GEO-FLO

Installation, Operating, and Maintenance Manual

Geothermal Closed Loop Flush Cart

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NOTES:

This guide provides the installer with instructions specific to the Geo-Flo Flush Cart. Please refer to your heat pump manufacturer's instructions, flow center installation manual and/or IGSHPA guidelines for additional detailed flushing, purging, and installation information. Please review the entire IOM document before proceeding with the installation.

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General Description

The Geo-Flo Flush Cart is the professional's choice to purge air and flush debris from residential and light commercial geothermal ground loops. The Flush Cart includes all the important features required to safely flush and purge the loop including power flushing, power draining, pump and dump, and debris filtering. Its compact design utilizes standard components which allows for easy field service. The high-head/high flow self-priming 120V pump is mounted above the cart's axle providing a well-balanced system that is easy to maneuver.

Technical Data

Features

The Geo-Flo flush has many features geared towards the geothermal professional, which are outlined below.

- ETL Safety Listing (Listed to UL standard 778)
- Tank: 10" Diameter, 13 gallon capacity
- Hand Truck: P-Handle, powder-coated steel
- Tires: 10" Pneumatic
- Wiring: 20' 12/3 SJO cord with 15 Amp male plug
- Power Switch: Weatherproof switch box with 20 Amp GFCI protected switch
- Filter: Removable/reusable, 31" long, 100 micron, 90 GPM max. (standard P/N 3594) (1 micron add-on P/N 3832; optional)
- Power Flush Valve: Brass, 2" Full port
- Dead-Head Valve: Brass, 1.5" Full port
- Hose Connections on cart: 1.5" cam male quick-connect
- Hoses: (2) 1.5" ID x 10' long, Flexible PVC hose with rigid PVC helix, working pressure 89 psi. (Premium 150 psi hose available P/N 4786)
- Female quick connect fittings (pump side) and 1" cam fittings (loop side)
- Power Drain Valve: ½" Brass, with garden hose swivel connection
- Pump & Dump Valve: ½" Brass, with garden hose swivel connection
- Fill Valve: ½" Brass, with garden hose swivel connection

- Pump Case Drain Port Valves: (2) ¼" Brass
- PT Port: Located on return piping; allows pressure measurement during dead-head and power flushing
- PT Port: Located on pump discharge; allows pressure management to check flow rate
- Pump/Tank Connection: 2" flexible wire reinforced hose with 2" cam connections
- Sight Tube: Flexible with O-ring; allows fluid level monitoring during dead-head

Cart Assembly: 27" Wide x 48" Tall x 24" Deep
Hoses: 10' long

ITEM	WEIGHT (lbs)
Flush Hoses	13.5
Flush Cart Assembly	155.5
Total	169
Shipping Weight*	183

Table 1: Physical Data
*Includes pallet and packaging materials required for shipping.

Physical Data

Table 1 shows physical data for the flush cart.

Pump Data

The flush cart pump is a self-priming Munro LP series 1.5 HP pump, constructed of heavy-duty cast iron with a brass impeller. The motor is a heavy-duty cap start type. Two drain ports ensure complete drainage. Maximum case pressure is 150 psi. Connections are as follows: 2" suction, 1.5" discharge ports. The Munro pump was selected based upon its ability to provide the high head and flow rates required for purging air from the ground loop. Figure 1 includes the performance curve.

NOTE: Max flow rate = 70 GPM. Pump discharge pressure must be no less than 25.5 PSIG to ensure that the pump is within the allowable operating range (70 GPM max). Running at a pressure less than this will result in the motor over-amping and may result the motor tripping. The motor has built in thermal overload which provides some protection. If the pump shuts off during operation, allow the motor to cool. Before restarting, turn the 1-1/2" supply valve approximately 2/3s of the way closed. Restart the pump and slowly open the supply valve while monitoring the discharge pressure until the necessary flow rate is achieved.

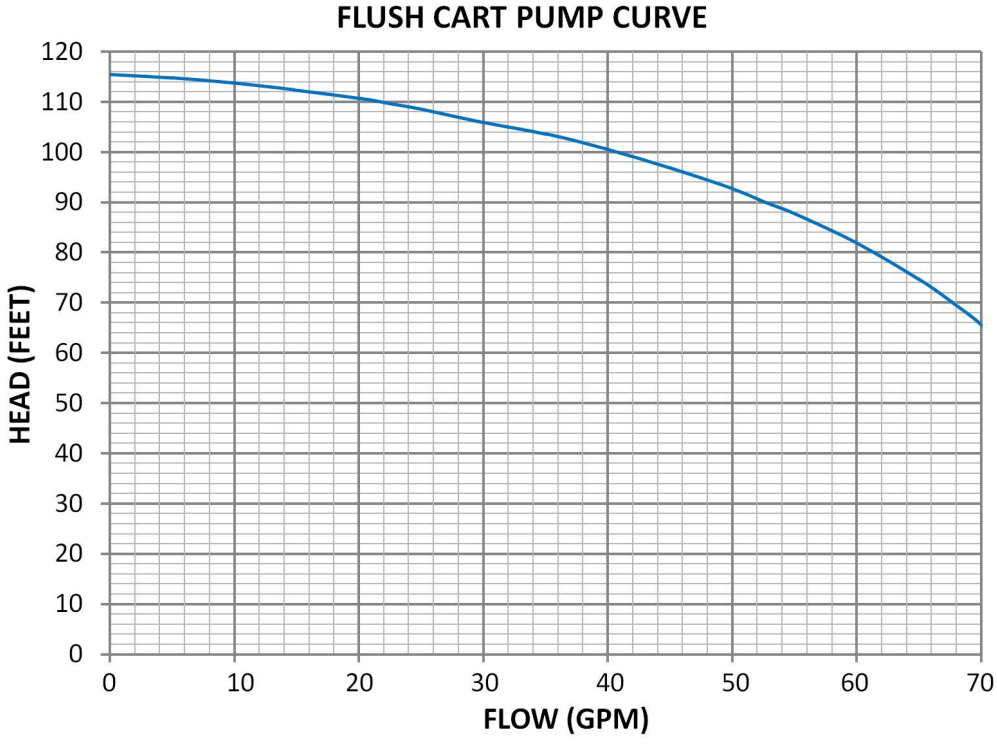


Figure 1: Munro LP Series performance curve

HP	Voltage	Hz/Phase	RPM	FLA
1.5	115 VAC*	60/1	3450	11.03

Table 2: Flush Cart Power Data

***Motor is dual rated 1X 115/208-230V; Factory wired 115V**

Pump Motor Electrical Data / Safety Listing

Table 2 includes electrical data for the Munro flush cart pump. The Geo-Flo flush cart includes an ETL safety listing for UL Standard 778. A UL listed flush cart is required in some U.S. states. Check local/state/provincial codes for compliance.

