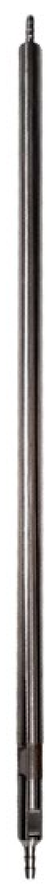
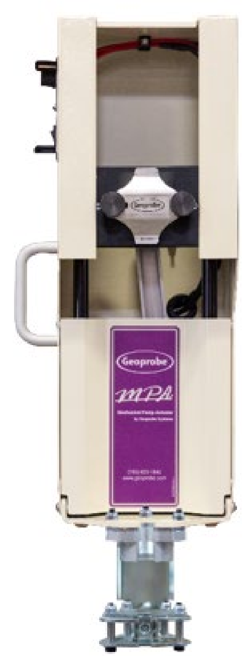
# Geoprobe® Mechanical Bladder and Syringe Pumps (MBP/MSP)

## Standard Operating Procedure

**Technical Bulletin No. MK3013**
**PREPARED: January 2003**
**REVISION III: August 2024**





Electric Actuator

MBP MSP
Components

Assembled
Pump

Not to Scale

Geoprobe® reserves the right to revise and improve its products at any time. Equipment and tool specifications, including weights, dimensions, and operating specifications listed in this Standard Operating Procedures are subject to change without notice.

Photos and illustrations may show optional equipment not supplied with standard unit.

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 Mechanical Bladder and Syringe Pumps to collect representative formation fluid samples.

# 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.

**Mechanical Bladder Pump* (MBP):** A device for obtaining high-quality, low-turbidity samples from groundwater monitoring wells, direct push installed groundwater samplers and groundwater profiler tools. The pumps can be installed through rods or casing with an inside diameter (ID) as small as 0.625 inches (16 mm). 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 mechanical bladder pump can provide representative samples for volatile organic compounds (EPA 2003).
**The Mechanical Bladder Pump was covered under U.S. Patent No. 6,877,965*.

Within the pump body, a corrugated bladder is mechanically compressed and expanded to push groundwater to the surface through a sample tubing. 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. Tubing is attached to the Inner tube adapter and 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 0.50 inches (13 mm) and an overall length of 20.5 inches (52cm) with a barbed nose intake installed.

**Mechanical Syringe Pump (MSP):** A device for obtaining high-quality, low-turbidity samples from groundwater monitoring wells, direct push installed groundwater samplers and groundwater profiler tools. The pumps can be installed through rods or casing with an inside diameter (ID) as small as 0.625 inches (16 mm).

Within the pump body, a stainless-steel piston is mechanically retracted and inserted to push groundwater to the surface through sample tubing. Check valves above and below the piston control flow direction. Tubing is attached to the Inner tube adapter and used to actuate the piston and transmit water to the surface. The pump body and internal components are made of stainless steel with an outside diameter (OD) of 0.50 inches (13 mm) and an overall length of 19inches (48cm) with a barbed nose intake installed.

## 2.2 Discussion

The mechanical bladder pump (MBP) and mechanical syringe pump (MSP) are used to collect high quality groundwater samples from the formation. These pumps can be operated in a variety of methods and tool strings. The pumps can be used to obtain groundwater samples from preexisting monitoring wells utilizing a latching catch arm within the well. They can also be used within Screen Point (SP) 16 or 19 tooling using the latching body assembly on the bottom of the pump. They can also be used within the 1.75 GW Profiler, or the 2.25 HPT-GW Sampler systems operated as single tube pumps. These different applications will be described in the coming sections.

# 3.0 System Components

## 3.1 Mechanical Bladder Pump

All pump components (Fig. 3.1) are made of stainless-steel material except for the three Buna O-Rings, two spring bushings, and the Teflon® or polyethylene bladder.

Beginning at the downhole end of the pump, either a Barb Nose Intake (213376) or Latching Body Assembly (240694) may be used as determined by project requirements. Both the barb nose intake and latching body assembly are open at the leading end and provide 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 (203792 and 203791) control groundwater flow through the bladder.

The lower end of the corrugated bladder is secured to the pump body by the Lower Bladder Adapter (203791). The top of the bladder is attached to the sample tubing set by the Upper Bladder Adapter (203792) and Inner Tube Adapter (203919). During operation of the pump, the inner tube is raised and lowered to expand and contract the bladder to move formation fluid to the ground surface.

## 3.2 Mechanical Syringe Pump

All pump components (Fig. 3.1) are made of stainless-steel material except for the three Buna O-Rings, two silicon O-Rings, and the acetal piston wear ring.

Beginning at the downhole end of the pump, either a Barb Nose Intake (213376) or Latching Body Assembly (240694) may be used as determined by project requirements. Both the barb nose intake and latching body assembly are open at the leading end and provide no filtering effect.

When operated as a syringe pump, the inner tubing adapter is attached to a stainless-steel piston (230993) with check balls (103212) that physically moves groundwater to the surface for purging and sampling. The lower end of the piston bottoms out on the top of the Lower Bladder Adapter (203791). During operation of the pump, the piston is raised and lowered within the pump and the tight fit within the pump body creates a syringe effect within the pump drawing water into the pump and the check balls control movement of the formation fluid to the ground surface.

