Region 4 **U.S. Environmental Protection Agency** **Science and Ecosystem Support Division** **Athens, Georgia**	
Operating Procedure	
Title: **Pump Operation**	ID: **SESDGUID-203-R4**
Issuing Authority: Chief, Field Services Branch	
Effective Date: March 14, 2018	

Purpose

This document describes procedures, methods and considerations to be used and observed when operating a variety of pumps that may be used for purging monitoring wells and for collecting samples of aqueous phase environmental media, including groundwater, surface water and certain wastewaters, for field screening or laboratory analysis.

Scope/Application

The procedures contained in this document are to be used by field personnel when using pumps during the process of collecting samples of aqueous phase environmental media in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section cannot be used to obtain samples of the particular media of interest, and that another method or pump must be used to obtain said sample, use of the variant pump and/or procedure will be documented in the field log book, along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

While this SOP may be informative, it is not intended for and may not be directly applicable to operations in other organizations. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

TABLE OF CONTENTS

1 Geotech Geopump™ Peristaltic Pump

1.1 General

These pumps are generally small, light-weight, portable and are powered by 12-volt batteries. The limit of suction is approximately 25 - 27 feet of vertical separation between the pump and water surface. They are appropriate for surface water sampling and for groundwater sampling where relatively small volumes of water are required for purging and sampling, and the water level is within the limit of suction.

1.2 Operation

l. The Geopump has two drive locations that the roller pump head can be fastened depending on anticipated use. In most cases the pump head should be attached in the 0-600RPM drive location. Where very low flow rates and fine control is required, the pump head can be attached to the 0-300 RPM drive location.

2. Connect the pump power cable to a 12 volt power source. Briefly turn the pump on to test.

3. Open the pump head with the lever and place a clean 9”-12” length of Silastic® flexible tubing in the head v-slots and reclose the head. New Silastic® tubing should be used for each sample. When the pump is run for extensive periods, it may be necessary to replace the Silastic® tubing or reposition it on the rollers.

4 Attach sample tubing approximately one inch into the Silastic® tubing.

5. Deploy the lower end of the sample tubing to the desired point in the well. This would be the top-of-water for the multi-volume purge method or to the mid-screen for the Low-Flow method.

6. Connect a short piece of discharge tubing from the pump-head Silastic® tubing to a measuring bucket.

7. Set the direction switch on the pump face in the direction of desired pump flow. Turn on the pump and set the rheostat to the desired pumping rate. For the multi-volume purge method, the rate will generally be a relatively fast rate that the well will sustain without elevating turbidity. For the low-flow purge method the pump rate is established at a slower rate to maintain a minimal and stable drawdown level.

1.3 Sampling with a Peristaltic Pump

It is not acceptable to collect samples for organic compounds analyses through the flexible tubing used in the pump head due to possible sorption of contaminants and contribution of stray organic compounds to the sample.

When collecting samples for semi-volatile organic compound analyses it is necessary to use a vacuum container placed in the sample line. Volatile organic compounds must be sampled using the 'soda-straw' method. The use of the vacuum container and the 'soda-straw' method is explained in Section 3.7.1 of the Groundwater Sampling Procedure SESDPROC-301.

Samples of some inorganic constituents (i.e., metals and cyanide) may be collected directly through the tubing, if the tubing has been blanked for the project contaminants of interest. SESD routinely blanks tubing prior to use in accordance with the Field Sampling Quality Control Procedure, SESDPROC-011, so a field tubing rinse blank is generally not required.

2 Small Diameter Electric Submersible Pumps

2.1 General

Small diameter submersible pumps are used in wells of 2" diameter and larger. They are especially useful where large volumes of water are to be removed or when the groundwater surface is a large distance below ground surface. Commonly used pumps are the Grundfos® Redi-Flo2, the Geotech GeoSub, and the various 'Monsoon' style pumps. Other pumps are acceptable if constructed of suitable materials.