Flush Cart Safety Information

WARNING: RISK OF ELECTRIC SHOCK. THIS PUMP IS SUPPLIED WITH A GROUNDING CONDUCTOR AND GROUNDING-TYPE ATTACHMENT PLUG. TO REDUCE THE RISK OF ELECTRIC SHOCK, BE CERTAIN THAT IT IS CONNECTED ONLY TO A PROPERLY GROUNDED, GROUNDING-TYPE RECEPTACLE.

WARNING: ONLY USE PREMIXED ANTIFREEZE IN A NON-FLAMMABLE STATE. FAILURE TO OBSERVE SAFETY PRECAUTIONS MAY RESULT IN FIRE, INJURY, OR DEATH. ACCEPTABLE ANTIFREEZE SOLUTIONS INCLUDE ETHANOL, METHANOL, AND PROPYLENE GLYCOL. SEE SECTION ON ADDING ANTIFREEZE FOR MORE INFORMATION.

WARNING: NEVER HANDLE OR MIX METHANOL OR ETHANOL IN AN ENCLOSED SPACE. PURE METHANOL AND ETHANOL ARE EXTREMELY FLAMMABLE AND THE FUMES CAN IGNITE. EXTREME CARE MUST BE EXERCISED WHEN HANDLING THESE CHEMICALS. SEE SECTION ON ADDING ANTIFREEZE FOR MORE INFORMATION.

CAUTION: USE APPROPRIATE SAFETY DEVICES, INCLUDING EYE PROTECTION, WHEN HANDLING AND MIXING ANTIFREEZE SOLUTIONS.

Flush Cart Diagram

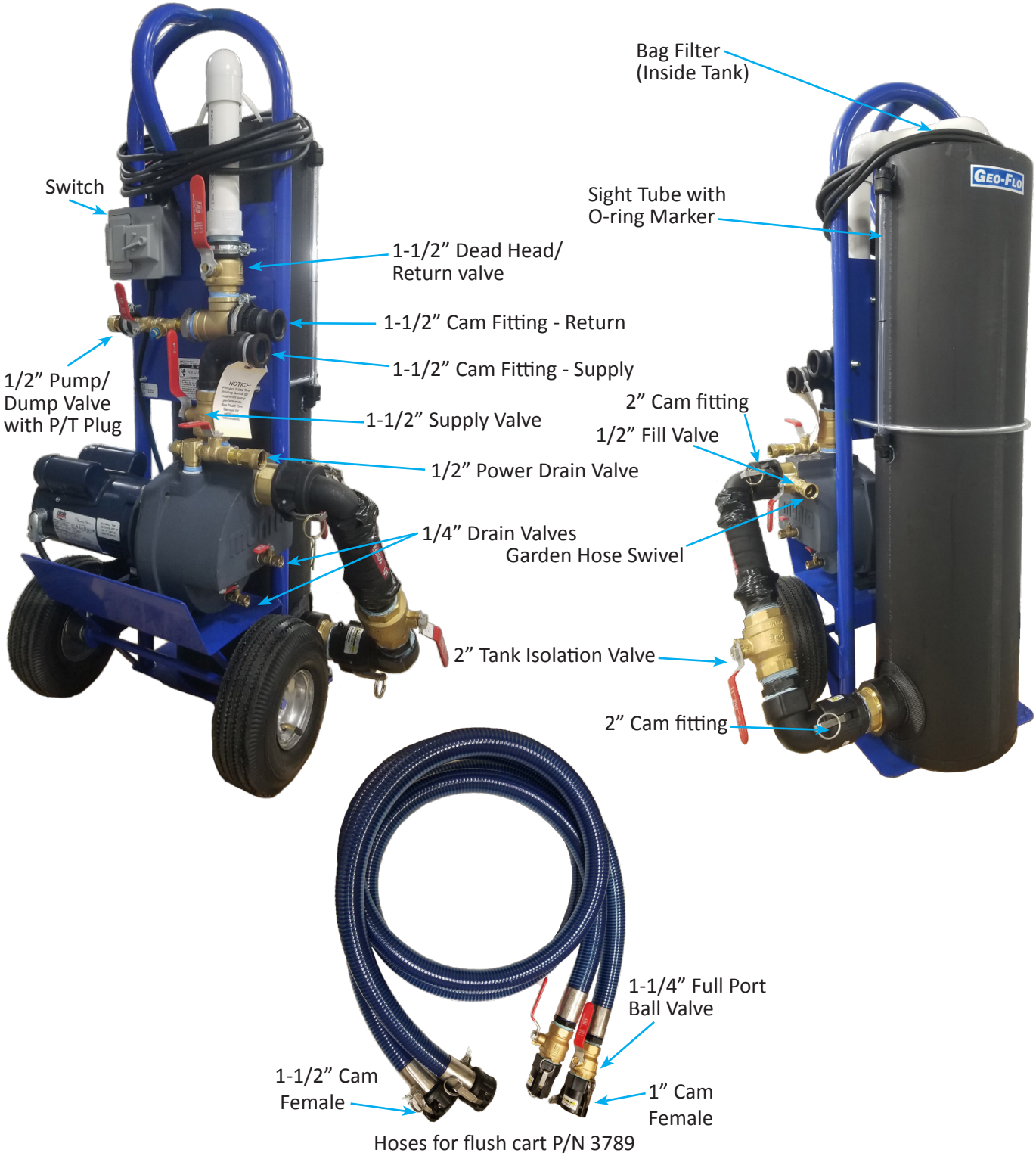


Figure 2: Flush cart diagram with descriptions

Each flush cart includes two flush hoses; the style depends on the flush cart purchased. Twenty foot hose extensions are also available (P/N 3793).

Flow Limiting Device

Figure 3: Flow regulator installed in 1-1/2” cam supply

This ETL listed flush cart is equipped with a removable flow regulator installed in the 1-1/2” supply cam fitting (see Figure 3) on the discharge of the pump. This flow regulator is intended to limit the starting amps to below 12 A to satisfy ETL requirements limiting amp draw for a device connected to a 15 amp circuit. Removing the flow regulator with a 3/8” square drive tool (such as a 3/8” drive socket wrench) will result in maximum performance of the pump as indicated by the pump performance curve. The same amp-limiting result can be achieved by closing the 1-1/2” supply valve prior to starting the pump, or by applying resistance to flow (head) such as when the flush cart is connected to a flow center during normal operation of the flush cart.

Standard Flushing/Purging Procedure*

Before beginning this procedure carefully study the flush chart diagram in Figure 2 to become familiar with the valves used throughout the process. Actual flushing time will vary depending on the size and configuration of the loop. However, typically flushing will require *at least* 2 hours of continues pump operation.