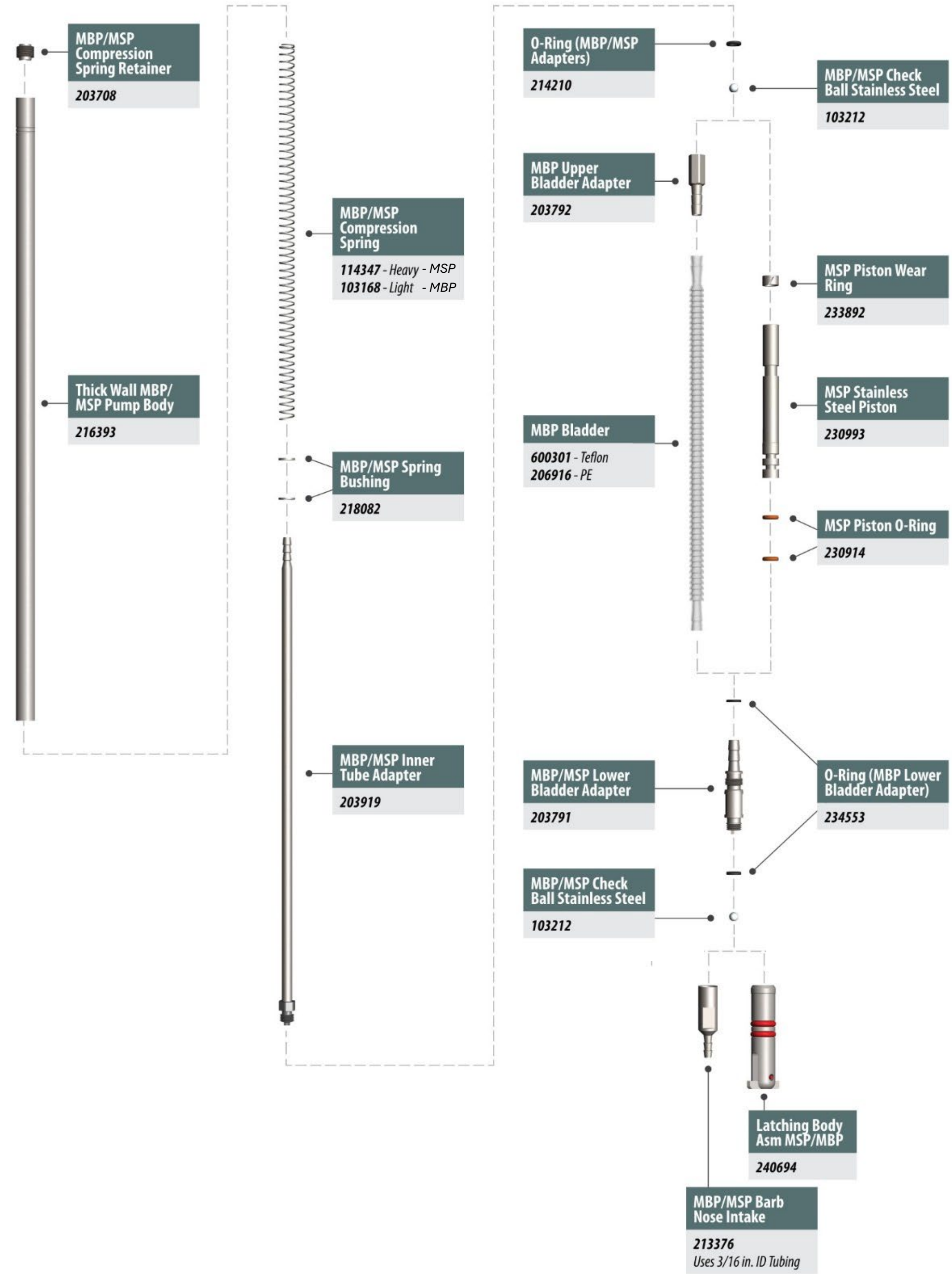



Figure 3.1: Mechanical Bladder/Syringe Pump Tool String Diagram. Material numbers 233892, 230993, and 230914 are used to operate the device as a syringe pump. Alternately, material numbers 203792 and 600301 or 206916 are used to operate the device as a bladder pump.

### 3.3 Electric Actuator

An actuator kit (214106) (Fig. 3.2) is available to mechanically cycle the pump's sample tube up-and-down operating the bladder and syringe pumps. The actuator also will work with tubing check valve systems within the direct push rods. The electric actuator is powered by a 12V*DC* power source such a 12VDC power supply AC adaptor or 12V*DC* vehicle battery or powered by a M18 Milwaukee® 18V*DC* battery. The actuator has a power switch and a variable speed control dial to adjust the speed of the actuator.

The base of the actuator has an adjustable rod clamp (245870) which can adapt from 1.5in to 2.25in rods. Alternatively, a rod specific (1.5in, 1.75in, 2.25in ) mount could be attached to the actuator.

Fig.3.2: Electric Actuator

## 4.0 Required Equipment

The following equipment is required to collect representative groundwater samples using the Mechanical Bladder or Syringe Pumps. Refer to Figure 3.1 for identification of the specified parts.

| Pump Components | Quantity | Material Number |
|---|---|---|
| Mechanical Bladder Pump | -1- | 214098 |
| Service Kit for MBP | 1 | 214112 |
| Includes: O-Ring Pick | -1- | 213743 |
| Light Compression SS Spring | -2- | 103168 |
| O-Ring for Lower Bladder Adapter (25/pk) | -1- | 234553 |
| O-Ring for Inner Tube Adapter (25/pk) | -1- | 214210 |
| Check Balls, SS, 10/pk | -1- | 103212 |
| MBP/MSP Spring Bushing (10/pk) | -1- | 218082 |
| Oetiker Band Clamp #7 (10/pk) | -1- | 220976 |
| MBP Assembly Tool | -2- | 203762 |
| MBP Cleaning Brush Kit | -1- | 214111 |
| Corrugated Bladder Teflon® FEP | 1 | 600301 |
| Polyethylene (PE) Bladder Kit (10/pk) | -1- | 206916 |
| Top Seal Assembly | -1- | 234817 |
| MSP Top Seal Pump 7/16-20 UNF | -1- | 247843 |
| MSP Top Seal tubing 1/8 NPT | -1- | 247846 |

## 4.0 Required Equipment (continued)

| Pump Components | Quantity | Material Number |
|---|---|---|
| Mechanical Syringe Pump | -1- | 234560 |
| Service Kit for MSP | 1 | 236511 |
| Includes: O-Ring Pick | -1- | 213743 |
| Piston Wear Ring (10/pk) | -1- | 233892 |
| MSP Piston O-Ring (10/pk) | -2- | 230914 |
| O-Ring Installation Tool | -2- | 236023 |
| Heavy Compression SS Spring | -1- | 114347 |
| O-Ring for Lower Bladder Adapter (25/pk) | -1- | 234553 |
| O-Ring for Inner Tube Adapter (25/pk) | -1- | 214210 |
| Check Balls, SS, 10/pk | -1- | 103212 |
| MBP Assembly Tool | -1- | 203762 |
| Top Seal Assembly | -1- | 234817 |
| 1/4in Acetal Compression Ferrule (10/pk) | -2- | 234807 |
| Barb Nose Intake | -1- | 213376 |
| GWP to MBP/MSP Connection Tube (10/pk) | -3- | 235924 |
| Oetiker Band Clamp #7 (10/pk) | -1- | 220976 |
| MBP Cleaning Brush Kit | -1- | 214111 |
| MSP Top Seal Pump 7/16-20 UNF | -1- | 247843 |
| MSP Top Seal tubing 1/8 NPT | -1- | 247846 |

| Tubing Options | Quantity | Material Number |
|---|---|---|
| HDPE Tubing, 5/16in OD x 3/16in ID x 100ft | * | 117811 |
| HDPE Tubing, 1/4in OD x 0.17in ID x 500ft | -1- | 114348 |
| Polypropylene Tubing, 1/4in OD x 3/16in ID x 500ft | * | 601060 |
| FEP Tubing, 1/4in OD x 3/16in ID x 100ft | -*- | 214252 |

| Actuator Options | Quantity | Material Number |
|---|---|---|
| MBP/MSP Electric Actuator | -1- | 214106 |
| Rod Clamp Electric Actuator | -1- | 245870 |
| MBP Actuator Slotted Adapter Kit | -*- | 218271 |
| 1/4in Tubing Clamp Pair MBP Actuator | -*- | 223584 |
| MBP Actuator Well Mount Kit | -*- | 214110 |

| SP16/19/22 Latching Options | Quantity | Material Number |
|---|---|---|
| Latching Body Assembly | -1- | 240694 |
| SP Latch (10/Pk) | -*- | 240695 |
| Shear Pin Latching SP MBP/MSP (20/Pk) | -*- | 239716 |
| O-Ring for SP Latch Body (10/Pk) | -*- | 239184 |

