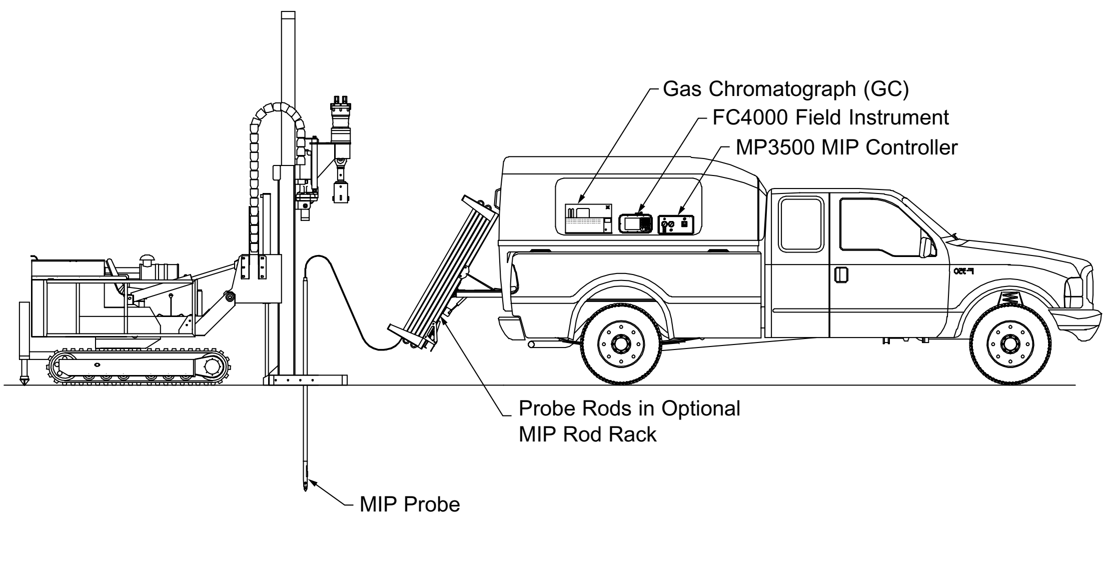
Standard Operating Procedure

GEOPROBE® MEMBRANE INTERFACE PROBE (MIP)

STANDARD OPERATING PROCEDURE

Technical Bulletin No. MK3010

PREPARED: May, 2003



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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Geoprobe Systems®

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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®.

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 contaminates 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.

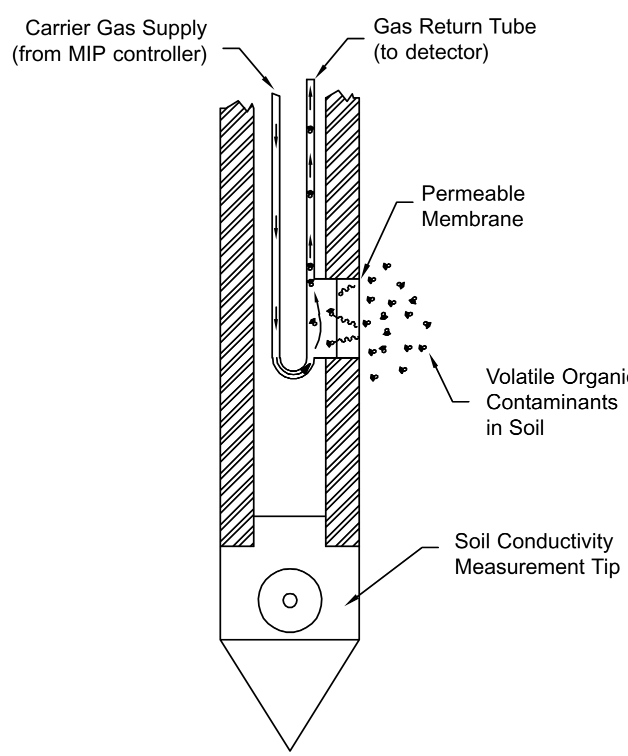

Figure 2.1
Schematic drawing of the MIP probe

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
MIP Controller	(1)	MP3500
MIP/EC Acquisition Software	(1)	MP3517
MIP Probe	(1)	MP4510
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