1. Position flush cart near the flow center. If flow center or purge valves are located in an area difficult to access (such as a crawl space), two extension hoses 20’ long (P/N3793) can be connected to the standard hoses to provide additional reach.

NOTE: Remove Flow Regulating Device (Figure 3) to achieve maximum pump performance.

2. Attach 1-1/2” hoses to 1-1/2” cam fittings on flush cart.

3. Attach flow center cam adapter fittings to flush cart hoses. If using a FPT flow center, attach 1” MPT X 1” cam fittings, or 1”

*This manual concentrates on flushing/purging for pressurized flow centers. For flushing procedures for non-pressurized flow centers, consult the NP series I.O.M.

MPT X Flo-Link female fittings to the flow center first (Figure 4). Then attach flush cart hoses . The 1” MPT X Flo-Link female along with the 1” cam X Flo-Link elbows allow the flush hoses to hang vertically and provide a rotating union connection.

4. Attach garden/utility hose to 1/2” fill valve (Figure 5). Attach other end of hose to acceptable municipal water supply or pre-mixed antifreeze source and transfer pump.

WARNING: ONLY USE PREMIXED ANTIFREEZE IN A NON-FLAMMABLE STATE. FAILURE TO OBSERVE SAFETY PRECAUTIONS MAY RESULT IN FIRE, INJURY, OR DEATH.

5. Rotate 3-way valves on flow center so that the heat pump circuit is isolated and fluid is directed toward the ground loop only. Figure 6 shows examples of how the valves may be oriented. This will vary depending on the type of flow center installed.

NOTE: Due to the nature of the installation process, the ground loop typically has a higher amount of debris than the heat pump circuit. Therefore, flushing the ground loop piping prior to flushing the heat pump and associated piping is recommended. This should prevent accidently pushing debris through the heat pump’s heat exchanger and/or the circulator pumps.

6. Insert pressure gage with large dial face with a P/T adapter (such as Geo-Flo P/N 3565) into P/T port on flush cart. Close 1/2” pump & dump valve (Figure 7).

7. Ensure that the bag filter is in place on the return PVC pipe. Geo-Flo recommends looping the filter bag strap over the top of the return piping.

8. Close 2” tank isolation valve (Figure 5) and open the 1-1/2” dead-head valve (Figure 8).

9. Open 1/2” fill valve (Figure 5) and allow the loop to fill. Watch the fluid level in the tank via the sight tube. When the tank is nearly full, shut off the 1/2” fill valve and 1-1/2” supply valve (Figure 8).

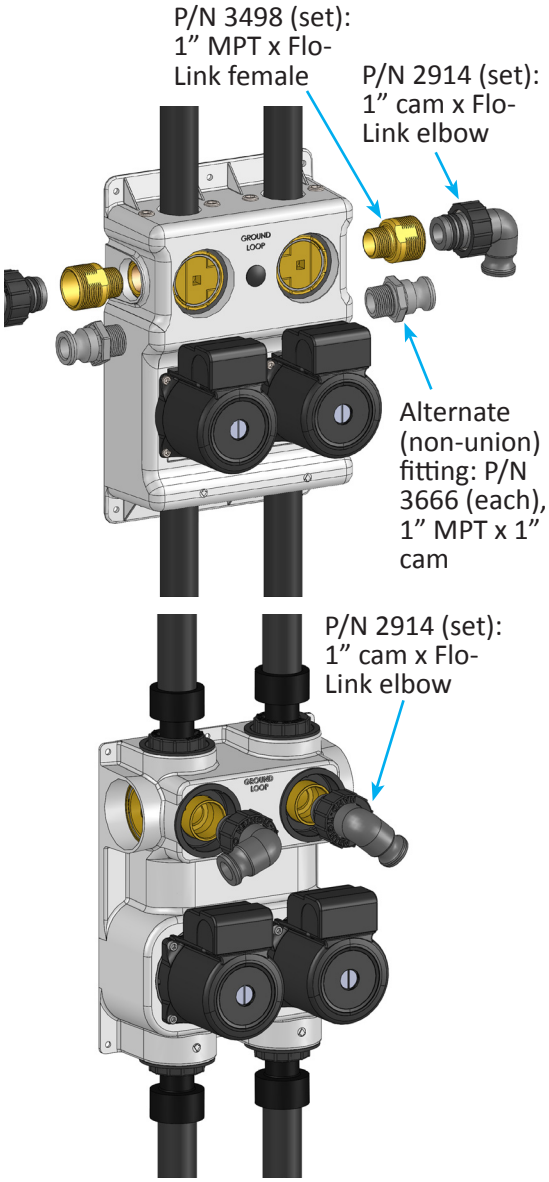


Figure 4: FPT flow center (top) and Flo-Link Double O-ring flow center (below) flush cart fittings

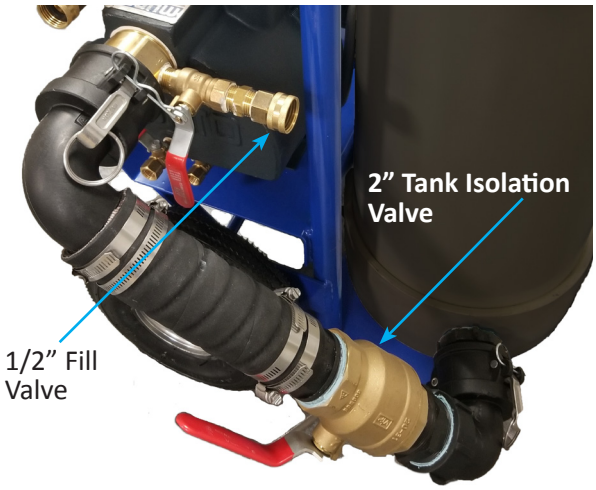
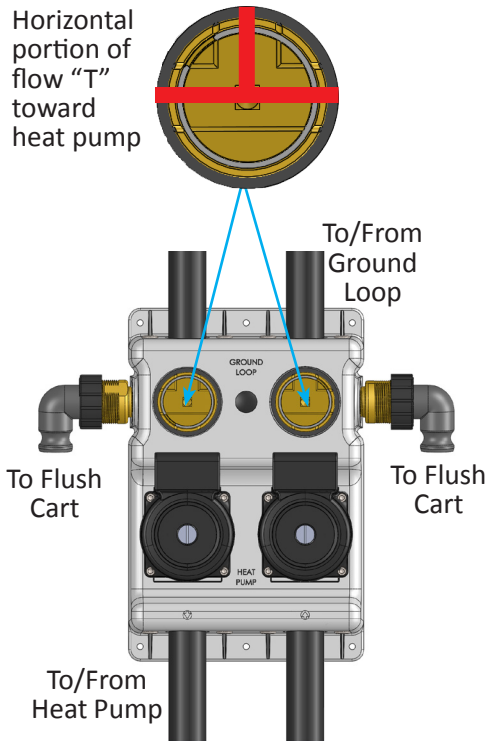