## 5.0 Operation

Use and operation of the Mechanical Bladder/Syringe Pump may be divided into the following main steps:

- **Assembling the Pump(s)**
- **Selecting the Proper Pump and Tubing for a Specific Application**
- **Installing Pumps within the Groundwater Profilers**
- **Use with the Latching Systems of the Screen Point 16, 19, and 22.**
- **Purging and Sampling**
- **Decontaminating the Pump**

### 5.1 Assembling the Mechanical Bladder Pump

This section identifies the procedures for assembling the components of the 214098 Mechanical Bladder Pump (Fig. 5.1) and performing a leak check on the corrugated bladder.

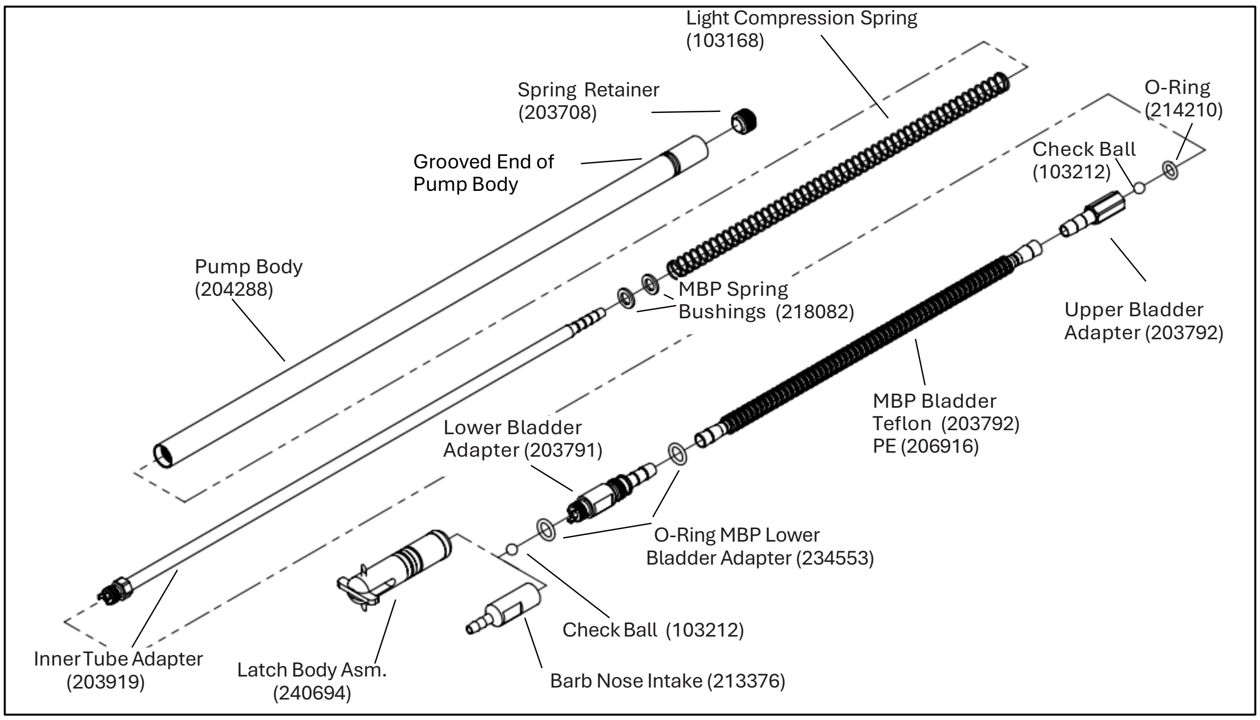



Figure 5.1: Isometric exploded view of the Mechanical Bladder Pump

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 Buna O-Rings (234553) on the Lower Bladder Adapter (203791). Note that these are the larger of the two sizes of O-Rings used with the bladder pump.

3. Lubricate the O-Ring of the lower bladder adapter and inside the Barb Nose Intake (213376) with clean water. Place a Check Ball (103212) in the barb nose intake and thread the intake onto the lower bladder adapter.

*Note: The barb nose intake is used here to make it easier to leak check the pump later in this procedure*. A different bottom adapter can be installed after the leak test.

**4.** Install a Buna O-Ring (234553) on the lower end of the Inner Tube Adapter (203919). Note that this is the smaller of the two sizes of O-Rings used with the bladder pump.

**5.** Lubricate the O-Ring of the inner tube adapter and inside the Upper Bladder Adapter (203792) with clean water. Place a check ball (103212) into the upper bladder adapter and thread 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.** Installing the Teflon® FEP Corrugated Bladder (600301) or the PE bladder (206916) (Fig. 5.2):

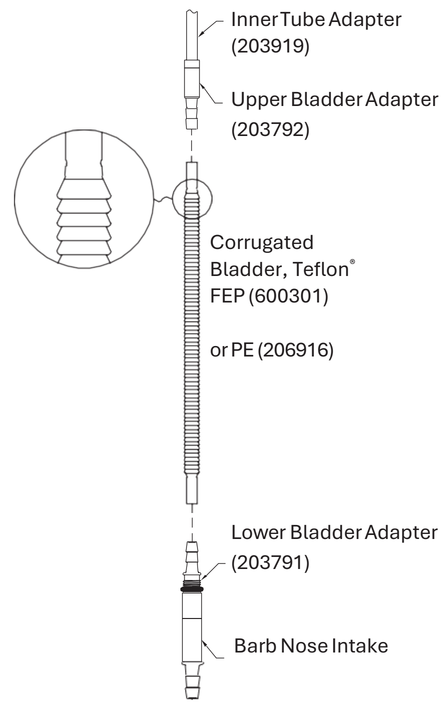


Figure 5.2: Bladder corrugations should point "up"

**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 5.2.
- 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 cuffs and corrugations to prevent damage.**

**B. Installation of PE Bladder on the Barbed Fittings**

- First disassemble the pump (Figure 5.1) and remove the existing bladder if in place.
- The PE bladder will install the same as a Teflon, however there is no specific direction required for the PE bladder material. Dipping the bladder ends in clean water to lubricate can aid in the instillation process.
- Attach the PE bladder cuff onto the lower bladder adapter (203791) and repeat for the upper bladder adapter (203792). Installation is done by firmly pushing and slightly twisting the bladder until seated fully over the barbs. Reassemble the pump (Figure 5.1) replacing any damaged O-Rings.