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

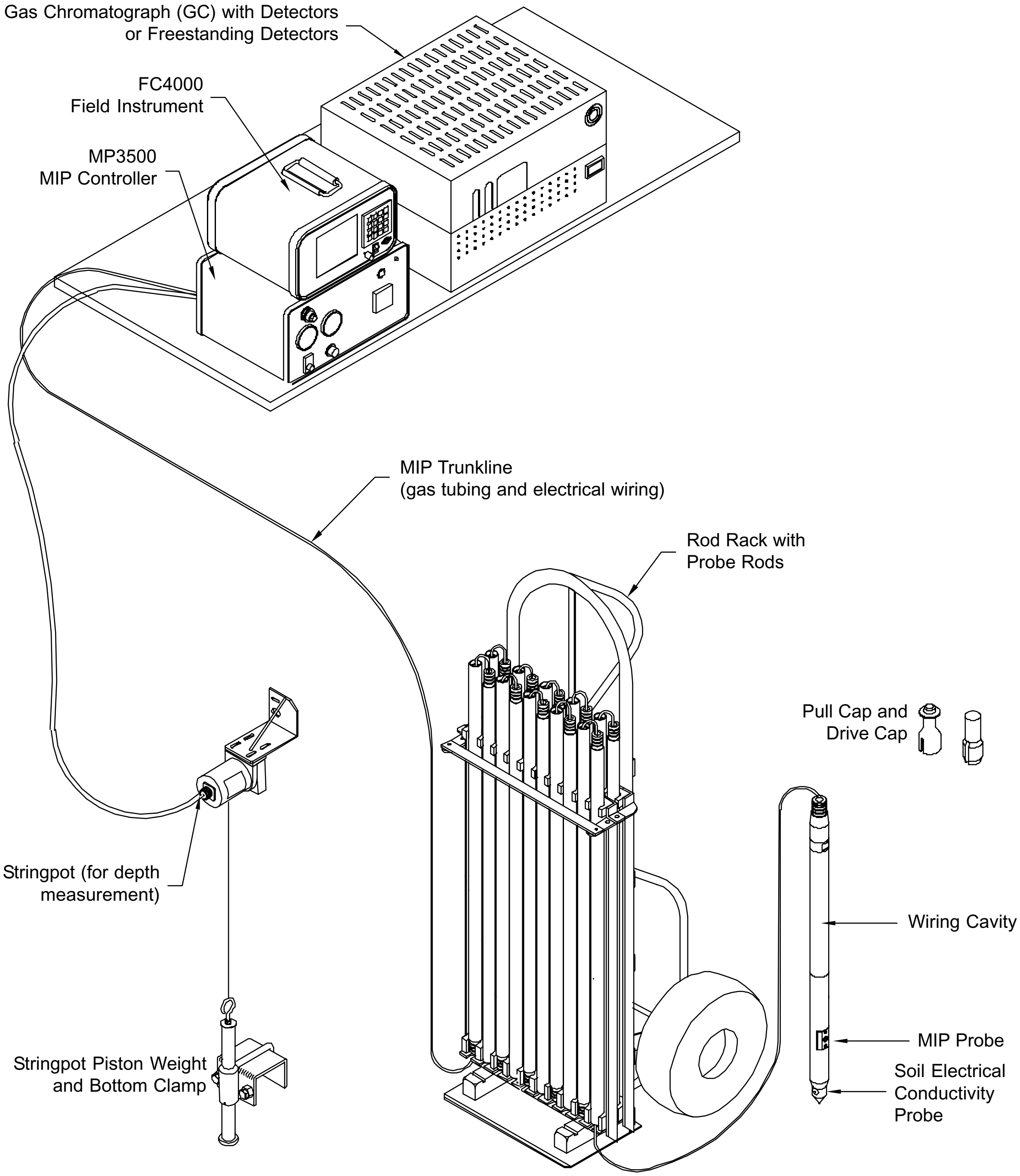

Figure 3.1
MIP system components

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.

Table 4.1
Density and required volumes of neat compounds used to make a 50 mg/mL working standard into 25 ml of methanol

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. Immerse the probe into the 5-gallon bucket of fine sand and water to stabilize the baseline. This is necessary due to the sensitivity of the photoionization detector (PID) and the electron capture detector (ECD) to water.

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.

