GEOPROBE® MODEL MB470 MECHANICAL BLADDER PUMP

STANDARD OPERATING PROCEDURE

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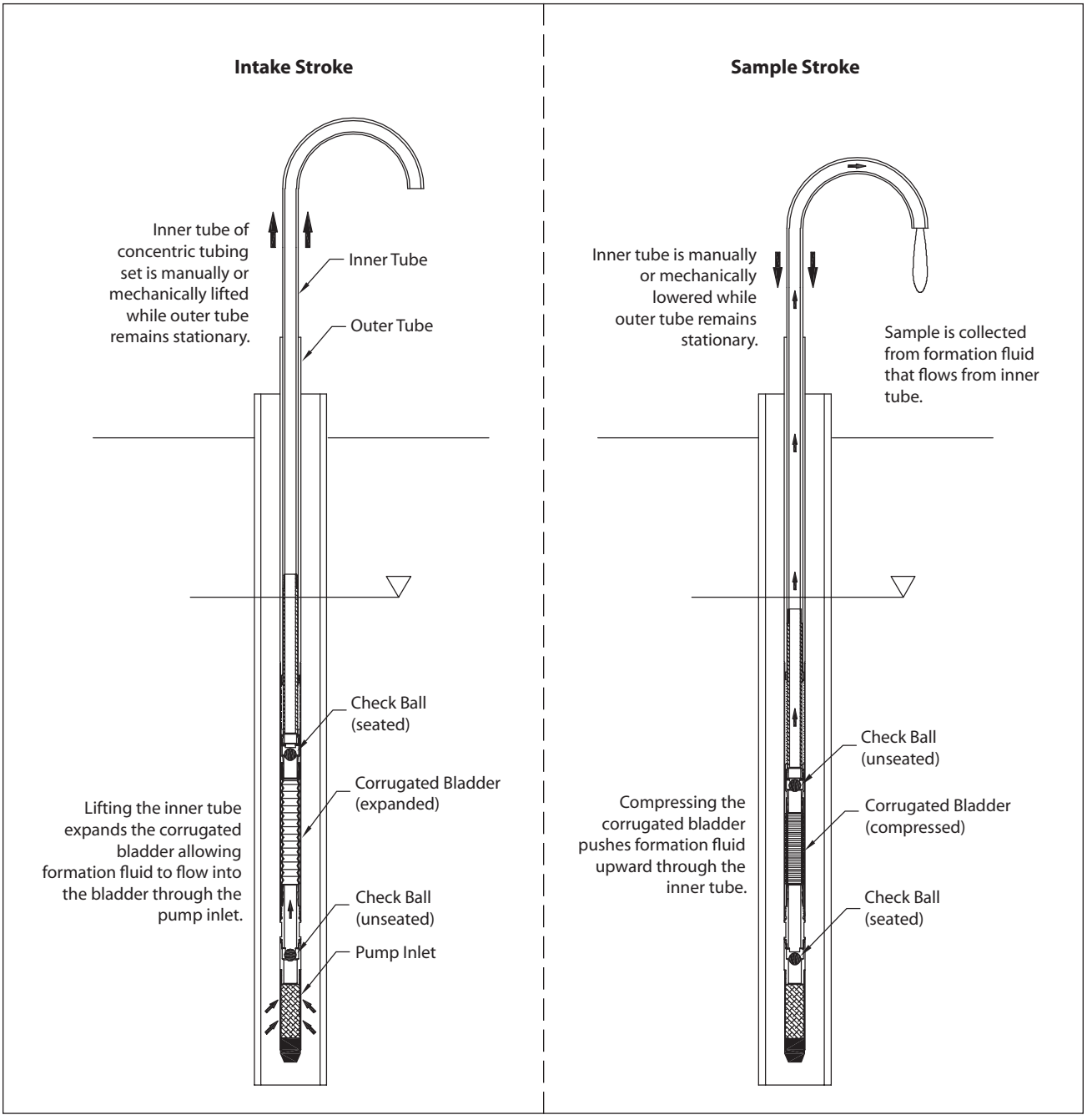

INTAKE AND SAMPLE STROKES OF THE MB470 MECHANICAL BLADDER PUMP

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**The Mechanical Bladder Pump is manufactured under
U.S. Patent No. 6,877,965 issued April 12, 2005.**

1.0 Objective

The objective of this document is to provide guidance on how to collect a representative sample of the subsurface formation fluid utilizing the Geoprobe® Model MB470 Mechanical Bladder Pump.

2.0 Background

2.1 Definitions

Geoprobe®*: A brand name of high quality, hydraulically-powered machines that utilize both static force and percussion or rotation 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, permeability and contaminant logging, grouting, and materials injection.
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MB470 Mechanical Bladder Pump (MBP):** A device for obtaining high-quality, low-turbidity samples from groundwater monitoring wells and direct push installed groundwater samplers as small as .5 inches (13 mm) inside diameter (ID). The MBP may be used to meet requirements of the low-flow sampling protocol (Puls and Barcelona 1996, ASTM 2003). Through participation in a U.S. EPA Environmental Technology Verification study, it was confirmed that the MB470 can provide representative samples (EPA 2003).
***The Mechanical Bladder Pump is manufactured under U.S. Patent No. 6,877,965 issued April 12, 2005.*

Within the MB470 pump body, a corrugated bladder is mechanically compressed and expanded to push groundwater to the surface through a concentric tubing set. The corrugated bladder can be made from either Teflon® fluorinated ethylene propylene (FEP) or polyethylene (PE). (Fig. 2.1) Check valves above and below the bladder control flow direction. The outer tube of the concentric tubing set holds the pump body in place while the inner tube is used to actuate the bladder and transmit water to the surface. The pump body and internal components are made of stainless steel with an outside diameter (OD) of .47 inches (12 mm) and an overall length of 26.75 inches (679 mm) with an inlet screen assembly installed.

2.2 MBP System Components

The three basic components of the Model MB470 Mechanical Bladder Pump system are the pump, concentric tubing set, and actuator.

Pump

All pump components (Fig. 2.1) are made of stainless steel material with the exception of the three fluorosilicone O-rings and the Teflon® or polyethylene bladder.

Beginning at the downhole end of the pump, either a Bullet Nose Intake (P/N 20675) or Inlet Screen Assembly (P/N 20725) may be used as determined by project requirements. The screen assembly includes a 60 mesh wire screen with an actual screen length of 6 inches (152 mm). The bullet nose intake is open at the leading end and provides no filtering effect.

Above the intake/inlet, the pump body contains the corrugated bladder and check balls that physically move groundwater to the surface for purging and sampling. As the top of the bladder is extended, the expanding action of the bladder draws groundwater into the bladder through the intake/inlet. Compressing the bladder then pushes the groundwater up through the connected inner tube of the concentric tubing set. Check balls at the Upper and Lower Bladder Adapters (P/N 20679 and 20677) control groundwater flow through the bladder.

The lower end of the corrugated bladder is secured to the pump body by the Lower Bladder Adapter (P/N 20677). The top of the bladder is attached to the inner tube of the concentric tubing set by the Upper Bladder Adapter (P/N 20679) and Inner Tube Adapter (P/N 21573). During operation of the pump, the inner tube is raised and lowered to expand and contract the bladder to move formation fluid to ground surface.