**7.** Performing a leak test

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

Leak check the corrugated bladders as follows:

- Completely submerge the bladder and lower end of the inner tube adapter in a clean beaker or small bucket of clean water. Place thumb or finger over the open end of the barb 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 (103212) in the upper bladder adapter and reinstall it in the inner tube adapter.
- Replace the barb nose intake with an Inlet Screen Assembly (203796) if desired. Remember to include the check ball when installing the inlet screen.

**8.** The Pump Body (204288) is internally threaded at each end and has 2 grooves at the top end. Thread the Spring Retainer (203708) into the grooved end of the pump body. Install the retainer with the slotted end out to allow use of a medium slotted screwdriver or the MBP Assembly Tool (203762) to thread or unthread the retainer.

**9.** Place two MBP Spring Bushings (218082) over the barbed end of the Inner Tube Adapter (203919) followed by the Light Compression Spring (103168). Slide the spring completely onto the adapter until the bushings and spring contact the hex fitting.

**10.** Slide the lower end of the Pump Body over the top of the Inner Tube Adapter and 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.** Next using the Lower Bladder Adapter with either the Barb Nose Intake or the Latching Body Assembly attached, push the bladder into the Pump Body, gently compressing the bladder and spring. Both the Teflon and PE bladders are sized correctly, do not cut.

**12.** Lubricate the O-Ring on the lower bladder adapter and inside the lower end of the pump body with clean water. Use care to avoid cutting or pinching the O-Ring while threading the lower bladder adapter into the lower end of the pump body. The O-Ring will no longer be visible when the adapter is fully seated.

*Assembly of the 214098 Mechanical Bladder Pump is now complete.*

## 5.2 Assembling the Mechanical Syringe Pump

This section identifies the procedures for assembling the components of the 234560 Mechanical Syringe Pump (Fig.5.3).

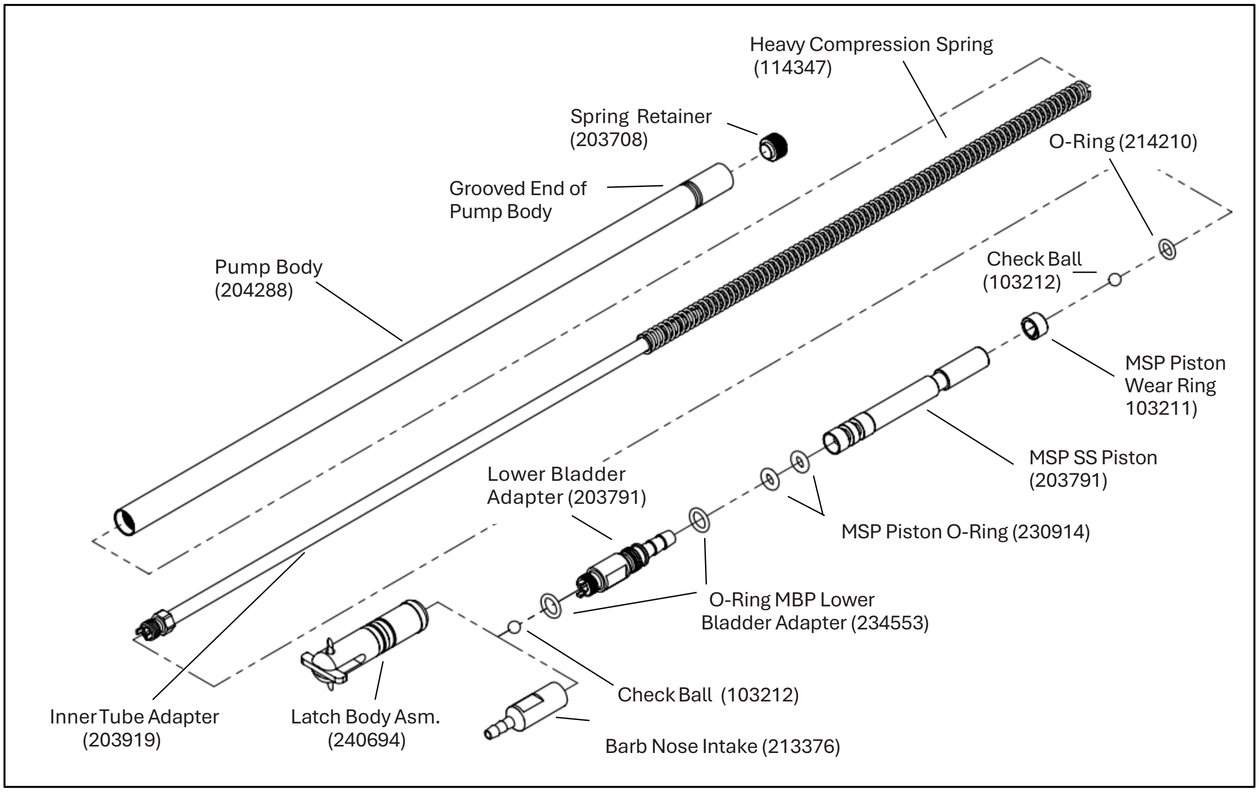



Figure 5.3: Isometric exploded view of the Mechanical Syringe Pump

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

2. Install two Buna O-Rings (234553) on the Lower Bladder Adapter (203791). Note that these are the larger of the three sizes of O-Rings used with the syringe pump.

3. Lubricate the O-Ring of the lower bladder adapter and inside the Barb Nose Intake (213376) with clean water. Place a Check Ball (103212) in the barb nose intake (213376 used with GW profilers) or the latch body assembly (240694 used within the SP-16/19 latching systems) and thread onto the lower bladder adapter.

4. Install a Buna O-Ring (214210) on the lower end of the Inner Tube Adapter (203919). Note that this is the smaller of the three sizes of O-Rings used with the syringe pump.

5. Lubricate the O-Ring of the inner tube adapter and inside the Upper Bladder Adapter (203792) with clean water. Thread the upper bladder adapter onto the inner tube adapter.

6. Place a Check Ball (103212) in the MSP SS Piston (203791) and thread onto the Inner Tube Adapter (203919).

7. Using the O-Ring installation tool (236023) (Fig. 5.4) with the post inserted into the lower section of the MSP Piston (230914 - nonthreaded side) first push the Piston Wear Ring (103211) over the installation tool and up to the wider slot on the upper end of the Piston. Next roll the two Piston O-Rings (230914) over the installation tool and up to the two O-Ring grooves. The first O-Ring will take up its position in the first O-Ring groove and the second can roll over the first and take its position in the second O-Ring groove.