Table 4.2
Volume of 50 mg/mL working standard and final concentration in 0.5 L test sample volume

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 5-gallon bucket of sand and water.

6. From the results on the MIP Time software the trip time and response time can both be measured (Fig. 4.2).

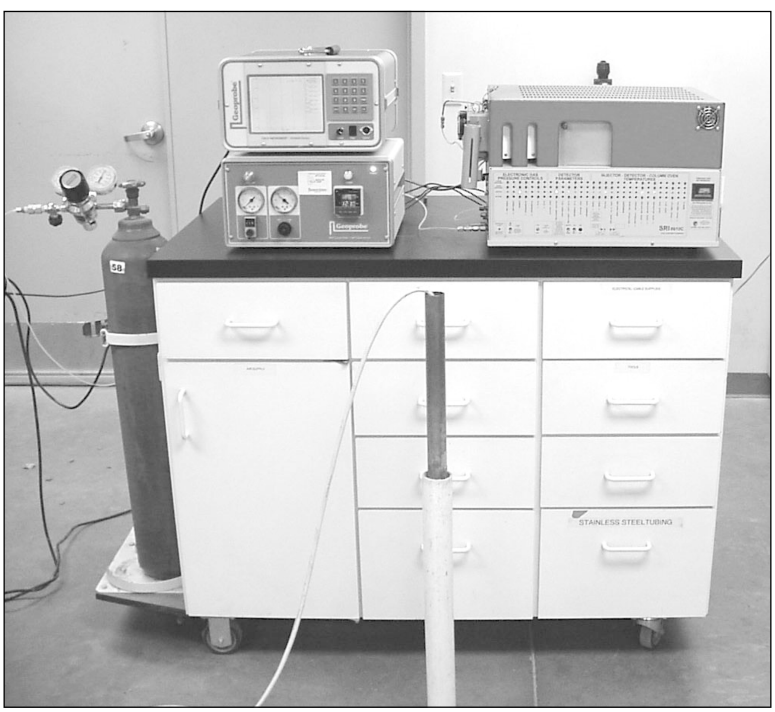

Figure 4.1
The MIP probe is placed in a PVC pipe containing the standard solution.

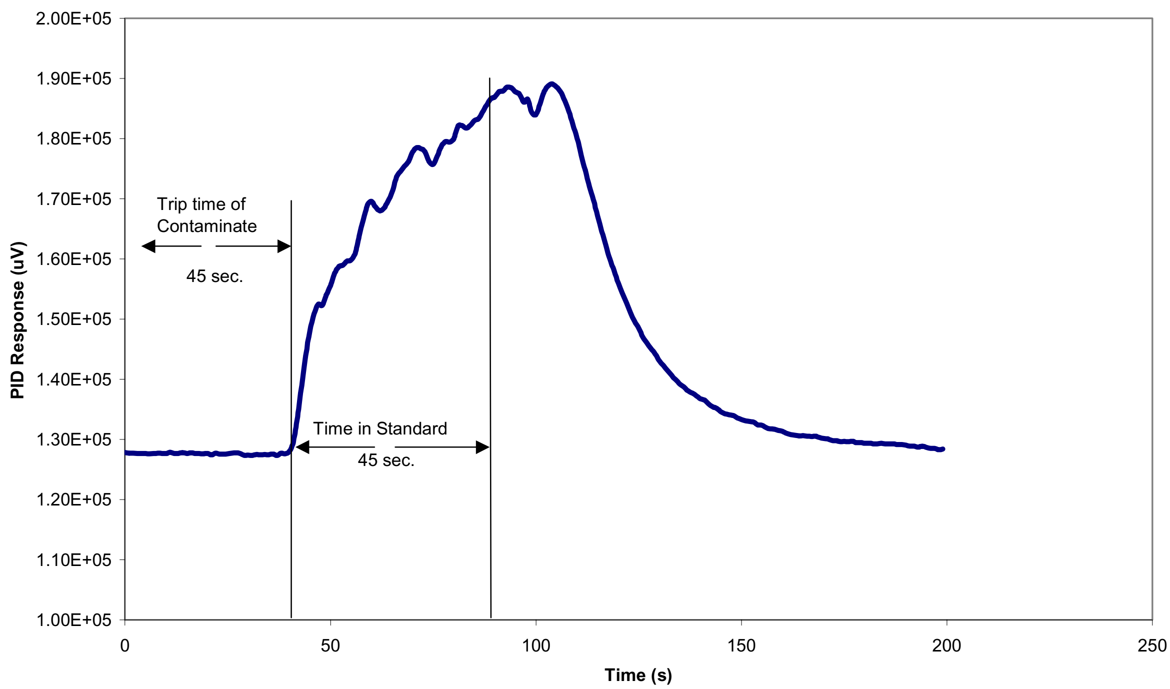

Figure 4.2
SRI PID Response Test - 10 ppm Benzene

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 MP2500 or MP3500 MIP Controller.