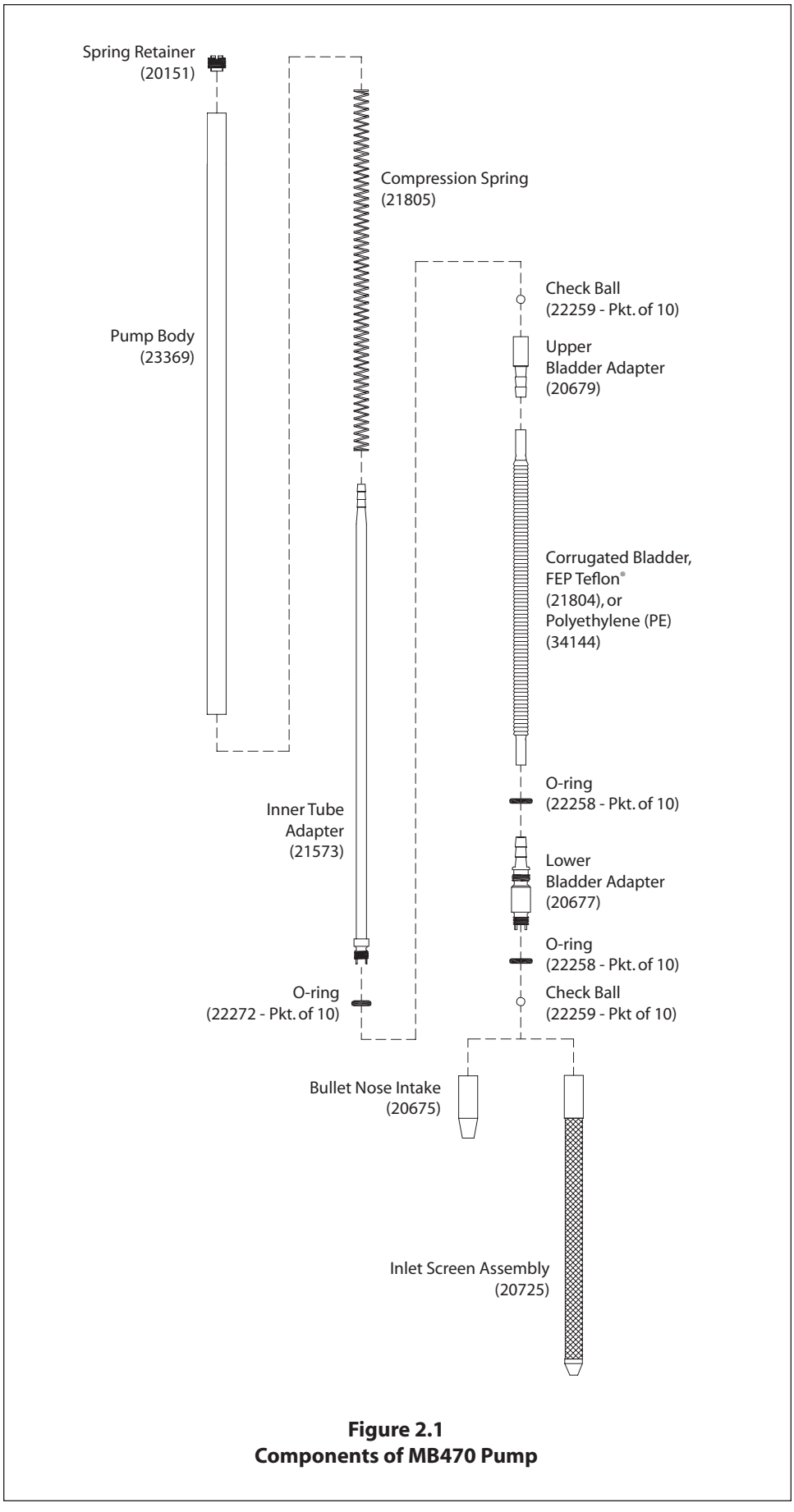


Figure 2.1
Components of MB470 Pump

Concentric Tubing Set

A concentric tubing set for the MB470 Mechanical Bladder Pump commonly consists of .19-inch (5 mm) ID / .25-inch (6 mm) OD Teflon® fluorinated ethylene propylene (FEP) tubing surrounded by .31-inch (8 mm) ID / .44-inch (11 mm) OD high-density polyethylene (HDPE) tubing. Where allowed by project requirements, other materials (e.g. low-density polyethylene (LDPE) or polypropylene (PP) tubing) may be utilized in place of the Teflon® inner tubing.

Available lengths for the concentric tubing set are 50 and 100 feet (15.2 and 30.5 m). Custom lengths may be assembled onsite from 500-foot rolls of appropriate tubing sizes and materials, some of which are listed on Page 6.

Refer to the inset view in Figure 2.2. The inner tube of the concentric tubing set is attached to the Inner Tube Adapter (P/N 21573) during assembly of the MB470 pump. The outer tube is then threaded inside the top end of the pump body. Once lowered down the sampler or monitoring well, the outer tube is held stationary either manually or by attachment to a mechanical actuator. The inner tube is raised and lowered by hand or through use of the mechanical actuator to expand and compress the pump bladder. Formation fluid is thus drawn into the pump bladder and then pushed to ground surface.

Actuator

Actuators provide the physical means of holding the outer tube of the concentric tubing set stationary while cycling the inner tube up-and-down. Actuator kits are available for manually, mechanically, or electrically powering the MB470 pump.

For the manual actuator shown in Figure 2.2, the outer tube of the concentric tubing set is attached to the probe rods using two adapters. The inner tubing is raised and lowered by hand to obtain the groundwater sample. Refer to Section 4.4 for more actuator options.

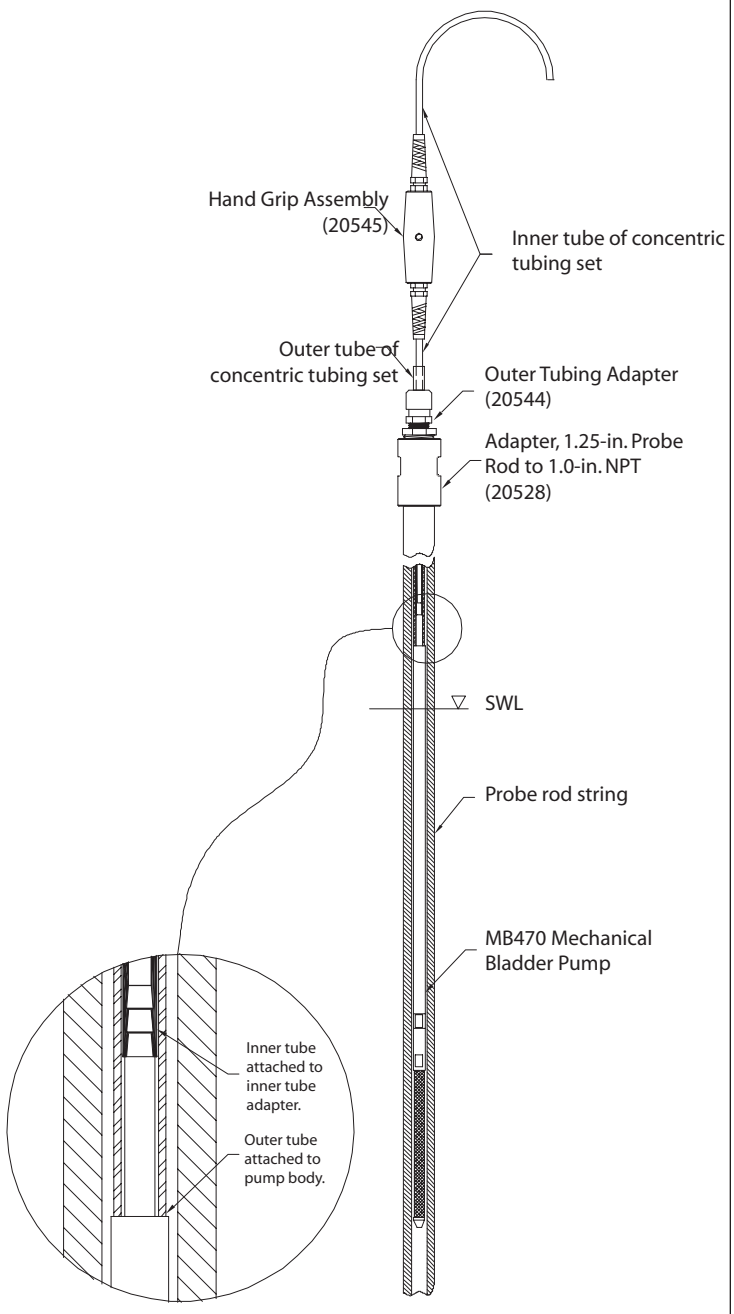


Figure 2.2
MB470 Mechanical Bladder Pump and manual actuator as used in a direct push installed groundwater sampler.

3.0 Required Equipment

The following equipment is required to collect representative groundwater samples using the Model MB470 Mechanical Bladder Pump. Refer to Figure 3.1 for identification of the specified parts.

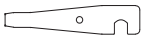
Pump Components	**Quantity**	**Part Number**
Mechanical Bladder Pump	-1-	MB470
Service Parts Kit, for MB470 Pump	-1-	MB7500
Includes: O-ring Pick	-1-	AT102
Compression Spring, Stainless Steel (SS)	-1-	21805
O-rings for Lower Bladder Adapter (#5-585 Fluorosilicone), Pkg. of 10	-1-	22258
O-rings for Inner Tube Adapter (#010 Fluorosilicone), Pkg. of 10	-1-	22272
Check Balls (7/32-in. diameter), SS, Pkg. of 10	-1-	22259
MBP Assembly Tool	-1-	20456
MBP Cleaning Brush Kit	-1-	MB7300
MBP Assembly Tool	-1-	20456
Corrugated Bladder, Teflon® FEP	-1-	21804
PE Bladder Kit (polyethylene bladders), Pkg. of 10	-1-	34144

Tubing Options	**Quantity**	**Part Number**
Concentric Tubing Set, HDPE (outer)/FEP (inner), .44-in. OD x 50-ft. length	Variable	MB5050
Concentric Tubing Set, HDPE/FEP, .44-in. OD - 100-ft. length	Variable	MB5100
Concentric Tubing Set, HDPE/LDPE, .44-in. OD - 50-ft. length	Variable	MB5051
Concentric Tubing Set, HDPE/LDPE, .44-in. OD - 100-ft. length	Variable	MB5101
Concentric Tubing Set, HDPE/PP, .44-in. OD - 50-ft. length	Variable	MB5052
Concentric Tubing Set, HDPE/PP, .44-in. OD - 100-ft. length	Variable	MB5102
LDPE Tubing, .19-in. ID x .25-in. OD - 100-ft. length	Variable	TB171L
LDPE Tubing, .19-in. ID x .25-in. OD - 500-ft. length	Variable	TB17L
Teflon® FEP Tubing, .19-in. ID x .25-in. OD - 50-ft. length	Variable	TB17T
Teflon® FEP Tubing, .19-in. ID x .25-in. OD - 100-ft. length	Variable	TB171T
Teflon® FEP Tubing, .19-in. ID x .25-in. OD - 500-ft. length	Variable	TB175T
PP Tubing, .17-in. ID x .25-in. OD - 50-ft. length	Variable	TB17P
PP Tubing, .17-in. ID x .25-in. OD - 100-ft. length	Variable	TB171P
PP Tubing, .17-in. ID x .25-in. OD - 500-ft. length	Variable	TB175P
HDPE Tubing, .31-in. ID x .44-in. OD - 50-ft. length	Variable	TB31H
HDPE Tubing, .31-in. ID x .44-in. OD - 100-ft. length	Variable	TB311H
HDPE Tubing, .31-in. ID x .44-in. OD - 500-ft. length	Variable	TB315H