8. With the Spring Retainer (203708) secured in the grooved end of the Pump Body (204288), place the Heavy Compression Spring (114347) over the barbed end of the Inner Tube Adapter (203919) and insert into the non-grooved end of the Pump Body.

9. Next using the Lower Bladder Adapter with either the Barb nose intake of the latching body assembly attached push the Inner Tube adapter into place inside the Pump Body and thready 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.


Figure 5.4: Syringe Pump Piston with O-Ring Installation Tool

*Assembly of the* 234560 *Mechanical Syringe Pump is now complete.*

## 5.3 Selection and installation of Tubing

It is recommended that the tubing used for sampling with the mechanical bladder and syringe pumps is constructed of high-density polyethylene (HDPE). HDPE tubing is stiffer and less prone to stretching especially when long lengths of tubing are needed for deep sampling. If low-density polyethylene (LDPE) tubing is used for sampling with the syringe pump it will stretch and reduce the amount of actuation seen at the pump thus reducing the volume of water pumped per minute. LDPE tubing would be appropriate as an injection tubing when the pumps are used within the 1.75in GW Profiler. HDPE is also the preferred tubing for PFAS (per- and polyfluoroalkyl substances) sampling over Fluorinated Ethylene Propylene (FEP) tubing since it contains fluorocarbons that are being sampled for. For VOC sampling, HDPE tubing can be used as well as FEP tubing which may be preferred due to its lower affinity to sorb VOCs than HDPE.

When installing the tubing on the barbed end of the MBP/MSP inner tube adapter it is recommended to carefully heat the tubing using either a heat gun or a lighter just attempting to soften the tubing which will allow for an easier fit over the barbed end. If overheating occurs weakening of the tubing can occur causing it to fold over. The tubing should be installed over all three of the barbs, once it has reached that point the installer should compress the warm tubing around the barbs with his/her fingers. This allows the tubing to form around the backside of the barbs strengthening its grip on the pump.

## 5.4 Mounting and Operating the Actuator

The Electric Actuator (214106) will easily mount onto direct push rods from 1.5in, 1.75in or 2.25in with the adjustable rod clamp or with rod specific mounts. This is used when operating the MBP/MSP on the Latching Screen Point systems or the Ground water Profilers and can also be used to actuate the tubing check valve systems.

The sample tubing mounts behind a tapered compression plate. That area is accessed by two threaded nuts on either side of the plate which when loosened allow the plate to swing up from the right side allowing the tubing to be placed behind it. The plate is then replaced in front of the tubing forming the tubing across a tapered ridge which secures the tubing in place as the nuts tighten down. The actuator should hold a wide range of tubing sizes up to 5/8in OD. Note: The electric actuator is sold separately.

Fig. 5.5 Electric actuator on rods

When installing the tubing into the securing plate, the actuator arm and the mounting block must be in its lowest position and the tubing needs to be pulled taut without engaging the pump. This allows the actuator to begin engaging the pump as the plate rises and the tubing is stretched.

The electric actuator is powered by a 12VDC power source such as a 12VDC power supply AC adapter or 12VDC vehicle battery or powered by a M18 Milwaukee 18VDC battery. The actuator has a power switch and a variable speed control dial to adjust the speed of the actuator (Fig. 5.6).

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

Fig. 5.6 Power/Speed control

Mounting the Actuator to a Flush or Above Grade Wellhead:

Well mount kit (MN 214110) is available to construct a mounting framework to above grade or flush mount wellheads that allow a user to mount the mechanical actuator for use with a monitoring well of either configuration (Fig. 5.7 & 5.8).

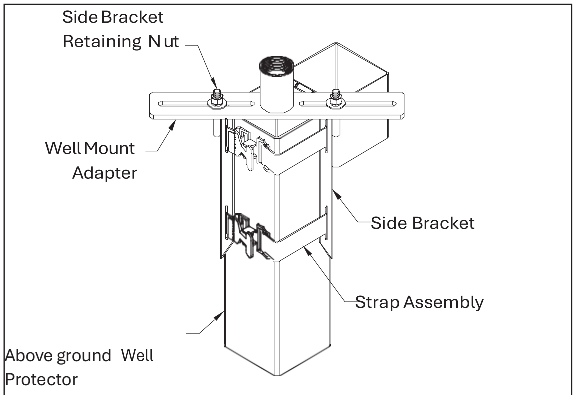



Figure 5.7: Well Mount Kit installed on an above ground well protector. (Kit may also be used with round protectors.)

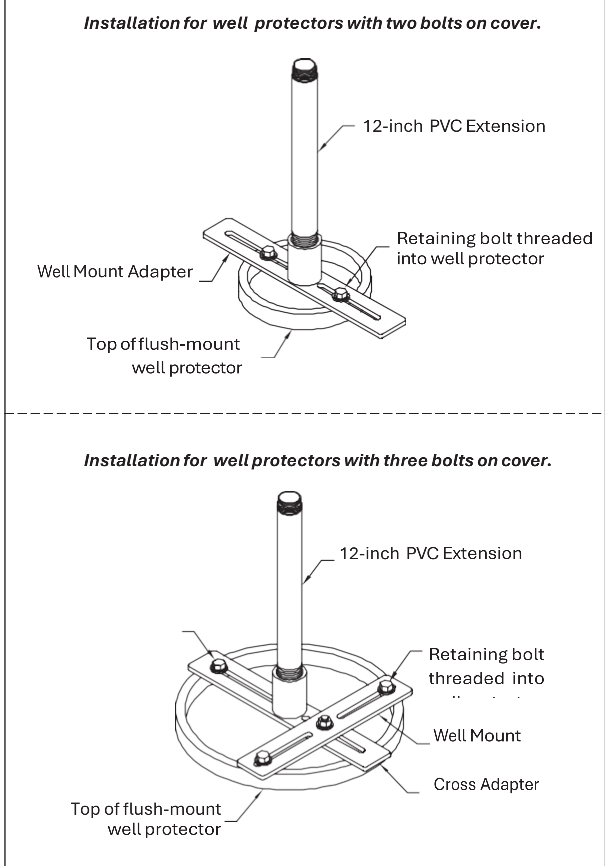



Figure 5.8: Well Mount Kit installed on flush-mount well protectors with 2- and 3-bolt patterns on cover.

If the operator chooses, instead of using the above mentioned bracket systems for mounting the actuator to a well head protection, one could build a 2in PVC extension (or specific well size) with a collar that will fit over the 2" PVC well and bring the well above the casing which will allow the actuator to be mounted directly to the 2" PVC extension piece with the universal rod clamp. This configuration would also allow plenty of room to insert the MBP with the 2" latching setup.