Figure 5: Fill Valve/Tank Isolation Valve



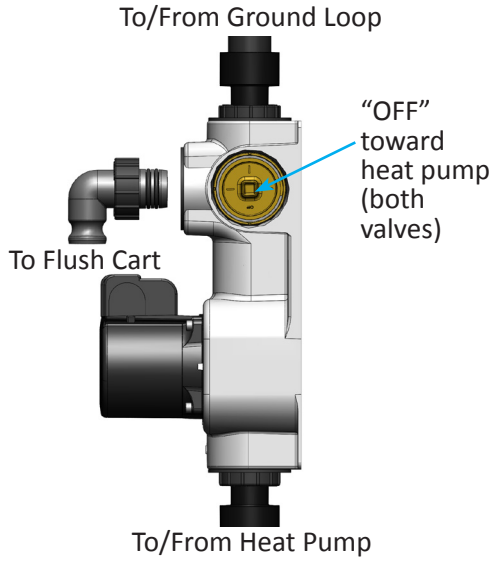


Figure 6: FPT flow center (top) and Flo-Link Double O-ring flow center (below) valve positions for heat pump isolation

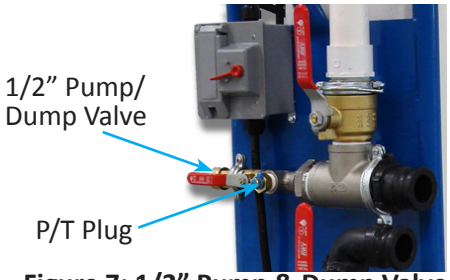


Figure 7: 1/2" Pump & Dump Valve

10. Open the 2" tank isolation valve (Figure 5) and energize the pump. Slowly open the 1-1/2" supply valve (Figure 8) approximately 1/4 to 1/2 open. Air and debris will be pushed through the return piping. Debris will be captured in the bag filter and air will be released to the atmosphere.

NOTE: The 100 micron bag filter must be in place during flushing to filter debris from the loop. Debris is a leading cause of circulator pump failure.

11. Regulate the fluid level in the tank with the 1/2" fill valve (Figure 5) and the 1-1/2" supply valve (Figure 8) while the pump is running. Do not allow the fluid in the tank to drop too low or air will be pushed back into the loop extending flushing time.

NOTE: When the pump is running any air remaining in the loop will be pressurized. Therefore, if the pump is powered off during the flushing process the compressed air will expand pushing the loop fluid back in the tank. This could cause the tank to overflow. If the pump must be shut off during the process, close the 1-1/2" supply valve (Figure 8) and the 1-1/2" dead-head/return valve (Figure 8) to prevent fluid from returning to the tank.

12. When the fluid level remains relatively stable ensure that the 1-1/2" supply valve (Figure 8) is fully open.

13. Allow the pump to operate until the fluid returning to the tank appears clear and free of air.

14. While the pump is running, "dead-head" the pump by turning off the dead-head/return valve (Figure 8). Then, quickly reopen the valve allowing the fluid to return to the tank. This process drives the loop pressure up thereby compressing any air remaining in the loop. Quickly opening the valve creates a sudden high velocity surge that helps dislodge air into the fluid stream where it can be returned to the tank.

15. Repeat the dead-head process 2-3 times over a period of 15 minutes. If necessary, add more fluid to the tank so the fluid level is visible in the sight tube.

16. With the pump continuing to run, mark the fluid level in the tank with the O-ring on the sight tube.

17. Close the 1-1/2” dead-head valve (Figure 8) while watching the fluid level in the sight tube. The dead-head process drives the static loop pressure to approximately 50 psi. Since fluid is incompressible but air can be compressed, this procedure shows whether air remains in the loop. In general, the fluid should not drop more than about 3/8” to 3/4” on a typical residential system. The slight drop in fluid is due to the expansion of the ground loop piping, and the actual drop will depend on the loop size (i.e. how much total pipe is in the loop) and fluid temperature.

18. Rotate 3-way valves on flow center so that the ground loop is isolated and fluid is directed toward the heat pump only. Figure 9 shows examples of how the valves may be oriented. This will vary depending on the flow center and installation.

19. Open the 1-1/2” dead-head valve (Figure 8) and allow the fluid to continue to circulate.

NOTE: If the preceding procedure is unsuccessful in removing all air from the loop, power flushing may be necessary. Proceed to the section of this document entitled “Power Flushing.”

20. Repeat Steps 11 through 17 above to ensure that all air has been purged from the heat pump circuit.

21. Rotate 3-way valves on flow center so that the fluid is directed toward both the ground loop and heat pump. Figure 10 shows examples of how the valves may be oriented. This will vary depending on the type of flow center installed.

22. Repeat steps 11 through 17 above to ensure that all air has been purged from the ground loop and heat pump system.

NOTE: If you suspect that the loop system is contaminated with very fine sand, silt, or clay, additional loop filtration is necessary. Proceed to the section of this document entitled “Fluid Filtering”.