Included within this category is the Grundfos® Redi-Flo2 small diameter electric submersible pump. With a diameter of approximately 1.75 inches, it is designed to be used in 2-inch diameter and larger wells. (Note: If used in any well larger than 4-inch diameter, this pump must be equipped with a cooling shroud to prevent the pump from overheating. If the pump overheats, internal sensors shut-off the pump it will not be operable until it cools to a temperature within the operating range). The Redi-Flo2® is a variable speed pump capable of providing pump rates from less than 100 ml/minute to in excess of 8 gallons per minute.

The Redi-Flo2 pump, depending on the controller being used, operates with either 115v or 220v power. The pump rate is controlled by adjusting the frequency of the current going to the pump motor. It is a light-weight pump and can be easily handled by one person when lowering, but two people are generally needed when removing the pump, one to pull and another to reel in the hose and power lead.

2.2 Safety

1. Place the generator on dry ground or plastic sheeting as far as practical from the well, in the down-wind direction.

2. Inspect the electrical extension cord, as well as the lead to the pump, for frays, breaks, exposed wiring, etc.

3. Where appropriate, check the head space of the well for the presence of an explosive atmosphere with a combustible gas meter, or for vapors with a PID/FID instrument.

4. Wear rubber boots in wet areas to insulate against shock hazards.

5. Take care not to touch steel well casings, the controller housing, cabling, or other metal objects while the pump is energized.

6. If purge water is not collected, direct the discharge away from the well and generator, preferably down gradient of the area.

7 Make sure that the generator is set to the proper voltage.

8. Do not add gasoline or oil to the generator while it is running.

9. Store and transport fuel in approved Type II gas cans. Store the fuel, generator, and oil in a trailer dedicated to this type of equipment.

10. Do not haul this equipment in the back of any passenger vehicle or with any sampling equipment or containers.

2.3 Pre-Loadout Checkout Procedures

1. Check the oil and gasoline in the generator. The fuel capacity for the portable Honda generator is 0.95 US Gallons (3.6 L).

2. Take the generator outside and start. Place a load on the generator, if possible.

3. Inspect the pump and all hoses, rope, and electrical cord and connections.

2.4 Operation

1. Place the pump, the controller, and enough hose for the measured well depth on plastic sheeting next to the well. Set the generator in a dry, safe location downwind of the well, but do not plug the cord from the controller into the generator.

2. Lower the pump, power lead, and hose into the well, placing the pump approximately five feet into the water column.

3. Start the generator, <u>then</u> connect the power cord from the pump controller. Make sure the proper voltage has been selected.

4. After starting the pump, closely observe operation to determine if drawdown is occurring in the well. If the water level is not pulled down, raise the pump in the water column one to two feet from the top of the water column and continue to purge. If the water level drops, however, lower the pump to keep up with the drawdown. Do not allow the pump to run dry. This condition can create a thermal overload and shut the pump down. Repeated thermal overloads may damage the pump and will create delays in sampling.

2.5 Maintenance and Precautions

1. Empty the hose of contaminated water before leaving the sampling location. Do not bring the hose back to the FEC if it contains purge water from a site.

2. Field clean the pump prior to using at the next sampling location in accordance with the SESD Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205).

3. Do not run the generator without first checking the oil.

4. Do not put the pump in the trailer with the generator.

5. If the pump is equipped with a check valve or back flow preventer, periodically check this device to make sure that it is operating. This is a common place for debris or other material to accumulate and interfere with the proper operation of the device. If the water level in a well pulls down to below the pump inlet when operating with a check valve, the pump can airlock. The airlock can be relieved by surging the pump or pulling the pump from the well and draining the hose or tubing.

2.6 Trouble Shooting

<u>Generator running, no pump output</u>	1.	Loose wiring connection.	1.	Check all connections. Repair as needed. (Generator off!!)
	2.	Cord unplugged at generator.	2.	Plug pump back in.
	3.	Over voltage or Under voltage on controller display.	3.	Adjust generator output/idle speed; allow generator more warm-up time. Use larger or shorter extension cord.
	4.	Pump out of water.	4.	Lower pump into water.
	5.	Hose collapsed or kinked.	5.	Un-kink hose.
	6.	Pump will not run or shuts down with thermal overload signal. Display indicates zero amps.	6.	Use cooling shroud in wells larger than 2”.