## 5.6 Purging and Sampling

The 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.

## 5.7 Groundwater Profilers

Field studies to look at vertical variations in groundwater quality are 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 line from the mechanical syringe or bladder pump may be connected to an inline flow cell to facilitate accurate measurement of these parameters in the field.

In studies where it is planned to vertically profile the aquifer and collect multiple (>3 samples) it is best to utilize the mechanical syringe pump rather than the bladder pump. This is due to the increased robustness of the internal components. It is best to utilize groundwater profilers in highly permeable aquifers. The groundwater profilers have limited screen surface area each model having 20 HPT screens (each with a diameter of 10mm) which would be significantly less surface area than an SP-16, 19 or 22 screen system. It can be difficult to obtain groundwater samples at a reasonable flow rate in formations dominated by fine-grained materials.

This SOP will discuss how and where to position up the MSP or MBP within the two groundwater profiler systems. Field operation of the groundwater profiler systems is discussed within the Groundwater Profiler SOP (MK3196).

### 5.7.1 Mounting with the 1.75 GW Profiler

The 1.75 GW Profiler creates a pressure injection log but does not have Electrical Conductivity dipoles or and downhole pressure sensor. Water injection is monitored with an up-hole pressure sensor and observed on screen as the probe is advanced. This allows the operator to identify good permeability zones of sampling. The GW Profiler has two barbed ports on top of the probe, one will serve as the injection port and the other will be the sample line port. Both lead to an inner open manifold within the probe and it does not matter which port you use for either function.

The preferred sample line tubing is high-density polyethylene tubing since it is stiffer and less subject to stretching. The Mechanical syringe pump is connected to one of the barbed ports on top of the probe with a short 3-inch connector tube (235924) which is fastened to the probe barb and the barb nose intake (211376) of the pump with #7 band clamps.

To protect the open top of the syringe (or bladder) pump from settling particulates it is important to install a top seal (Figure 5.9) over the lowest section of the sample line and the top of the pump. The Top Seal uses an O-Ringed barb fitting (247843) that is threaded into the top of the pump body which allows the inner tubing adapter to continue to protrude out the top so sample tubing can be attached.

**Installation of the Top Seal:**

1. Install the top nut of the MSP Top Seal Fitting (234811) with the female thread facing the pump on the bottom of the sample line and move it approximately 24in (60cm) up the tubing.
2. Install the 1/4in acetal ferrule (115962) onto the tubing and slide it up to the nut with the taper facing the nut.
3. Install the MSP Top Seal barbed fitting (247846) into the female threads of the lower section of the MSP Top Seal Fitting (234811).
4. Install the combined MSP Top Seal Fitting with the threaded barb onto the sample line with the barb end facing the pump.
5. Install the Top Seal Silicon Tubing over the bottom of the sample line and move all of these components up so that the sample line is exposed out the end of the Top Seal – do not secure.
6. Install the MSP Top Seal pump barbed fitting (247843), with O-Ring installed (115802), over the Inner bladder adapter of the MSP/MBP pump. Thread the fitting into the top of the pump until the O-Ring is secure inside the pump body.
7. Heat the bottom 1in (2.5cm) of the sample line with a heat gun for about 5 seconds to soften the tubing.
8. Push the sample line over the barbed end of the pump's inner tubing adapter until all the barbs are covered.
9. With your fingers, press the tubing around the barbs while the tubing is still warm. This allows the tubing to take the shape of the barb and form around the backside of the barbs securing the tubing in place.
10. Now bring the Top Seal Silicon tubing down and slide this over the barbed end of the Top Seal Fitting (234811) until it covers all the barbs, secure with a small zip tie.
11. Pull the sample tubing tight without engaging the pump and stretch the Top Seal until it is straight but not stretched.
12. Bring the upper Top Seal barb fitting down to the Top Seal and insert the barbs into the silicon tubing and secure with a small zip tie.
13. Ensure that the sample line and the Top Seal are both pulled straight but not engaged or stretched and bring the upper Top Seal Nut with the Acetal Ferrule down and secure these together until tight.
14. When pulling on the sample tubing to engage the pump the Top Seal should stretch and allow full movement of the pump.
15. The Pump and the Top Seal components should all fit within the connection tube (234570 or 234706).