23. Close the 1-1/2” dead-head valve (Figure 8).

24. Close the 1-1/2” supply valve (Figure 8) to trap pressure in the system. Turn off the pump.

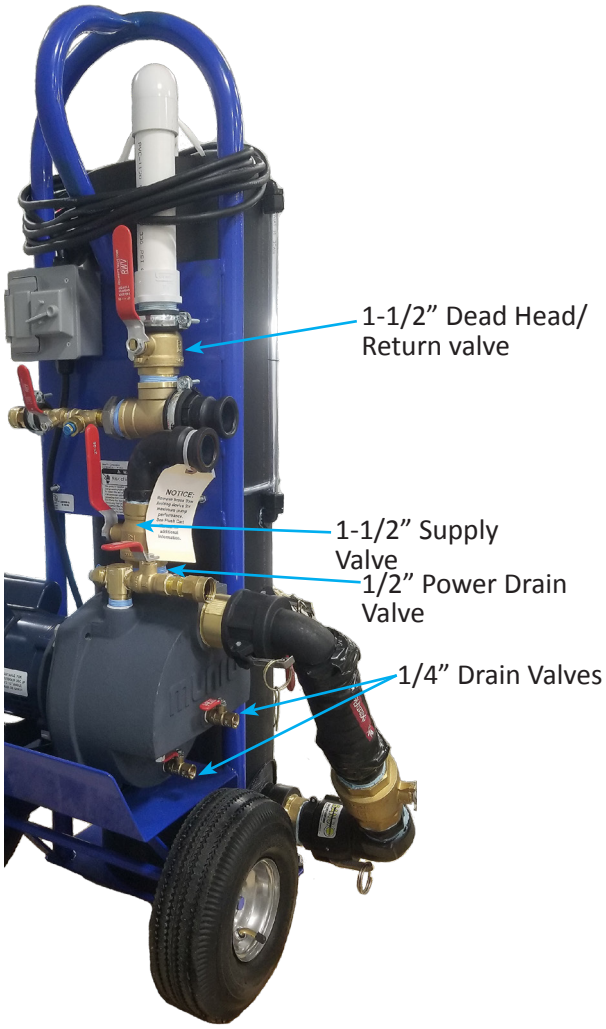


Figure 8: Flush Cart Valves in flushing steps

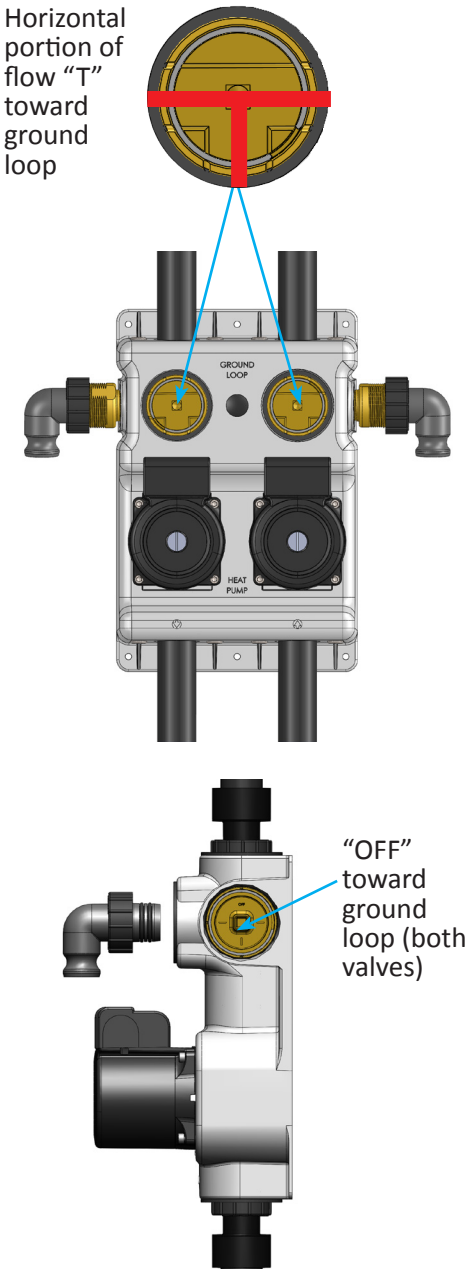


Figure 9: FPT flow center (top) and Flo-Link Double O-ring flow center (below) valve positions for ground loop isolation

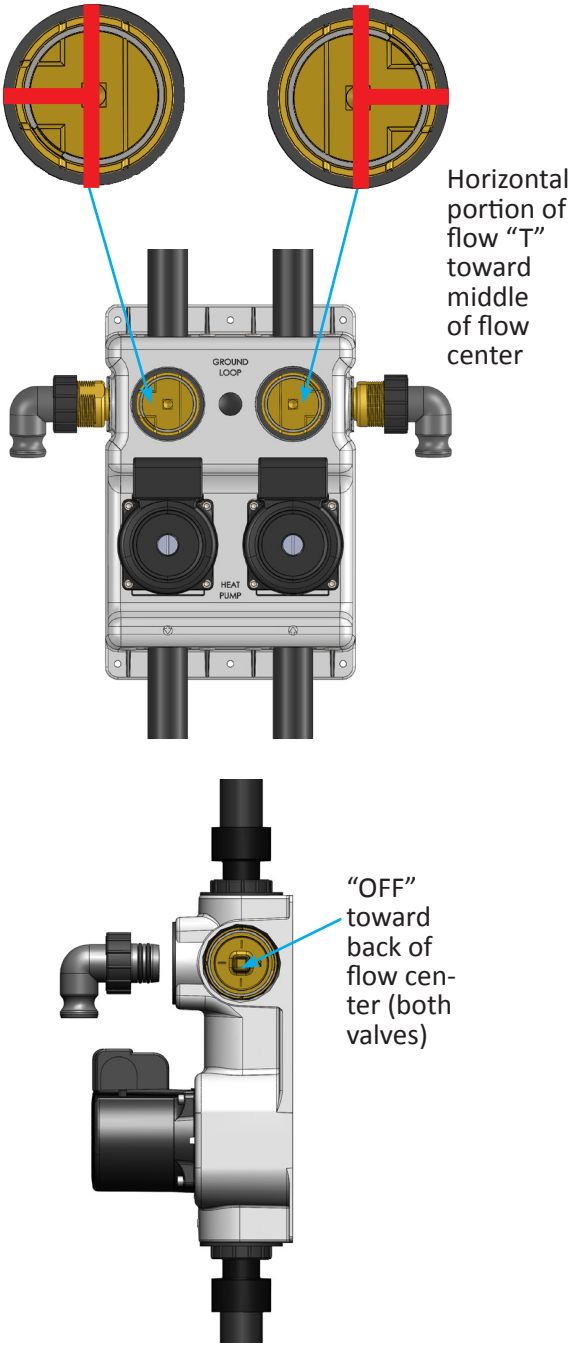


Figure 10: FPT flow center (top) and Flo-Link Double O-ring flow center (below) valve positions to allow flow to both the ground loop and the heat pump

25. Using a large flat head screwdriver, slightly open the vent screw on the face of the Grundfos pump(s). After a few drops of water escapes, retighten the screw.

NOTE: This step is critical. Opening the vent screw and allowing fluid to drip out ensures that all trapped air has exited the pump motor. Skipping this important step could lead to premature pump failure.

26. Monitor the pressure gauge for 10-15 minutes. The pressure should not drop substantially (typically no more than 3-4 psi). The slight pressure drop is due to the loop pipe relaxing and is normal. If there is substantial pressure drop there is likely a leak in the system. Inspect all piping connections in the mechanical room for signs of fluid and correct any issues discovered. If there is a leak in a flush cart connection the flush cart should be isolated from the system as shown in step 27. Then, the pressure gauge can be installed in a P/T port at the heat pump to monitor pressure.

27. If installing a pressurized system, rotate the 3-way valves so that the flush cart is isolated from the system. Figure 11 shows an example of how the valves may be oriented. This will vary depending on the type of flow center installed.