Actuator Options	**Quantity**	**Part Number**
Manual Actuator Kit	-1-	MB7000
Includes: Hand Grip Assembly	-1-	20545
Outer Tubing Grip	-1-	22758
Outer Tubing Adapter	-1-	20544
Mechanical Actuator Assembly	-1-	MB6000
Electric Actuator Assembly, 12VDC	-1-	MB6120
Electric Actuator Kit, 12VDC	-1	MB6120K
Well Mount Kit (for use with MB6000)	-1-	MB7200

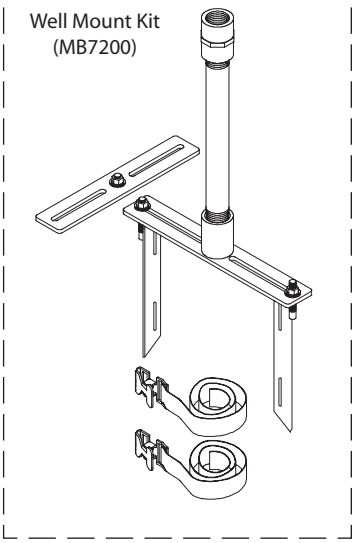
Adapters for Use with Actuators, and for profiling	**Quantity**	**Part Number**
MBP PVC Riser Adapter Kit	-1-	MB7100
Includes: PVC Extension, 1.0-in. NPT Pin x 1.0-in. NPT Pin - 12-in. Length	-1-	17560
PVC Coupling, 1.0-in. NPT Box x 1.0-in. NPT Box	-1-	21145
Adapter, 2.0-in. PVC to 1.0-in. NPT Pin	-1-	22759
O-rings for 2.0-in. PVC to 1.0-in. NPT Pin Adapter, pkg. of 25	-1-	22313
Adapter, 1.0-in. PVC to 1.0-in. NPT Pin	-1-	17558
O-rings for 1.0-in. PVC to 1.0-in. NPT Pin Adapter, pkg. of 25	-1-	13942
Adapter, 0.75-in. PVC to 17558 Adapter (0.75-in. PVC requires 2 adapters)	-1-	19424
O-rings for 0.75-in. PVC to 17558 Adapter, pkg. of 25	-1-	13196
Adapter, 0.5-in. PVC to 17558 Adapter (0.5-in. PVC requires 2 adapters)	-1-	17559
O-rings for 0.5-in. PVC to 17558 Adapter, pkg. of 25	-1-	GW1555R
Adapter, Geoprobe® 1.25-in. Probe Rod Pin to 1.0-in. NPT Pin	-1-	20528
Adapter, Geoprobe® 1.5-in. Probe Rod Pin to 1.0-in. NPT Pin	-1-	20529
MBP Adapter 1.5-in., LH Thread	-1-	28709
MBP Inner Tube Coupler	-1-	28711
MBP Outer Tube Coupler	-1-	28710

Mechanical Bladder Pump
(MB470)

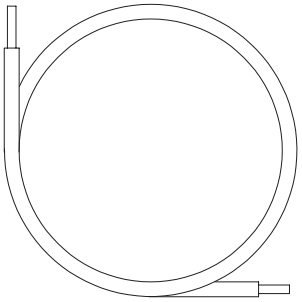


MBP Assembly Tool
(20456)

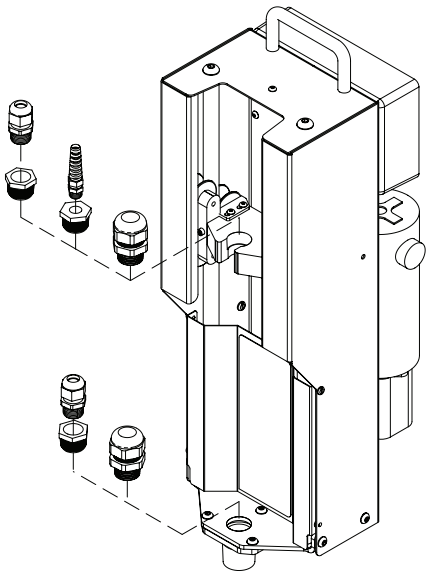
Service Parts Kit, for MB470 Pump
(MB7500)



Well Mount Kit
(MB7200)



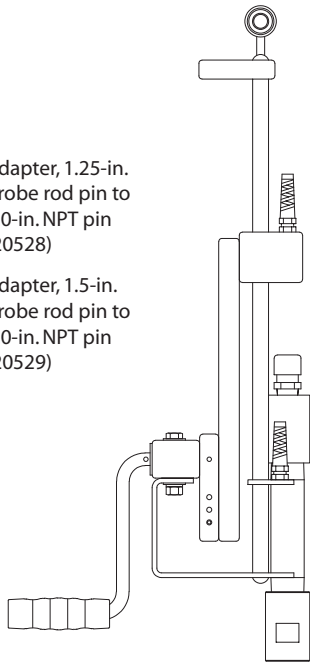
Concentric Tubing Set
(see Page 6 for part numbers)



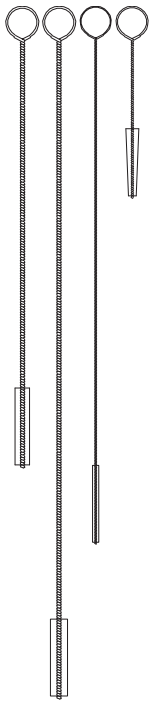
Electric Actuator Assembly, 12VDC
(MB6120K)

Adapter, 1.25-in.
probe rod pin to
1.0-in. NPT pin
(20528)

Adapter, 1.5-in.
probe rod pin to
1.0-in. NPT pin
(20529)

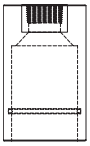


Mechanical Actuator Assembly
(MB6000)

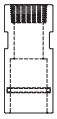


MBP Cleaning Brush Kit
(MB7300)

PVC Coupling,
1.0-in. NPT
(21145)



Adapter, 2.0-in. PVC to
1.0-in. NPT pin
(22759)



Adapter, 1.0-in. PVC to
1.0-in. NPT pin
(17558)

PVC Extension,
1.0-in. NPT Pin x
1.0-in. NPT pin,
12.0-in. length
(17560)

Adapter, .75-in. PVC to
17558 adapter
(19424)

Adapter, .5-in. PVC to
17558 adapter
(17559)

MBP PVC Riser Adapter Kit (MB7100)

Hand Grip Assembly
(20545)

Outer Tubing
Adapter
(20544)

Outer Tubing Grip
(22758)

Manual Actuator Kit (MB7000)

Figure 3.1
MB470 Mechanical Bladder Pump Parts and Accessories

4.0 Operation

Use and operation of the MB470 Mechanical Bladder Pump may be divided into five main steps:

- ***Assembling the Pump***
- ***Selecting and installing the concentric tubing set***
- ***Selecting and installing the actuator and pump***
- ***Purging and sampling***
- ***Decontaminating the Pump***

4.1 Assembling the Pump

This section identifies the procedures for assembling the components of the MB470 Mechanical Bladder Pump and performing a leak check on the corrugated bladder. Refer to Figure 4.1 for parts identification.

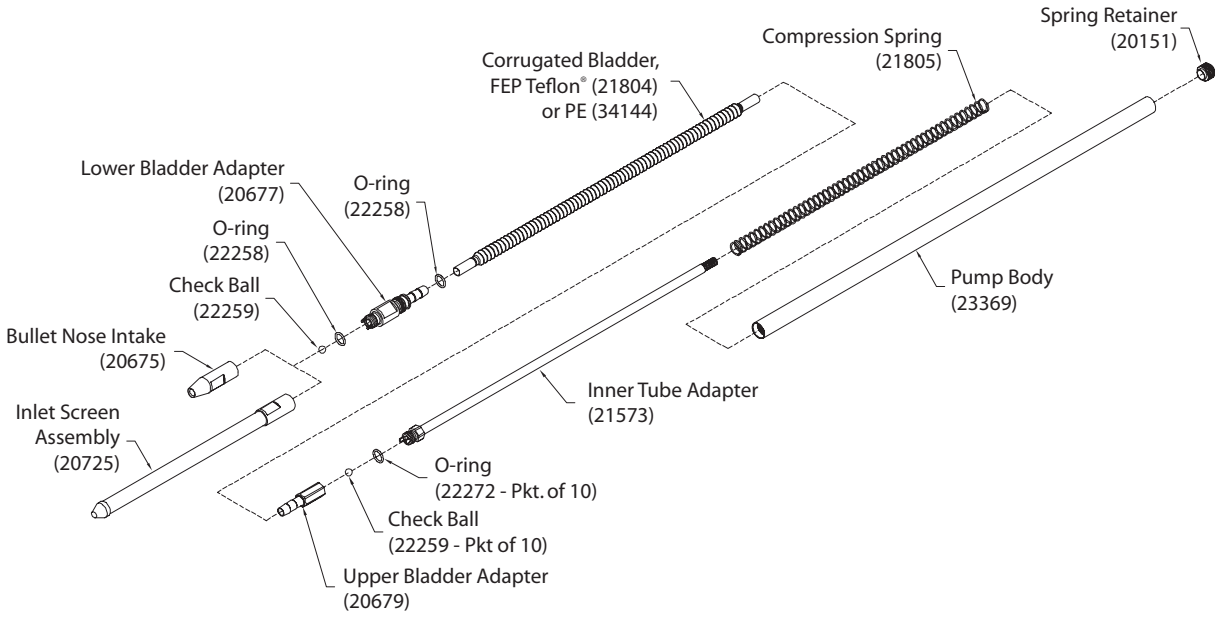


Figure 4.1
Isometric exploded view of the MB470 Mechanical Bladder Pump

1. Ensure that all metal parts are clean and free of burrs that may damage the pump threads or the corrugated bladder during assembly.