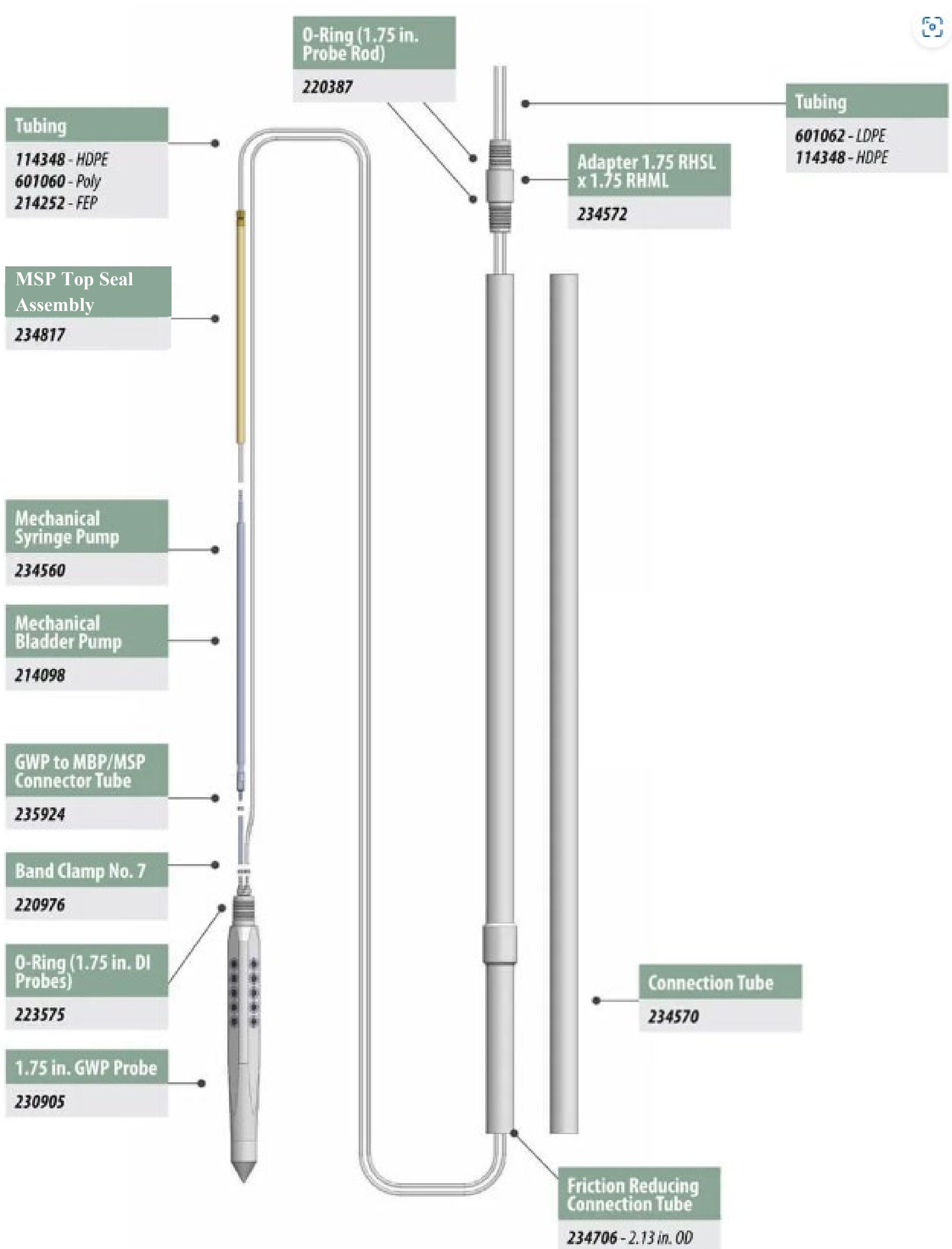



Fig. 5.9: 1.75 GW Profiler Tool String Diagram

### 5.7.2 Mounting with the 2.25 HPT GW Sampler

The 2.25 HPT-GW Sampler creates an HPT and EC log and allows the operator to collect groundwater samples while logging. This tool includes the Electrical Conductivity dipoles and a downhole HPT sensor. Subsurface permeability is recorded with the HPT sensor for the determination of the best zones of GW sample collection. The HPT-GWS has two barbed ports on top of the probe, one will serve as the injection port and the other will be the sample line port. Both lead to an inner open manifold within the probe and it does not matter which port you use for either function.

The preferred sample line tubing is high-density polyethylene tubing since it is stiffer and less subject to stretching. A tubing section approximately 36in (90cm) is fastened to one of the probe barbs and the barb nose intake (211376) of the pump with #7 band clamps. The pump and top seal assembly must all be within the first rod and secured to the trunkline with zip ties. Before attaching the pump to the connection tubing verify that this section will be entirely within the first rod above the connection tube, once confirmed the pump can be attached to the tubing.

To protect the open top of the syringe (or bladder) pump from settling particulates it is important to install a top seal over the lowest section of the sample line and the top of the pump. The Top Seal uses an O-ringed barb fitting (247843) that is threaded into the top of the pump body which allows the inner tubing adapter to continue to protrude out the top so sample tubing can be attached. Top seal installation is covered in section 5.7.1. The pump and top seal components will be mounted above the connection tube and drivehead within the first full rod of the tool string. We recommend securing the pump to the trunkline with small zip ties.

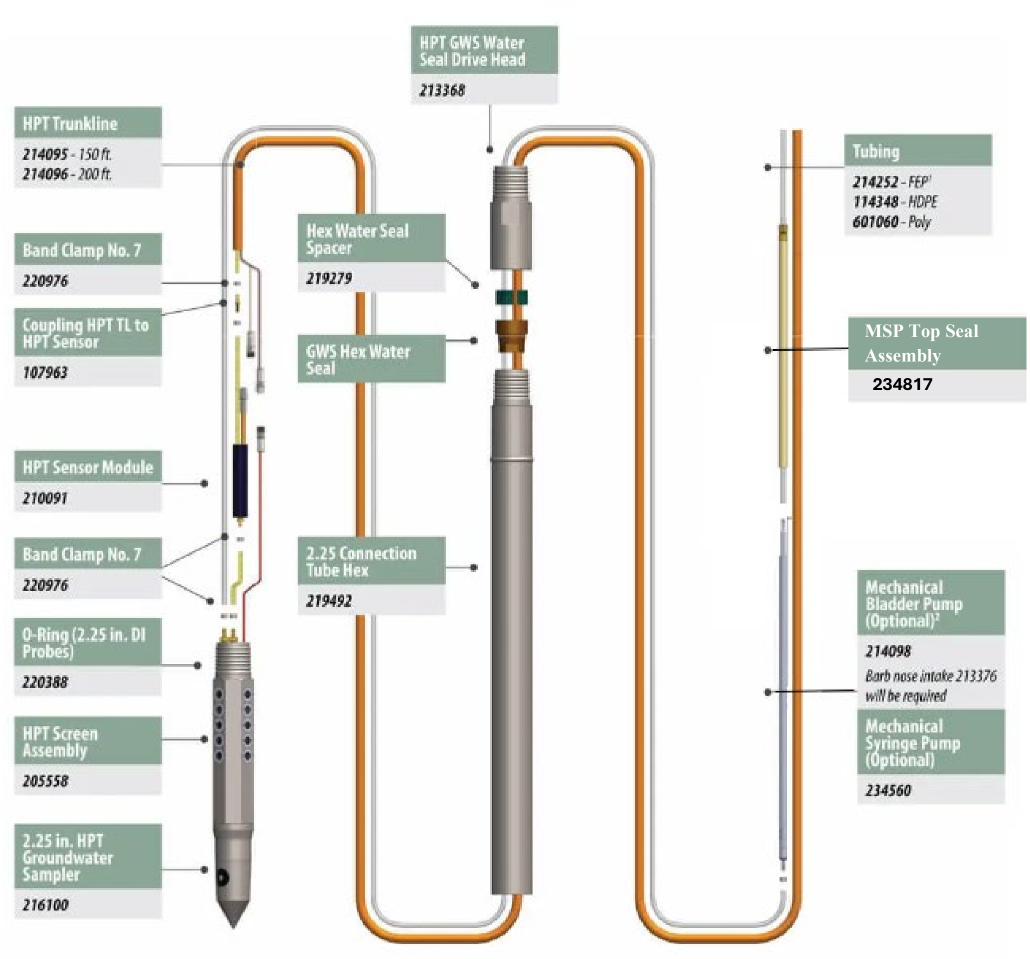



Fig. 5.10: 2.25 HPT-GW Sampler Tool String Diagram

## 5.8 Screen Point Latching Tools SP-16/19/22

The use of the MBP/MSP pumps within the screen point samplers has been made easier with the latching configuration. To operate in this manner the bottom end fitting on the pump needs to be the latching body assembly (240694). The bottom of the assembly has a flip latch which is deployed vertically as the pump is lowered down the rods. Once the latching body assembly moves into the latching drive head and the latch clears the bottom of the drive head it will swing horizontal allowing the latch to catch underneath the drive head securing the pump in place (Fig.5.11). The latch is held in place with a shear pin which allows the pump to be recovered after sampling is finished, the operator would apply an additional force on the sample tubing to break the shear pin and allow the latch to drop into the screen which can be recovered later. The latching body assembly also has two O-Rings which seal within the drivehead isolating the formation water within the screen and sheath from water within the rods. Rod joints can leak, without these seals water from above the screen would be able to mix into water from the screen diluting or contaminating the desired groundwater sample.