28. Open the 1-1/2” Supply and Return valves (Figure 8) to relieve the pressure in the hoses.

29. If using the flush cart hoses with 1-1/4” ball valves (P/N 3789), close the ball valves.

30. Disconnect the hoses from the flow center.

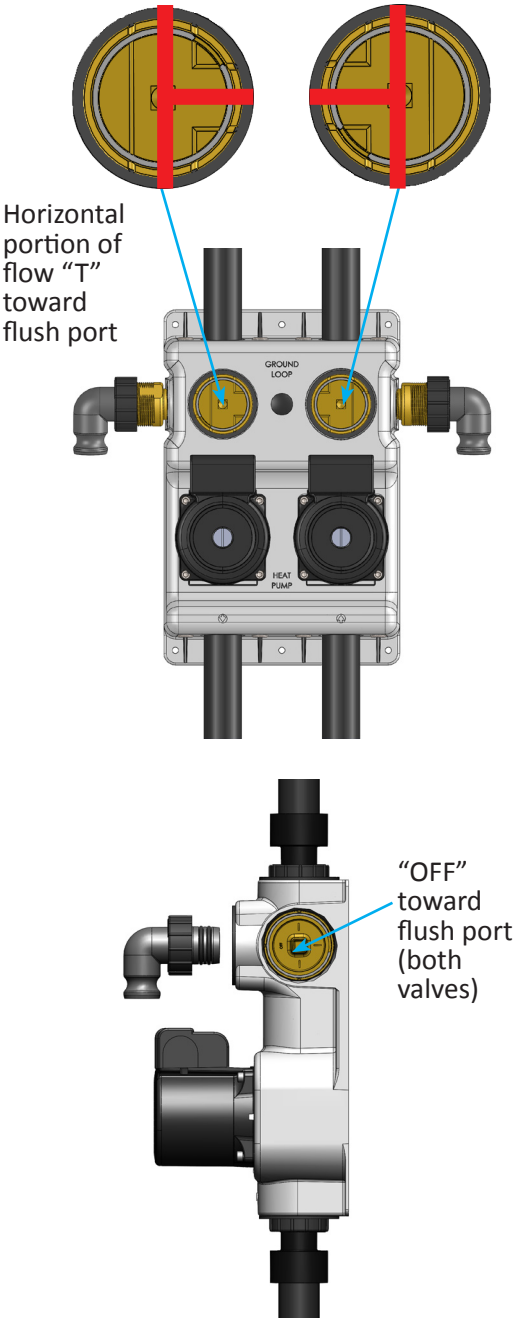


Figure 11: FPT flow center (top) and Flo-Link Double O-ring flow center (below) valve positions in operating position

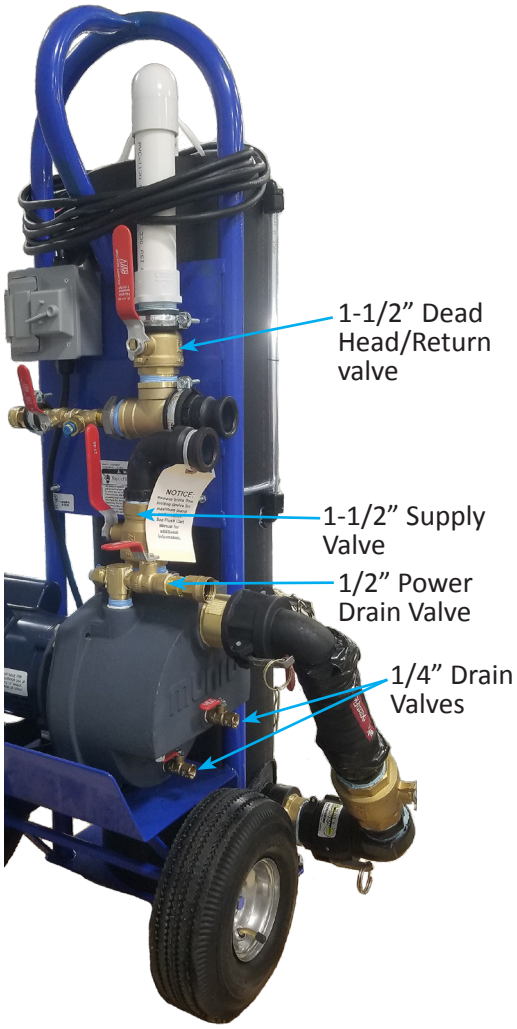


Figure 12: Flush Cart Valves in flushing steps

Power Flushing

Power flushing is a technique that can be utilized to help purge air from a ground loop when the standard flushing procedure does not eliminate all air from the loop. This procedure utilizes the flush cart pump and municipal water pressure together to provide maximum system pressure to compress and purge air pockets. The following procedure describes this process and assumes that steps 1-18 in the Standard Flushing/Purging section have been completed.

1. Be sure there is sufficient capacity in the tank to add more fluid. If necessary, remove fluid from the tank before proceeding.
2. With the pump running, close the 1-1/2” dead head valve (Figure 12) and 2” tank isolation valve (Figure 13), and open the 1/2” fill valve (Figure 13).
3. Monitor the pressure; it will quickly climb to 80-100 psig.
4. When the pressure reaches 80-100 psig, close the 1/2” fill valve (Figure 13). Then, open the 1-1/2” dead head valve (Figure 12) and the 2” tank isolation valve (Figure 13) simultaneously.
5. Repeat steps 1-4 above.
6. Return to step 16 of the Standard Flushing/Purging section.

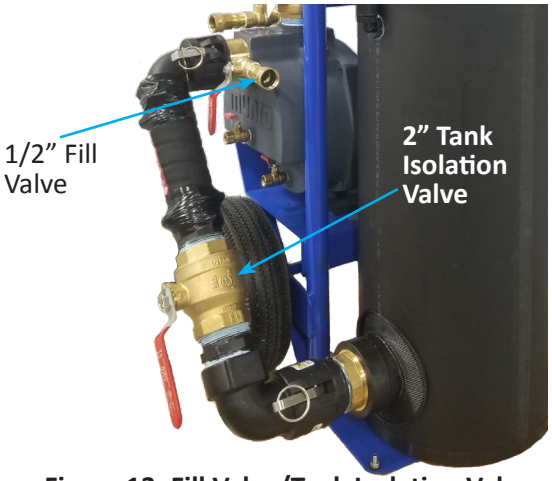


Figure 13: Fill Valve/Tank Isolation Valve

Fluid Filtering

The circulation pumps used in closed loop geothermal systems require clean fluid to operate properly and reliably. The standard

100 micron filter provided with the flush cart is acceptable for capturing relatively large debris such as pipe shavings, gravel, and medium sand particles. In certain installation locations other smaller materials such as fine sand, silt and clay may be present in the water supply or introduced to the loop system during installation. These fine particles can travel to the circulation pumps used during system operation possibly causing erosion of the pump housing and/or a locked rotor and pump failure. Debris in the closed loop system is a leading factor in premature pump failure. Therefore, it is good practice to always preform additional fluid filtration to ensure the clearest fluid possible before completing a system installation. The following procedure assumes that steps 1-22 of the Standard Flushing/Purging section have been completed.