2. Install two fluorosilicone O-rings (22258) on the Lower Bladder Adapter (20677). Note that these are the larger of the two sizes of O-rings used with the MB470 pump.

3. Lubricate the O-ring of the lower bladder adapter and inside the Bullet Nose Intake (20675) with DI water. Place a Check Ball (22259) in the bullet nose intake and thread the intake onto the lower bladder adapter.

   Note: The bullet nose intake is used here to make it easier to leak check the pump later in this procedure. After the leak check has been performed, the bullet nose intake may be replaced with a Screen Inlet Assembly (20725) if desired.

4. Install a fluorosilicone O-ring (22272) on the lower end of the Inner Tube Adapter (21573). Note that this is the smaller of the two sizes of O-rings used with the MB470 pump.

5. Lubricate the O-ring of the inner tube adapter and inside the Upper Bladder Adapter (20679) with DI water. Thread the upper bladder adapter onto the inner tube adapter.

   Note: A check ball must be installed in the upper bladder adapter after performing the leak check in Step 7.

6. Install the Teflon® FEP Corrugated Bladder (21804) or the PE Bladder (34144):

   A. Teflon® FEP Corrugated Bladder

   • The bladder should be installed with the corrugations pointing "up" (toward the upper bladder adapter/inner tube adapter) as indicated in Figure 4.2.

   • Firmly push and rotate the lower cuff of the bladder over the barbed end of the lower bladder adapter.

   • Firmly push and rotate the upper cuff of the bladder over the barbed end of the upper bladder adapter.

   • Both ends of the bladder should be fully seated on the adapter barbs.

   CAUTION: Although firmness is required during installation of the bladder, avoid crushing, kinking, or twisting the bladder corrugations to prevent damage.

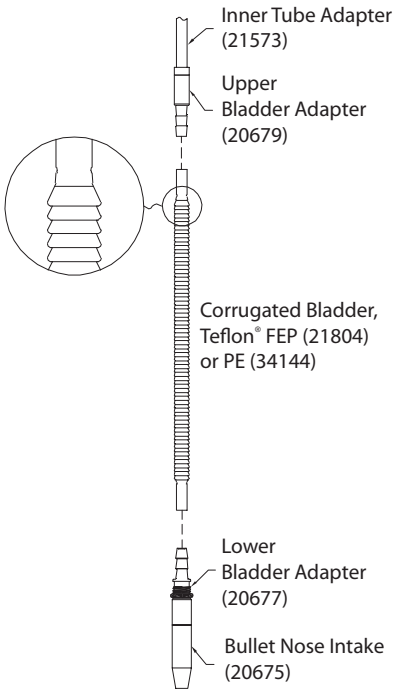


Figure 4.2
Bladder corrugations should point "up"

   B. Installation of PE Bladder on the Barbed Fittings

   First disassemble the pump (Figure 4.1) and remove existing bladder if in place. It may be necessary to use a knife to split the cuffs if an FEP Teflon® Bladder is on the pump.

   Attach the PE bladder to the lower bladder adapter (PN 20677) and upper bladder adapter (PN 20679) following the steps below (see Figures 4.3 and 4.4). Reassemble the pump (Figure 4.1) replacing any damaged O-rings.

7. Perform a leak check on the corrugated bladder before fully assembling the pump components to ensure that the bladder assembly is free of leaks.

Figure 4.3: Install bladder on lower bladder adapter (PN 20677) with gentle but firm twist and push.

Figure 4.4: Push and twist the bladder onto the barbed fitting until 5 to 7 corrugations are compressed over the barbs. Repeat the same procedure for the upper bladder adapter (PN 20679)

Leak check the corrugated bladder as follows:

- Completely submerge the bladder and lower end of the inner tube adapter in a clean beaker or small bucket of distilled or DI water. Place thumb or finger over the open end of the bullet nose inlet to provide an air-tight seal.

- Firmly blow into the open end of the inner tube adapter. Leaks in the bladder or assembled parts will be indicated by bubbles.

- If leaks are found, replace the damaged O-ring(s) or bladder. Retest to ensure that all leakage has stopped.

- Once the pump has passed the leak test, unthread the upper bladder adapter from the inner tube adapter. Place a Check Ball (22259) in the upper bladder adapter and reinstall it in the inner tube adapter.

- Replace the bullet nose intake with an Inlet Screen Assembly (20725) if desired. Remember to include the check ball when installing the inlet screen.

8. The Pump Body (23369) is internally threaded at each end. Threads run all the way to the end of the pump body at the upper end, but stop .25 inches (6 mm) from the end at the lower end of the pump body to permit an O-ring seal with the lower bladder adapter (20677).

Thread the Spring Retainer (20151) into the top of the pump body. Install the retainer with the slotted end out to allow use of a medium slotted screw driver or the MBP Assembly Tool (20456) to thread or unthread the retainer.

9. Place the Compression Spring (21805) over the top of the inner tube adapter. Slide the spring completely onto the adapter until it contacts the hex fitting.

10. Slide the lower end of the pump body over the top of the inner tube adapter and pump spring. The inner tube adapter will slip through the spring retainer and extend approximately 3 inches (75 mm) from the top of the pump body.

11. The lower bladder adapter is now threaded into the pump body to complete the assembly process.

- Lubricate the O-ring on the lower bladder adapter and inside the lower end of the pump body with DI water.

- Grasp the pump body with one hand and the lower bladder adapter with the other hand.

- Gently compress the spring and bladder into the pump body.

- Thread the lower bladder adapter into the pump body. Use care to avoid cutting or pinching the O-ring while threading the parts together. The O-ring will no longer be visible when the adapter is fully seated.

Assembly of the MB470 Mechanical Bladder Pump is now complete.

4.2 Selecting and Installing the Concentric Tubing Set

Selecting the Concentric Tubing Material

The outer tube of the concentric tubing set commonly consists of .44-inch OD x .31-inch ID (11.2 mm x 7.9 mm) HDPE material. Inner tube material options are Teflon® FEP, LDPE, or PP. Teflon® FEP and LDPE tubing have dimensions of .25-inch OD x .19-inch ID (6.4 mm x 4.8 mm) while the PP tubing measures .25-inch OD x .17-inch ID (6.4 mm x 4.3 mm). Preassembled concentric tubing sets are available from Geoprobe in lengths of 50 and 100 feet (15.2 and 30.5 m). Separate rolls of tubing material for both inner and outer tubes are also available in lengths of 100 or 500 feet (30.5 or 152.5 m). See Section 3.0 for a list of available tubing materials, lengths and part numbers.

LDPE inner tubes are the least expensive option. The elasticity of this material may be excessive for deeper wells and in warm ambient conditions (summertime). Teflon® FEP inner tubes are less elastic and provide higher sample quality compared to LDPE due to the chemical properties of the two materials. Teflon® FEP also has a lower coefficient of friction for smoother actuation of the bladder and less resistance to operation, especially at greater depths. The main drawback of Teflon® FEP is its higher cost. PP inner tubes provide a compromise between LDPE and Teflon® FEP in that they are less elastic and provide higher sample quality than LDPE at a lower cost than Teflon® FEP.

While Teflon® FEP exhibits relatively good chemical inertness, it will absorb and desorb some volatile organic contaminants (Parker & Ranney 1998). Because of this, ambient groundwater should be purged through the pump and tubing system for a period of time to achieve equilibrium between the bladder and tubing and sample fluid. The period of time may vary for different volatile organic compounds (VOCs), but if low flow sampling (Puls and Barcelona 1996, ASTM 2003) is conducted, chemical equilibrium may be achieved by the time the monitored water quality parameters (DO, ORP, turbidity, etc.) have stabilized.

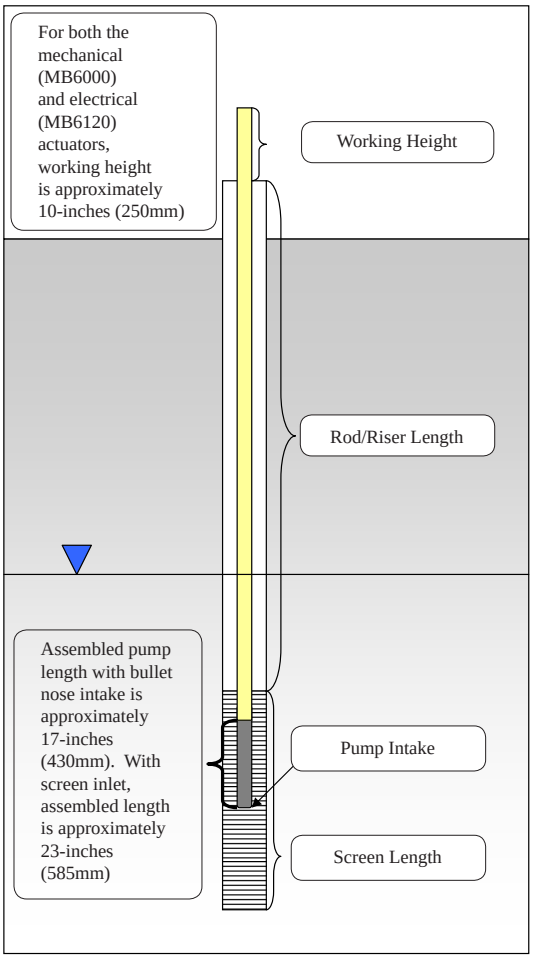


Figure 4.5
Determine Tube Length

Pump Depth/Tubing Length

To determine the length of outer tubing required for your sampling location refer to Figure 4.5. Be sure to leave the inner tube at least 3 feet (~1m) longer than the outer tube to facilitate pump operation and sample collection. Calculate the required outer tubing length as follows:

Outer Tubing Length = Working Height + Rod/Riser Length + ½(Screen length)* – Pump Length

* Pump intake is most often placed at midpoint of screen, adjust if necessary for your specific application.