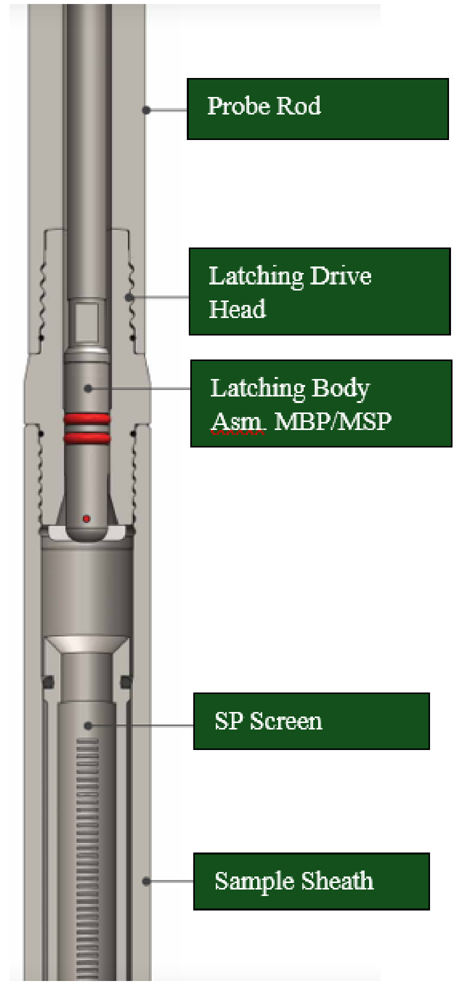


Figure 5.11: Latching Setup in SP16/19

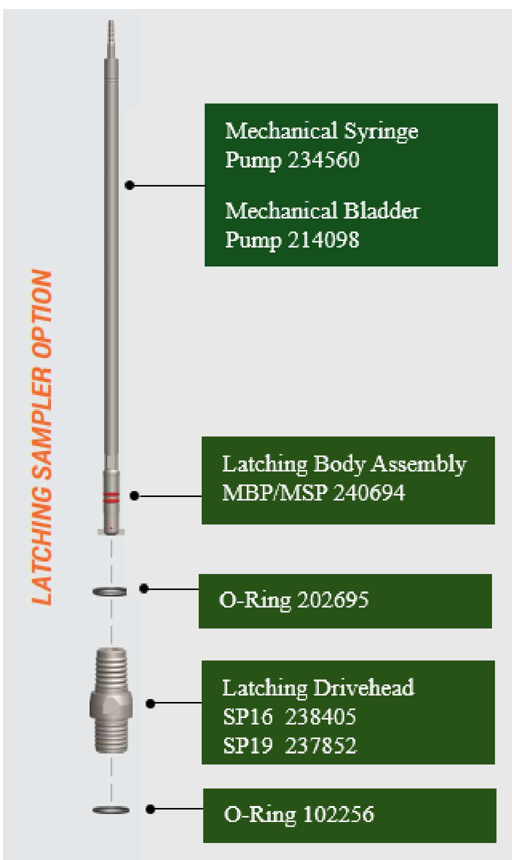


Figure 5.12: MBP/MSP Latching Components

Because water can leak in through the rod joints and would contain higher levels of suspended solids which can clog/bind the actuation of the inner tube adapter and bladder or syringe it is recommended to operate the bladder/syringe pump with the Top Seal Assembly. Installation of the top seal assembly is covered in Section 5.7.2

## 5.9 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 tubing 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 locations 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. Certified PFAS free water may be required when sampling for PFAS analytes. Add approved soap to the water. Thoroughly clean and brush all inside and outside surfaces. The MBP Cleaning Brush Kit (214111) includes four small-diameter brushes selected specifically to clean inside the various pump components. Double rinse all parts with clean 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 decontamination 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. Certified PFAS free water may be required for rinsate sampling when sampling for PFAS analytes. This will provide another level of quality control and assurance that samples meet the site-specific data quality objectives. Pump clean 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.

## 6.0 References


American Society of Testing and Materials (ASTM), 2021. D6771-21 Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations. ASTM, West Conshocken, PA. (www. astm.org)

American Society of Testing and Materials (ASTM), 2020. D5088-20 Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites. ASTM, West Conshocken, PA. (www.astm.org)

American Society of Testing and Materials (ASTM), 2020. D6001/D6001M-20Standard Guide for Direct Push Groundwater Sampling for Environmental Site Characterization. ASTM, West Conshocken, PA. (www.astm.org)

American Society of Testing and Materials (ASTM), 2018. D5521/D5521M-18 Standard Guide for Development of Ground- Water Monitoring Wells in Granular Aquifers. ASTM, West Conshocken, PA. (www.astm.org)

American Society of Testing and Materials (ASTM), 2016. D8037/D8037M-16 Standard Practice for Direct Push Logging of Profiling Variations of Permeability in Soils. ASTM, West Conshocken, PA. (www.astm.org)

U.S. Environmental Protection Agency (EPA), 2003. Environmental Technology Verification Report: Geoprobe Inc., Mechanical Bladder Pump Model MB470. Office of Research and Development, Washington, D.C. EPA/600R-03/086. August.

U.S. Environmental Protection Agency (EPA), 2016. Expedited Site Assessment Tools for Underground Storage Tank Sites: A Guide for Regulators. Office of Solid Waste and Emergency Response. EPA 510-B-16-004. October.

Geoprobe®, 2002. Groundwater Quality and Turbidity vs. Low Flow. Geoprobe Systems®, Salina, KS. May.

Nielsen, David M., and Gillian L. Nielsen, 2002. Technical Guidance on Low-Flow Purging & Sampling and Minimum- Purge Sampling: Second Edition. The Nielsen Environmental Field School, Galena, OH. April.

Parker, Louise V. and Thomas A. Renney, 1998. Sampling Trace-Level Organic Solutes with Polymeric Tubing, Part 2. Dynamic Studies. Groundwater Monitoring & Remediation (GWMR) Vol. XVIII No. 1, pages 148-155. Winter.

Puls, Robert W., and Michael J. Barcelona, 1996. Ground Water Issue: Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures. EPA/540/S-95/504. April.

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