NOTE: Prior to using the one micron filter, rinse it thoroughly with clean water to remove any residual debris from the manufacturing process.

1. Turn off the pump and drain fluid from the tank until the level is below the bottom of the filter (make sure that the level does not drop below the suction inlet to the pump). This step is necessary to prevent debris captured in the 100 micron filter bag from being reintroduced into the tank. If possible, capture the fluid drained from the tank in a container so it can be added back to the tank in step 3.

2. Replace the 100 micron filter with a one micron filter.

3. Replace the fluid removed in step 1 to refill the tank to the level it was before filter replacement.

4. Rotate the valves on the flow center to direct the fluid to the ground loop only. Figure 6 shows examples of how the valves may be oriented. This will vary depending on the type of flow center installed.

5. Run the flush cart for at least 30 minutes, while monitoring the filter. This 1 micron filter (P/N 3832) will catch clay, sand and other debris. If the filter overflows during the process, stop the pump and clean or replace the filter as necessary. Continue

until the loop fluid is completely filtered. Clean the 100 micron filter with clean water while the one micron filter is being used. Rotate the valves on the flow center to direct the fluid to the heat pump and allow the pump to run for another five minutes. Figure 9 shows examples of how the valves may be oriented. This will vary depending on the type of flow center installed.

6. Turn off the pump and drain fluid from the tank until the level is below the bottom of the filter (make sure that the level does not drop below the suction inlet to the pump). This step is necessary to prevent debris captured in the one micron filter bag from being reintroduced into the tank. If possible, capture the fluid drained from the tank in a container so it can be added back to the tank in step 8.

7. Replace the one micron filter with a clean 100 micron filter.

8. Replace the fluid removed in step 7 to refill the tank to the level it was before filter replacement.

9. Return to step 21 of the Standard Flushing/Purging section.

NOTE: Dead-heading the pump to check for air in the loop system is not possible with the one micron filter in place. The fluid in the tank is drawn down from the tank faster than it passes through the filter. Therefore, if the pump is dead-headed with the one mircon filter in place, the fluid level in the tank around the filter drops while the fluid level in the filter remains at a higher level. After filtering with the one micron filter and re-installing the 100 micron filter, it is important to repeat the dead-heading procedure described in the Standard Flush/Purging section to ensure air did not enter the system during the filtering process.

Adding Antifreeze

Antifreeze is used in a ground loop system when the loop fluid entering the heat pump (EWT) is expected to drop below 40 degrees

Fahrenheit. In general, antifreeze is added at concentration high enough to achieve a freeze protection level that is 10 degrees lower than the lowest expected entering fluid temperature (EWT) to the heat pump. For example, if the lowest design or expected EWT is 35 F, antifreeze is added to achieve a freeze protection level of 25F (see table 3). Adding too much antifreeze will result in reduced loop capacity and increased pump power consumption. The freeze protection level depends on the type and concentration of antifreeze. The antifreeze types most commonly used are methanol, ethanol, and propylene glycol. Pure methanol and ethanol are extremely flammable and the fumes can ignite. Extreme care must be exercised when handling these chemicals. Table 4 provides the flash point of ethanol and methanol solutions. The flash point is the lowest temperature where the alcohol will evaporate enough to form a combustible concentration of gas. Therefore, the flammability of ethanol and methanol antifreeze solutions depends on the temperature of the mixture. Pure methanol or ethanol should never be mixed in an enclosed area. Since the flash point of propylene glycol is above the boiling point of water, there is little fire hazard in storage or handling. Geo-Flo recommends using only pre-mixed alcohol antifreezes in a non-flammable state or propylene glycol at the job site. Some municipalities restrict the use of certain antifreeze solutions in the ground loop system so be sure to check with state and local authorities.

WARNING: ONLY USE PRE-MIXED ANTIFREEZE IN A NON-FLAMMABLE STATE. FAILURE TO OBSERVE SAFETY PRECAUTIONS MAY RESULT IN FIRE, INJURY, OR DEATH.

Antifreeze	% by vol	Freeze Protection deg F	Specific Gravity * (at 20°C/68°F)
Methanol	10%	22.7	0.983
	15%	17.3	0.975
	17%	15.1	0.972
	20%	11.5	0.968
Ethanol	15%	23.1	0.978
	20%	17.9	0.972
	22%	15.4	0.970
	25%	11.6	0.966
	30%	4.2	0.960
Propylene Glycol	15%	23	1.016
	20%	19.4	1.022
	25%	15.1	1.027
	30%	10.0	1.031

Table 3: Freeze protection and specific gravity for common ground loop antifreeze mixtures

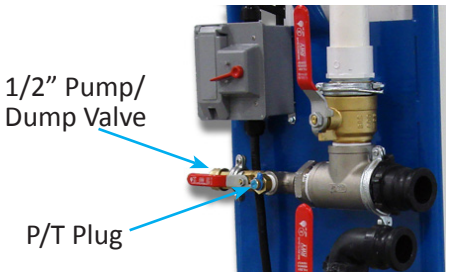
*NOTE: The specific gravity of a mixture varies with temperature so the measurement should be taken at the reference temperature for the most accurate results.

Data obtained from Geo-Flo Calculator apps, www.geo-flo.com/calculators, with additional sources listed there.

% by vol	Flash Point, deg F	
	Ethanol	Methanol
10%	120	130
20%	97	110
30%	84	95
40%	79	85
50%	75	75
60%	72	70
70%	70	60
80%	68	54
90%	63	54
100%	63	54

Table 4: Flash point* for ethanol and methanol mixtures (source: engineeringtoolbox.com)

*The flash point of a chemical is the lowest temperature where it will evaporate enough fluid to form a combustible concentration of gas. The flash point is an indication of how easy a chemical may burn.