If you are using the Manual Actuator kit (MB7000) the working height will simply be a comfortable distance above the top of rod/casing where you want to hold the grips to operate the pump. When you are using the Mechanical (MB6000) or Electrical (MB6120) actuators the working height will be approximately 10-inches (250mm). If unsure of exact length required cut outer tube a little longer and trim once setup is confirmed.

NOTE: Concentric tubing must be unrolled to allow for pump installation. Inner tube will not slide in outer tube with just one loop in the tube set.

For precise measurement of tubing length sections of clean PVC casing may be assembled together and placed on the ground surface. Cap one end to keep out dust and dirt. Assemble PVC sections to be just short of desired tubing length. Insert the concentric tubing set and cut the outer tube (Figure 4.6) to desired length and leave inner tube at least 3 feet longer. Assembled PVC sections may also be used for assembly of concentric tube sets that are prepared in the field from separate rolls of outer and inner tubing. Simply slide the outer tube into the PVC casing and cut to length. Then insert the inner tube in the outer tube and cut about 3 feet longer. Once the tubing is cut to length install the pump on the tubing, see next section.

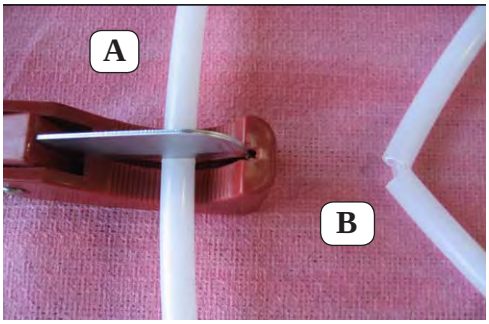


Figure 4.6 A poly tubing cutter or pocketknife is used to score the outer tube (A). Rotate cutter back-and-forth to keep single clean score. Then grasp the outer tube and bend across the scored mark to break through the outer tubing (B). The inner tube is not cut or damaged and may be left longer as needed for sampling. Note: Use care when cutting with sharp tools to prevent injury.

Since the tubing must be unrolled to allow for pump installation a field friendly method to determine tubing length is:

- Insert one end of the tube set in the well-head as the tubing is unrolled.
- Continue to unroll tubing down the well until the bottom end of the tube contacts the bottom of the well.
- Decide on your working height. Mark this length on the outer tube.
- Retract the tubing ½ screen length + pump length. Mark tube here.
- Cut outer tube at this lower mark. Leave inner tube at least 3 feet (~1m) longer. Be careful not to drop tubing down the well.
- Install pump on end of tubing set sticking out of well-head (see next section).
- Retrieve tubing and insert pump down the well.

Keep all tubing stored in clean airtight bags or containers so that dirt, dust, and cross contamination are not a concern or problem. No matter how clean the pump is, sample quality will suffer if the tubing is dirty. Be sure the tubing is of clean, quality material and is not marked with inks that may contribute to cross contamination.

Attaching Pump To Concentric Tubing

To attach the assembled pump to the concentric tubing, the tubing must first be unrolled. The easiest method is to hang the concentric tubing down the well the appropriate distance for your sampling depth. Cut the concentric tubing to length, being sure to leave the inner tube about 3 feet (~1m) longer than the outer tube (see previous section). Be careful not to drop the tubing down the well. Use Vise-Grip® locking pliers or similar tool to hold the tubing (do not crush or kink the tubing). Alternatively, as the tubing is unrolled, it can be inserted through a string of .5-inch PVC casing laid out on the ground surface. Follow the steps outlined in Figures 4.7 and 4.8 to install the inner tube on the inner tube adapter.

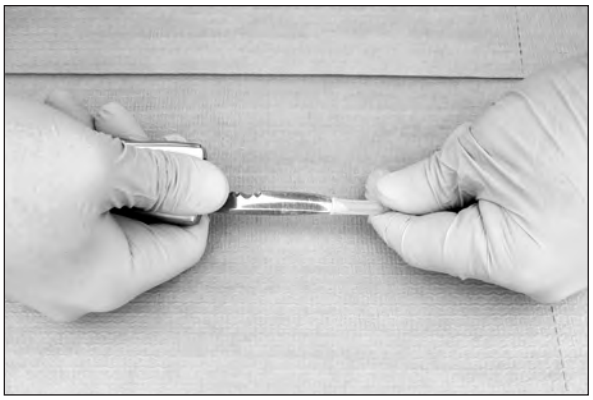


Figure 4.7: Use a knife blade or similar tool to swedge out the end of the PP tube to make this stiff tubing easier to install on the inner tube adapter (PN 21573). Rotate and gently push the blade into the open end of the tube.

Caution: Use care with sharp tools to prevent injury.

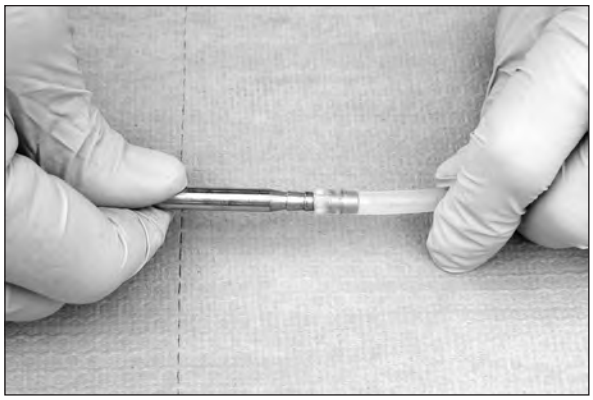


Figure 4.8: Firmly twist and push the inner tube onto the barbed end of the inner tube adapter. Be careful not to kink the tubing. PP tubing should cover at least 2 barbs. Push the tubing over 3 or more barbs if polyethylene or FEP Teflon® inner tubing is used.

Gently slide the inner tubing down inside the outer tubing until the top of the pump body touches the outer tubing. Follow the steps outlined in Figures 4.9 and 4.10 to install the pump on the outer tubing.

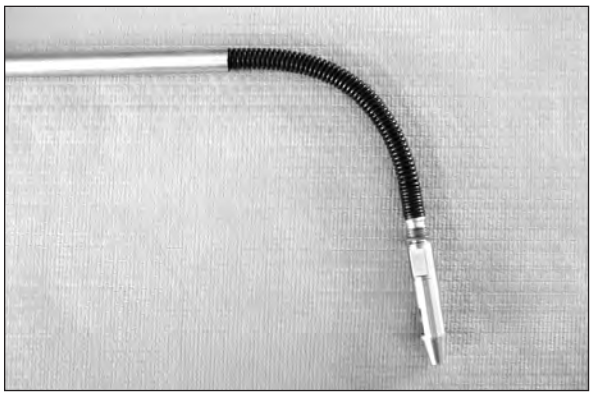


Figure 4.9: Unthread the lower bladder adapter (PN 20677) from the bottom of the pump body. This will prevent damage to the bladder as the pump body is rotated to attach to the outer tube.

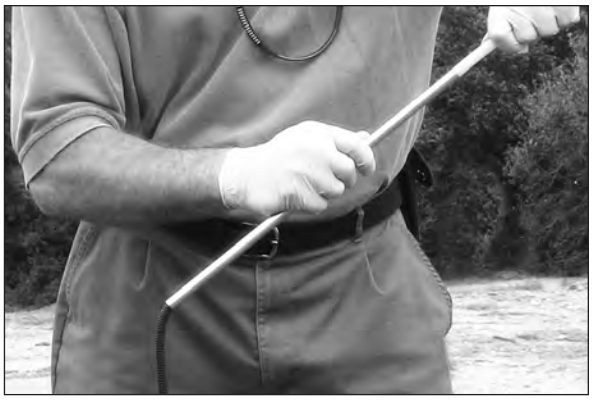


Figure 4.10: Firmly push and twist the pump body onto the outer tube. Threads inside the pump body will self-thread onto the outer poly tubing. The tubing should thread about 0.5 to 0.75 inches (12 to 18 mm) into the pump body.

Gently push the bladder back into the pump body and thread the lower bladder adapter back onto the bottom of the pump body. Be sure the O-ring seats and seals. Retrieve the concentric tubing and pump from well or PVC casing. Lower the pump back down the well or groundwater sampler. Do not drop.

4.3 Selecting and Installing the Actuator

Operating the mechanical bladder pump requires holding the outer tube of the concentric tubing set stationary while moving the inner tube up-and-down. Although this maneuver is possible by simply holding the outer tube in one hand and moving the inner tube with the other hand, an actuator makes operation of the pump significantly easier.

NOTE: The tubing set must be completely unrolled for the inner tube to slide freely within the outer tube.

This section identifies the available actuator options. Methods by which the actuators attach to the concentric tubing set and are installed on the monitoring well or tool string are also addressed.