3 Geotech Portable Bladder Pump

3.1 General

The Geotech Portable Bladder Pumps is primarily suitable for low-flow purging and sampling of wells as small as ¾" casing diameter. As deployed by SESD, the system uses the GeoControl Pro portable compressor/controller to power the downhole bladder and check valve mechanism.

In operation, the pump is connected to drive tubing and sample tubing. On each pump cycle, the drive tube pressurizes a tubular bladder, compressing it inward and forcing well water through an upper check valve and up the discharge sample tubing to the surface. On release of pressure, the bladder relaxes, allowing water to enter the lower check valve from the well. The pumps are available in 1.5", 0.85", and 0.675" diameters. As of this revision, SESD owns a 0.85" pump, but these instructions apply to all pumps in the series.

Bladder pump operation slows with increasing length of the drive tubing. As the volume of this tubing increases with length, the controller requires longer times to pressurize and depressurize the pump on each cycle. In wells with a tall water column, this effect can be minimized by the use of a drop tube. The pump is positioned submerged but near the top of the water column and the drop tube extends to the sampling interval. The drop tube conducts water from the sampling interval to the pump and the controller only has to pressurize enough drive tubing to reach the water surface.

3.2 Operation

1. Prepare the pump by connecting sample tubing to the central barb fitting and drive tubing to the outer barb fitting. The sample tubing should be new tubing suitable for the work, generally teflon. The drive tubing can be teflon or poly tubing and may be field cleaned between wells with the pump. If used, fasten a measured drop tube of new sample tubing to the lower barb on the pump and to a pickup screen.

2. Lower the pump into the well and locate it at the desired sampling interval.

3. Cut the tubing to suitable above-ground working lengths, allowing drive tubing to reach the controller and sample tubing to reach a bucket or flow-through cell. Connect the drive tubing to the controller.

4. Turn the controller on. As a starting point, the discharge time should allow the air line to pressurize to about 1 psi for each foot the water level is below ground surface. The fill time should initially be set to allow the air pressure to return to zero at the end of each cycle.

5. If the pump does not discharge or is still discharging at the end of the pressure cycle, the discharge time can be increased. The fill time can be adjusted for maximum or desired flow.

3.3 Trouble Shooting

Air in Sample Line	1.	Damaged bladder or O-rings or bladder shifted	1.	Inspect and replace. Limit air pressure to pump.
	2.	Outgassing of sample.	2.	No action required.
No sample line output	1.	Pump above water	1.	Check and adjust pump level. Reduce output to achieve stable drawdown.
	2.	Kinked drive or sample tubing	2.	Check tubing and remedy.
	3.	Inadequate Air Pressure	3.	Increase Discharge Time.
	4.	Silt in check valve.	4.	Surge pump in well or remove from well and clean. Consider further well development with alternate pump.

4 Geoprobe® Model MBP 470 Mechanical Bladder Pump

4.1 General

The Geoprobe® Model MBP 470 Mechanical Bladder Pump can be used for purging small diameter temporary monitoring wells installed by direct push technology (DPT). These pumps represent one of only a few types of pumps that are capable of fitting inside the ID of the probe rod and that are also capable of pumping ground water whose water level is below the limit of suction.

4.2 Operations

The Geoprobe® Model MBP 470 Mechanical Bladder Pump operates by manually or mechanically cycling a corrugated FEP Teflon® bladder contained within a small diameter pump body. The bladder is actuated by movement of a smaller diameter sample tubing within an outer tubing which positions and stabilizes the pump. As this pump is sensitive to silt, it is generally advantageous to develop the well first with an impulse pump before deploying the mechanical bladder pump for purging and sampling.

The basic operation is as follows.