5. Power on the computer or the FC4000 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. If the trip time is different than what was placed into the software, restart the software and enter the correct trip time.

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.

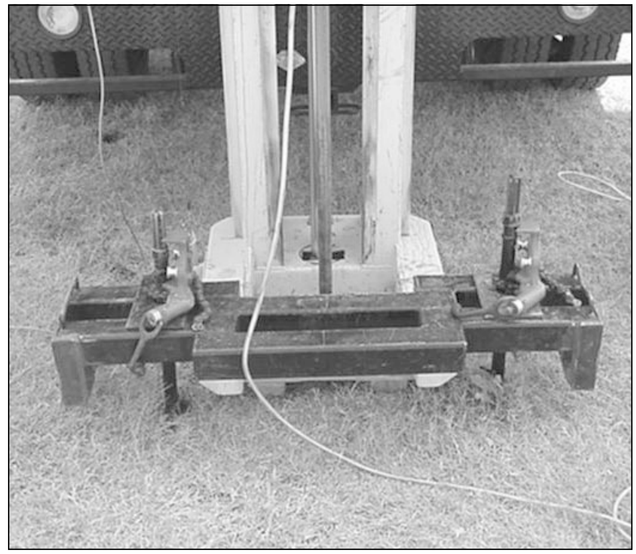

Figure 5.1
Anchor the probe foot to allow advancement of MIP probe by push only (no percussion).

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 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 <u>Not</u> 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.

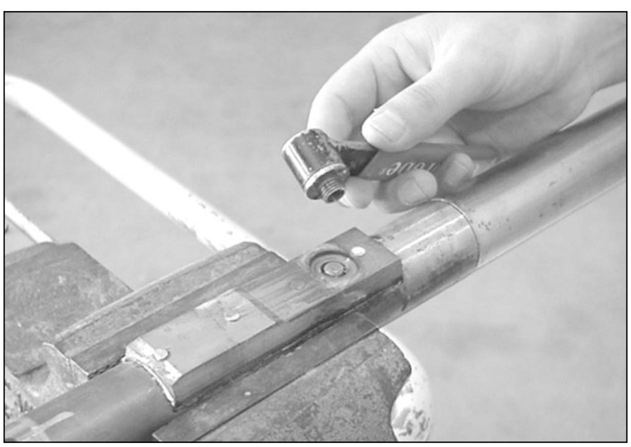

Figure 6.1
Unthread the membrane from the probe block.

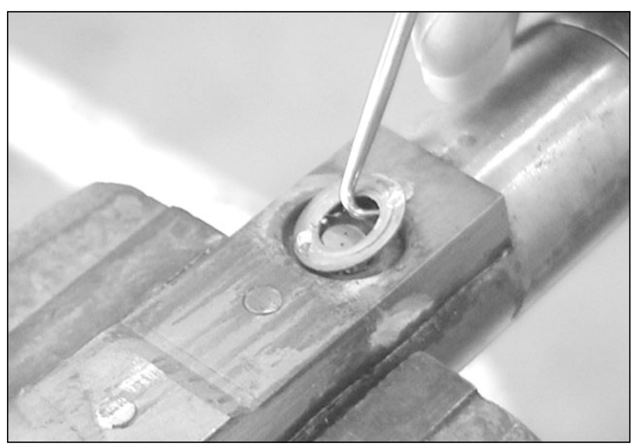

Figure 6.2
Remove and discard the copper washer.

Appendix I: Tools for Various Direct Push Machines

Model 5400 and 54DT Direct Push Machines

Description	***Part Number***
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

Description	***Part Number***
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

Description	***Part Number***
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

Description	***Part Number***
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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