Handheld Manual Actuator

With this option, a Hand Grip Assembly (20545) and Outer Tubing Grip (22758) are installed on the concentric tubing set (Fig. 4.11). Sampling or purging is accomplished by physically holding the outer tubing grip in one hand while raising and lowering the hand grip assembly with the other hand. A handheld actuator may be used to purge or collect samples from a temporary groundwater sampler or from a permanent monitoring well.

Installation of the handheld actuator is described below.

1. Leading with the end opposite the compression fitting, slide the outer tubing grip over the top end of the tubing set. It may be necessary to loosen the fitting slightly (Fig. 4.11) to allow installation.

2. The specific location of the grip should be determined by operator preference. The important thing is that the pump inlet is maintained at the appropriate level during sampling as determined in Section 4.2.

3. Secure the grip to the outer tube by tightening the large nut of the compression fitting (Figure 4.11) until it is "hand tight". Do not overtighten as this may damage the plastic fitting.

4. Carefully cut off any excess outer tube leaving at least .25 inches (6 mm) above the compression fitting. (Note that the inner tube is not cut at this location). Measure and cut the inner tube leaving it at least 3 feet (1 m) longer than the outer tube.

5. Slide the hand grip assembly over the inner tube and position it 1-2 inches (25-50mm) above the outer tubing grip as shown in Figure 4.11. It may be necessary to first loosen the two compression fittings to allow installation over the inner tube.

6. Secure the hand grip by tightening the two compression fittings. Take care not to overtighten and damage the fittings. Also avoid kinking the inner tube while completing this step

To operate the mechanical bladder pump with the handheld actuator, simply insert the pump into the probe rod string or monitoring well. Lower the pump and concentric tubing set until the tubing set is at the desired working height (Figure 4.5). Initiate pump flow by holding the outer tubing grip stationary with one hand while cycling the hand grip assembly up-and-down with the other hand. A pump stroke of up to approximately 6 inches (150 mm) is recommended.

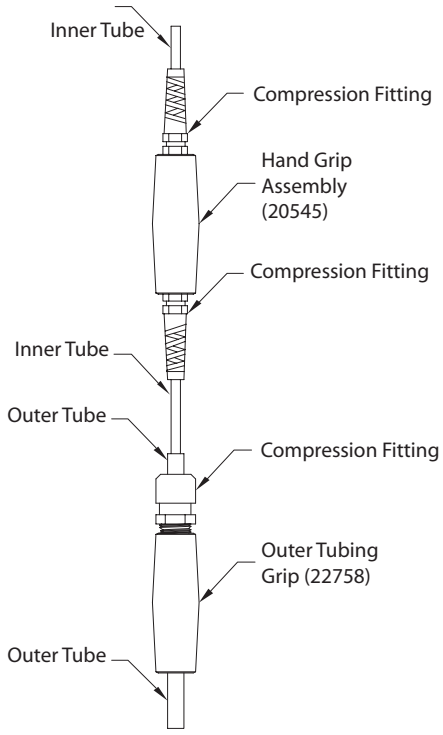


Figure 4.11
Close-up view of hand grip and outer tubing grip

Anchored Manual Actuator

The anchored actuator option is similar to the handheld actuator in that the mechanical bladder pump is cycled by physically raising and lowering the inner tube using the Hand Grip Assembly (20545). While the handheld actuator requires a second hand to hold the outer tube, the anchored actuator option utilizes adapters to mechanically secure the outer tubing to the top probe rod or riser pipe as shown in Figure 4.12. Determine the appropriate tubing length and install the assembled mechanical bladder pump on the tubing set as outlined in Sections 4.1 and 4.2.

Review Figures 4.8, 4.9 and 4.10 and Table 4.1 to select and assemble the appropriate adapters for the size probe rod or PVC riser diameter you are using. The PVC riser adapters are available in a complete kit (MB7100) or individually. Be sure to order the correct O-ring sizes if PVC adapters are ordered individually (see Section 3.0 for listing). The O-rings are required so the adapter will grip the PVC riser and hold the outer tubing in place.

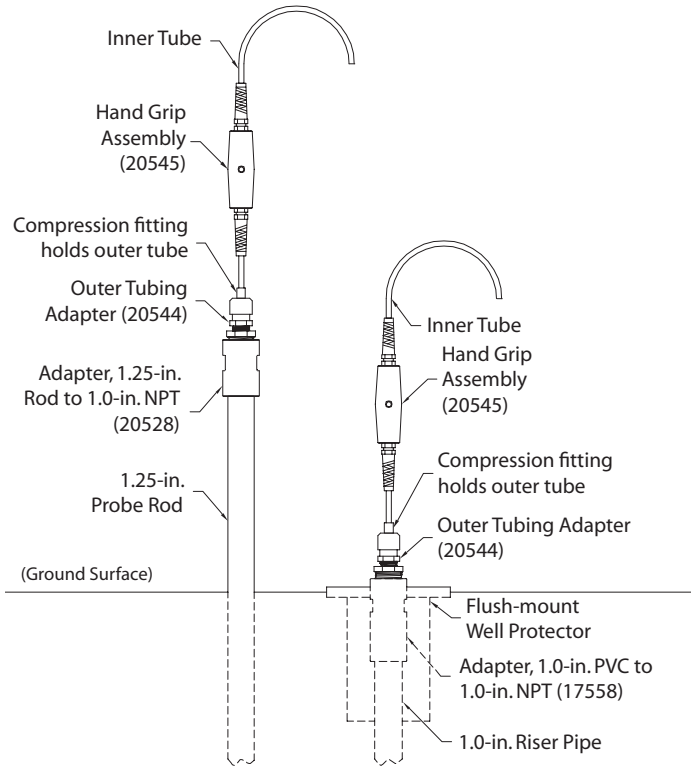


Figure 4.12
Manual actuator parts for use with groundwater samplers and monitoring wells. (Part numbers specified for 1.25-inch probe rods and 1.0-inch riser pipe.)

Proceed with anchored manual actuator installation as follows:

1. Assemble the appropriate probe rod or PVC adapter referring to figures 4.13, 4.14, and 4.15, and Table 4.1

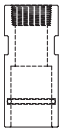
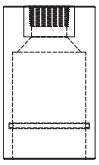
Drawing	P/N	Description	Drawing	P/N	Description	Drawing	P/N	Description
	20544	Outer Tubing Adapter		20529	Adapter, 1.5-in. probe rod pin to 1.0-in. NPT pin		17558	Adapter, 1.0-in. PVC to1.0-in. NPT Pin
	20528	Adapter, 1.25-in. probe rod pin to 1.0-in. NPT pin		22759	Adapter, 2.0-in. PVC to 1.0-in. NPT Pin		19424	Adapter, .75-in. PVC to17558 Adapter
							17559	Adapter, .5-in. PVC to17558 Adapter

Table 4.1
Adapters for attaching the outer tube to probe rods and PVC riser pipe.

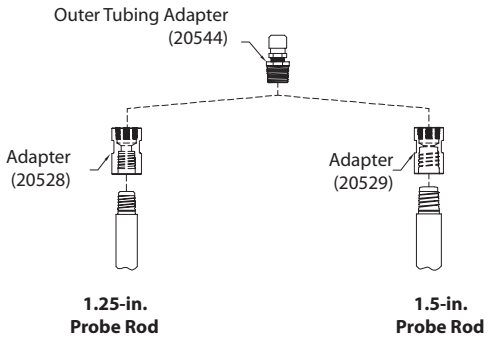


Figure 4.13
Adapters for attaching the outer tube to 1.25- and 1.5-inch probe rods.

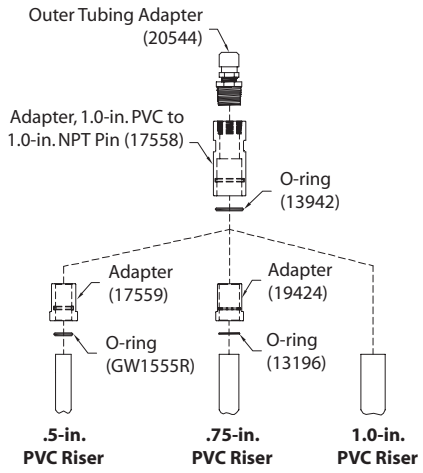


Figure 4.14
Adapters for attaching the outer tube to .5-, .75-, and 1.0-inch PVC riser pipe.

2. Carefully insert the pump and concentric tubing assembly down the well (see Section 4.2).

3. Slide the top end of the tubing set through the base of the assembled adapter(s) until the outer tubing extends about ½-inch above the top of the Outer Tubing Adapter (20544) (see Figure 4.12).

4. Tighten the compression fitting at the top of the Outer Tubing Adapter by hand to firmly grip the outer tubing.

5. Lower the pump down the well and slip the adapter over the PVC riser or thread the adapter onto the probe rod (see Figure 4.12). If the top of the PVC riser has a sharp or jagged edge it may be necessary to smooth and round the cut pipe with sand paper to make installation easier. Lubricating with DI water will help slip the O-ring in place.

6. Loosen the compression fittings on each end of the Hand Grip Assy (20545). Slide the assembly over the inner tube until the bottom end of the assembly rests against the top of the outer tube.