1. Following manufacturers guidelines, assemble the bladder pump with a new bladder.

2. Attach the pump to the larger diameter outer tubing by screwing it onto the tubing. The pump will cut shallow threads into the tubing.

3. Lower the pump into the well to the desired sampling interval. Note that it will be very difficult to reposition the pump later, often requiring recutting and redeploying the tubing system.

4. While holding the downhole tubing securely, cut off the tubing near the top of the well.

5. Using gravity as an aid, thread the sample tubing (generally teflon®) down into the outer tubing until it bottoms out against the pump. Cut off the sample tubing at a convenient length to reach a discharge bucket or flow-through cell. Remove the pump and the tubing assembly from the well.

6. Unscrew the pump from the outer tubing. Either push and shake the inner tubing from the top or cut off several inches of the outer tubing at the bottom until several inches of the inner tubing is exposed.

7. Unscrew the lower bladder adapter on the pump (refer to Geoprobe® Instruction Bulletin MK3022 or Technical Bulletin MK3013). Push the pump barbed fitting onto the sample tubing.

8. Again screw the pump onto the outer tubing. Screw the lower bladder adapter back into the pump. This step may be facilitated by temporarily lowering the tubing assembly into the well upside down, uncoiling it onto a clean surface, or uncoiling it into a clean section of well casing assembled on the surface.

9. Again deploy the pump and tubing into the well. Secure the top of the outer tubing at the top of the well casing using either the Outer Tubing Grip of a manual actuator or the Outer Tubing Adapter of an electric actuator.

10. Using the Hand Grip Assembly of a manual actuator or the mechanism of an electric actuator, cycle the inner tubing up and down to actuate the pump bladder. The tubing should be gently tensioned at the bottom of the stroke and pulled upward several inches each stroke.

5 Inertial Pump (Geoprobe® or Waterra®)

5.1 General

The inertial pumps consist of a length of tubing with a check valve affixed to the lower end. It is a very simple device that is very effective at developing wells. As it is very difficult to produce low turbidity water with this pump due to the constant surging, it should generally not be used for sampling. The Geoprobe version of the pump can fit inside of the small diameter drive casing used for the installation of temporary screen-point wells. The Waterra version of the valve can use an attached surge block pressed onto the valve to develop 2" diameter wells.

The inertial pump operates by manually or mechanically cycling the length of tubing and attached check valve up and down in the water column. The basic operation is as follows.

5.2 Operation

1. Affix a check valve to bottom of appropriate tubing by threading it onto the discharge tubing. The valve will cut shallow threads into the tubing.

2. Lower the valve and tubing to the bottom of the well. Cut the tubing to an appropriate length to reach a bucket or other discharge location.

3. Either by hand or by attaching the tubing to a mechanical actuator, rapidly move tubing and check valve up and down in the water column.

4 During each cycle, as the tubing is plunged downward in the water column, water will move upward through the check valve, past the ball check. On the upward stroke, the ball check will seat in the check valve, capturing water and moving it upward with the tubing.

5. For well development, cycle the valve in different portions of the screened interval. The inertial pump is also effective at vacuuming silt out of the bottom of the well.

6 References

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

SESD Operating Procedure for Groundwater Sampling, SESDPROC-301, Most Recent Version

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

7 Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
SESDGUID-203-R4, *Pump Operation*, replaces SESDPROC-203-R3. **General:** Corrected any typographical, grammatical, and/or editorial errors. Additionally, the document was edited to reflect new Document Control Processes. The Operating Procedure was converted to a Guidance Document.	March 14, 2018
SESDPROC-203-R3, *Pump Operation*, replaces SESDPROC-203-R2.	September 12, 2013
SESDPROC-203-R2, *Pump Operation*, replaces SESDPROC-203-R1.	November 6, 2009
SESDPROC-203-R1, Pump Operation, replaces SESDPROC-203-R0.	November 1, 2007
SESDPROC-203-R0, *Pump Operation*, Original Issue	February 05, 2007