7. Hand tighten both compression fittings on the Hand Grip Assembly.

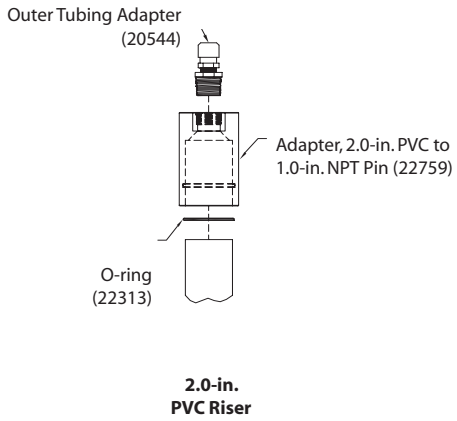


Figure 4.15
Adapters for attaching the outer tube to 2.0-inch PVC riser pipe.

Raise and lower the Hand Grip Assy and inner tube to operate the pump and purge the well or sample the water. Length of stroke is usually 4 to 6 inches (100 to 150 mm). Slightly longer stroke may be needed if PE inner tube is used. If the tubing slips in the Outer Tubing Adapter or the Hand Grip Assy retighten the compression fittings as required.

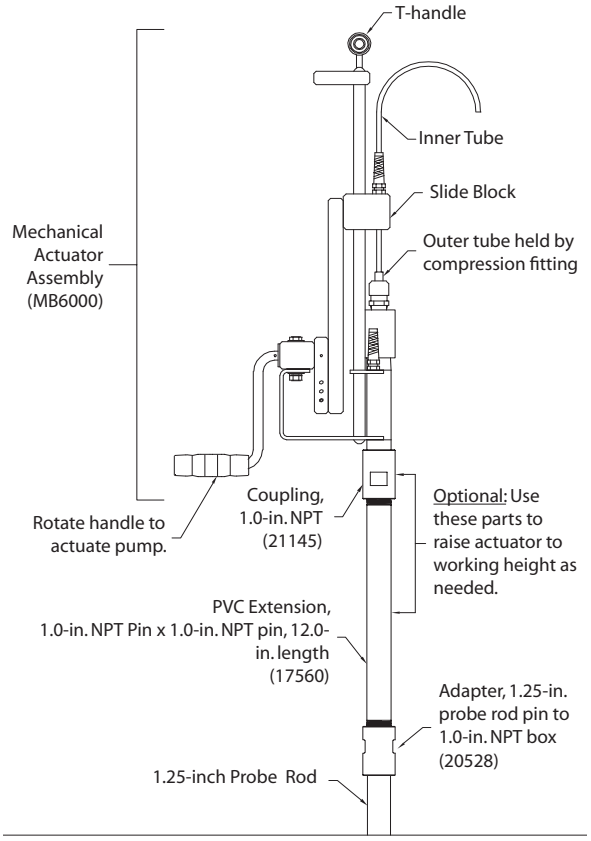


Figure 4.16
Mechanical actuator option for the MB470 Mechanical Bladder Pump (parts shown for attachment to 1.25-inch probe rods).

Figure 4.17 - Electric Acuator mounted on a 2-inch PVC well using a PVC adapter (22759).

Attaching the pump and concentric tubing to the 12V actuator or mechanical actuator

The mechanical actuator assembly may be installed directly on a probe rod string (Figure 4.16) or attached to a flush-mount or aboveground well protector using a Well Mount Kit (MB7200) as shown in Figures 4.17, 4.18 and 4.19. Installation and operation of the mechanical actuator are described below.

Assemble the pump and concentric tubing as outlined in Sections 4.1 and 4.2. Insert the pump and tubing assembly down the well so that the concentric tubing extends above the top of the well.

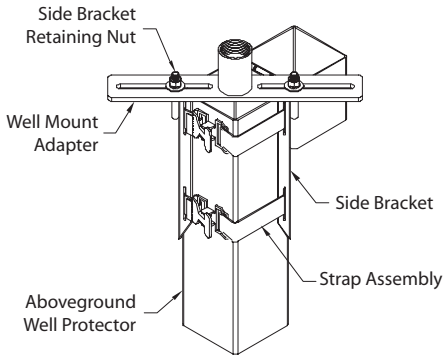
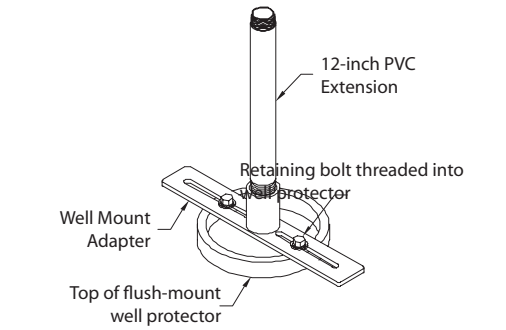


Figure 4.18
Well Mount Kit installed on an above ground well protector. (Kit may also be used with round protectors.)



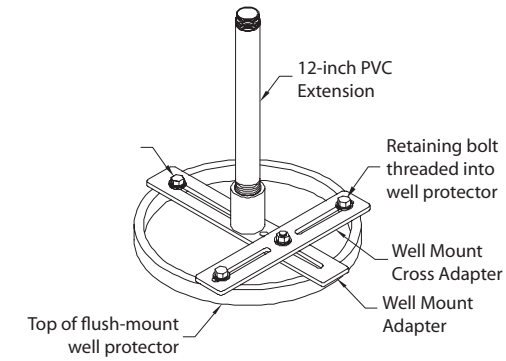


Figure 4.19
Well Mount Kit installed on flush-mount well protectors with 2- and 3-bolt patterns on cover.

Mechanical Actuator

When using the mechanical actuator simply turn the crank to lower the slide block to its lowest position (Figure 4.20). With the mechanical actuator laying on its side insert the concentric tubing through the compression fittings. The outer tube should extend 2 to 4-inches (50 to 100 mm) above the outer tubing compression fitting. The inner tube should extend out through the inner tubing compression fitting. Tighten the outer tube compression fitting to hold the pump and tubing in position. Do not tighten the compression fitting on the inner tube at this time.

Caution: Keep hands away from moving parts to avoid pinch or injury.

Install the actuator on the well or groundwater sampler using the appropriate adapter (See Figs. 4.8 – 4.10 for adapters).

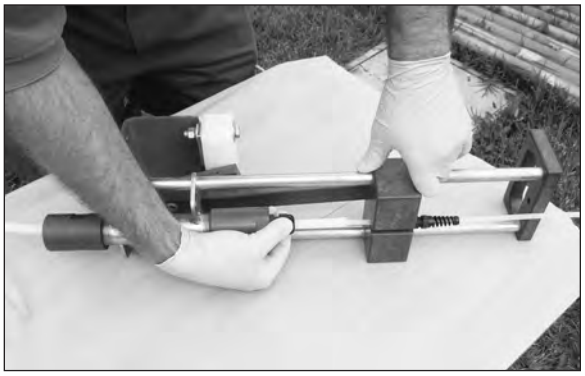


Figure 4.20: Insert the concentric tubing through both compression fittings on the actuator. Tighten the lower compression fitting to hold the outer tube in position. The outer tube should stop 2 to 4 inches (50 to 100mm) above the lower compression fitting. Do not lock the inner tube into position yet.

Positioning the Inner Tube

With the slide block at its lowest position push the inner tubing down firmly to compress the bladder (Figure 4.20). Mark the inner tubing at the top of the outer tubing to provide a visual reference of this position. To position the Inner tubing correctly refer to the directions below.

· Use the reference mark on inner tubing as a guide.
· If the tubing set is about 50feet or less in length allow the inner tube to spring back about 1 inch (25mm). More for longer tubing, less for shorter lengths.
· If the tubing set is about 60 feet long or longer allow the inner tube to spring back about 2 inches (50mm). More for longer tubing sets, less for shorter lengths.
· Now lock the inner tube in position with the ¼" compression fitting on the slide block. Manual tightening preferred, gentle application of wrench only when necessary.

Figure 4.21: With the pump, tubing set and actuator installed on the well, be sure the slide block is at its lowest position. Now push the inner tube down firmly to compress the bladder. Mark the inner tubing at the top of the outer tubing to provide a visual reference. This mark will be used to guide the inner tube placement.

12V Actuator

With the 12V actuator (MB6120) laying on a clean flat surface connect it to appropriate power supply (see bulletin MK3082 supplied with actuator). Set speed control knob to slow. Turn the actuator on and allow the slide block to move to its lowest position. Stop the motor.

Caution: Keep hands away from moving parts to avoid pinch or injury.

Once the pump is lowered into the well insert the concentric tubing through the compression fittings while the actuator is lying on its side. The outer tube should extend 4 to 6 inches (100 to 150 mm) above the outer tube compression fitting and the inner tube extends up through the inner tube compression fitting (Figure 4.21). Tighten the outer tube compression fitting to hold the pump and tubing in position. Do not tighten the compression fitting on the inner tube at this time.

Install the actuator on the well or groundwater sampler using the appropriate adapter(s) (See Figures 4.8 – 4.10 for adapters). Refer to the section above on Positioning the Inner Tube to correctly set the inner tube in position before tightening the inner tube compression fitting.

Once the inner tube is positioned correctly and the ¼" compression fitting is tightened simply turn the actuator on and adjust the speed setting to the desired position. Under most conditions operating at about 60 cycles per minute provides optimum performance. Adjust speed setting as needed.

Tubing Adjustments
Be sure the actuator slide block is at the bottom of stroke to make all tubing length adjustments.
If the tube set is bowing excessively beneath the slide block at the bottom of the stroke readjust the inner tube setting. Pull the inner tube out about ½" (12mm) and relock in position. Repeat adjustment as needed. A small amount of bowing on down stroke is OK.

Occassionally the outer tube will slip upward when actuator goes to top of stroke. Reset the outer tube and adjust inner tubing down relative to outer tubing to prevent this problem.

4.4 Purging and Sampling

The MB470 Mechanical Bladder pump was designed to provide an economical and efficient method to conduct the low flow sampling protocol (Puls and Barcelona 1996, ASTM 2003), Nielsen and Nielsen 2002). The basis of this protocol is that a sampling flow rate of 500 ml/min or less for 2-inch wells (100 to 200 ml/min for smaller diameter direct push wells) generally provides a sample of higher quality that is more representative than sampling at high flow rates (e.g. several liters or gallons per minute). Higher quality samples for volatile organic compounds are obtained because the water being sampled is subjected to less physical and chemical stress so that loss of these analytes does not occur. Additionally, higher quality samples for inorganic analytes (e.g. lead, hexavalent chromium, etc.) are obtained because the low flow sampling method minimizes turbidity that can cause significant bias for these sensitive analytes.

To obtain the most representative samples, the monitoring well or temporary groundwater sampler should be developed before sampling is conducted. Development may consist of simple surging and purging with an inertial pump for temporary samplers depending on the data quality objectives (Geoprobe® 2002). However, more elaborate methods may be required for some monitoring wells (ASTM 2001).

To meet the full requirements of the low flow sampling protocol, field parameters of the pre-sample purge water (temperature, pH, specific conductance, ORP, DO, and turbidity) should be monitored using an in-line flow cell. Once these parameters have stabilized, the samples are then collected in clean, preserved sample containers appropriate for the analytes of concern. Pre-sample purging may be completed in as little as 10 to 20 minutes in adequately developed small-diameter wells with as little as 5 to 10 liters of water generated. In larger diameter wells that have not been adequately developed, a significantly longer purge time and volume may be required.

4.5 Profiling with the MBP

Field studies to look at vertical variations in groundwater quality have become common practice in some areas. These studies often look at contaminant distribution, degradation products of contaminants and electron donors/acceptors such as iron species, sulfates and nitrates versus depth. These projects almost always include measurement of field parameters such as dissolved oxygen (DO), oxidation-reduction potential (ORP), pH, turbidity and specific conductance at each depth interval. The sample/inner tube from the MBP may be connected to an inline flow cell to facilitate accurate measurement of these parameters in the field.

Probe rods and many sampling tools are made of steel that consists largely of zero valent iron. When these tools come into contact with groundwater they can alter the ambient ORP, DO, and dissolved iron content of the local groundwater in a relatively short time. Because of this Geoprobe has developed some groundwater profiling tools that minimize or eliminate contact of the sampled groundwater with the tool steel. These tools include the DT22 Groundwater Profiler (GW2100) and the Groundwater Profiler (GW14400 series). The DT22 GW Profiler (Figure 4.22) uses a PVC screen and riser to perform dual-tube groundwater sampling and profiling (Technical Bulletin #19275).

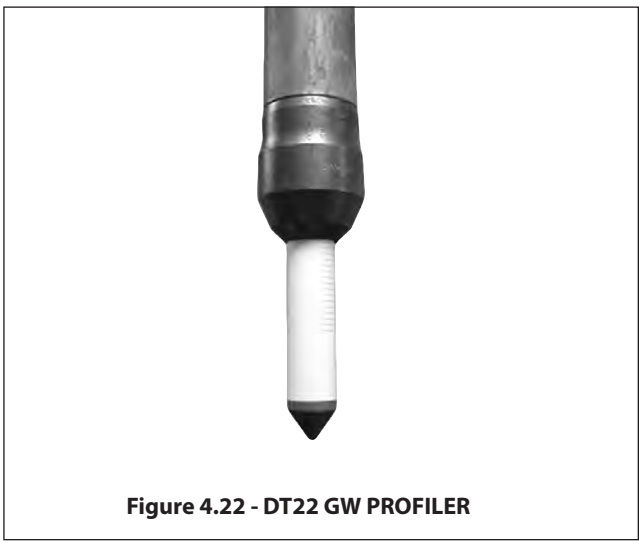


Figure 4.22 - DT22 GW PROFILER

The single-tube Groundwater Profiler (Figure 4.23) is equipped with a screen and other sample-contact components made of stainless steel to minimize impact to water quality during sampling. This tool is often telescoped through larger diameter casing to prevent clogging of the exposed screen when shallow soils are fine grained. The drive head has internal threads that allows for tubing or the MBP to be connected directly to the drive head with adapters. This isolates sampled groundwater from the steel drive rods.

As the Groundwater Profiler is advanced to the next depth interval additional tubing must be added to the MBP tube set to reach the next depth. Adapters for both the outer tube (Figure 4.24 - p/n 28710) and inner tube (Figure 4.25 - p/n 28711) make it possible to add additional sections of tubing to the MBP to make profiling easier and more cost effective. Note, the MBP is a delicate tool and cannot remain connected to the Groundwater Profiler drive head as the tool string is driven to the next interval. The MBP must be removed to prevent damage as the tool string is driven, and then re-installed after the tool string has been advanced to the next sample interval.

It is recommended that development of the profiler screen be done at each depth interval with a tubing check valve (GW4210) or similar device. In sandy formations this will speed up the development process and yield higher quality samples.

Figure 4.23

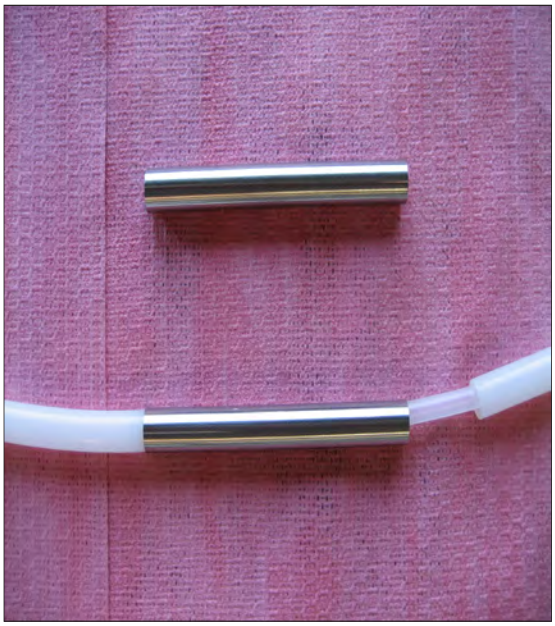


Figure 4.24

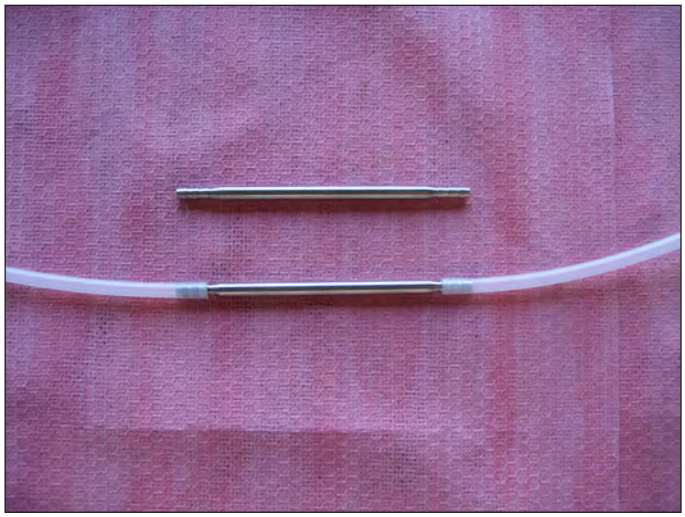


Figure 4.25

4.5 Decontaminating the Pump

Decontamination of the pump may be performed in two general ways. For the highest integrity samples the pump should be fully disassembled for thorough decontamination (decon) and the bladder and O-rings replaced. The PE bladders are inexpensive and easily replaced. If the pump is being used as a portable pump for sampling multiple locations daily and a Teflon® bladder is being used, the pump may be decontaminated while assembled. Review and understand the sampling and data quality objectives for your project before selecting the appropriate decontamination procedure . (For further information on data quality objectives see EPA 1997, or Geoprobe® 2002). The concentric tubing set should be replaced between each sampling location to minimize the potential for cross contamination. If possible, sample from background or low concentration wells to higher concentration wells to minimize the chance for cross contamination.

Disassemble for Decontamination

Simply reverse the procedures described in Section 4.1 to disassemble the pump. Place the disassembled pump in a small bucket of clean water. Use distilled water for highest level of decon. Add Alconox soap (or similar cleaning agent) to the water. Thoroughly clean and brush all inside and outside surfaces. The MBP Cleaning Brush Kit (MB7300) includes four small-diameter brushes selected specifically to clean inside the various pump components. Double rinse all parts with distilled or deionized (DI) water and allow to air dry. Reassemble the pump using a new bladder and O-rings. The PE bladders are inexpensive and easily replaced.

Review ASTM Practice D5088 for further guidance and detail on decon procedures. Additional decontamination may be obtained by drying the disassembled pump in a clean drying oven at about 95°C (203°F). This will provide additional assurance that volatile contaminants are removed from pump surfaces.

Rinsate Samples

Regularly collect rinsate samples from the pump following decontamination and submit the samples for analysis for the analytes of concern . This will provide another level of quality control and assurance that samples meet the site-specific data quality objectives. Pump clean distilled water through the pump and collect the fluid in an appropriate preserved container. Store, ship and handle rinsate samples in the same manner as field samples.

5.0 References

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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®.

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