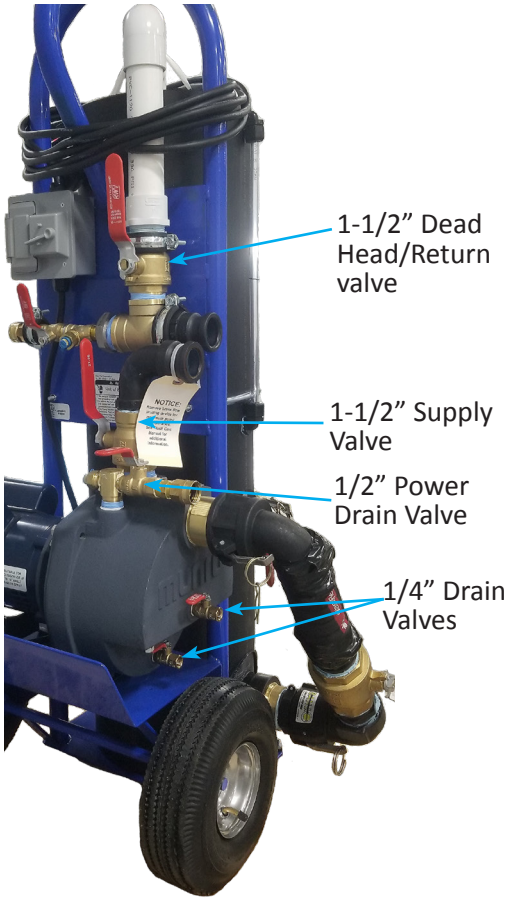


Figure 14: Flush Cart Valves in adding antifreeze steps

WARNING: ONLY USE PREMIXED ANTIFREEZE IN A NON-FLAMMABLE STATE. FAILURE TO OBSERVE SAFETY PRECAUTIONS MAY RESULT IN FIRE, INJURY, OR DEATH.

Pump and Dump Method of Adding Antifreeze

1. Calculate the amount of antifreeze needed to achieve the freeze protection required for the system. Geo-Flo provides a free on-line calculator (go to any of the pressure drop calculators at www.geo-flo.com) to assist in determining the quantity and freeze protection level of the antifreeze chosen for a particular installation. Table 3 provides freeze protection levels for ethanol, methanol, and propylene glycol.

2. Attach a hose to the 1/2” pump & dump valve (Figure 14). Direct the opposite end of the hose to an appropriate drain.

3. Rotate the flush valves on the flow center to direct fluid to the ground loop only (Figure 6). Since most of the loop fluid is in the ground loop, most of the antifreeze would likely dump down the drain if antifreeze were introduced toward the heat pump.

4. Open the 1-1/2” supply valve (Figure 14).

5. Close the 1-1/2” dead head valve (Figure 14). This prevents fluid from returning to the tank.

6. Slightly open the 1/2” pump & dump valve (Figure 14).

7. Energize the pump. The water from the tank/loop is pumped to the drain. Closely monitor the fluid level in the tank and turn off the pump before the fluid level drops below the suction pipe so air is not drawn into the system. If air is drawn into the system, the flushing procedure described above must be repeated.

8. Carefully add the antifreeze fluid to the tank. Propylene glycol can be poured directly into the top of the tank. However, methanol and ethanol should be handled with extreme caution. These chemicals should never be poured directly into the top of the flush cart tank when the flush cart is located in an enclosed space such as a home or mechanical room. Pure methanol and ethanol are extremely flammable and the fumes can ignite. ***Always pre-mix alcohols before taking them to the job site.*** For example, if the desired concentration of methanol is 17% (15.1 deg. F freeze protection), bring a 25% mixture to

the job site, and simply use four times as much of the mixture vs. pure methanol. Extreme care must be exercised, especially in hot weather, as 25% methanol by volume has a flash point of about 100 deg. F.

9. Energize the pump. The water from the tank/loop is pumped to the drain while the antifreeze is pumped to the ground loop. Closely monitor the fluid level in the tank and turn off the pump before the fluid level drops below the suction pipe so air is not drawn into the system. If air is drawn into the system, the flushing procedure described above must be repeated.

10. Repeat steps 8 and 9 until the required antifreeze has been added to the loop.

11. Close the 1/2" pump and dump valve (Figure 14).

12. Open the 1-1/2" supply valve (Figure 14) and energize the pump to mix the antifreeze with the water in the loop.

13. Rotate the flush valves on the flow center to direct the fluid to both the heat pump and the ground loop to allow the antifreeze to mix. Allow the pump to run until the fluid is thoroughly mixed. If installing a pressurized flow center, pressurize the system as described in the Standard Flushing/Purging Procedure section of this document.

Verifying Antifreeze Concentration/ Freeze Protection

The antifreeze concentration is checked using a specific gravity hydrometer or refractometer. Be sure to use the proper specific gravity hydrometer for the antifreeze type used. Table 3 and Figures 15 through 18 provide specific gravity versus freeze protection for methanol, ethanol, and propylene glycol.

Water Quality

Unfortunately for some system owners, water quality is not considered for closed loop systems. One of the leading causes of premature pump failure is poor water quality. Water quality related to pump or system component failure may be categorized into four

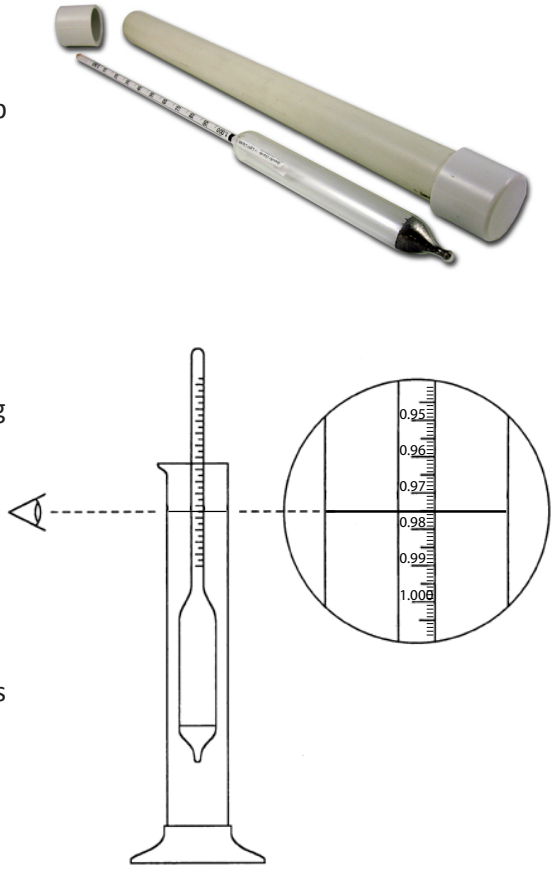


Figure 15: Typical hydrometer (above); reading a hydrometer (below). In the example, this hydrometer would be read as 0.975, approximately 24% ethanol by volume. NOTE: There are two types of hydrometers, one for fluids lighter than water (ethanol and methanol); and one for fluids heavier than water (propylene glycol).

Figure 16: Freeze protection for common ground loop antifreeze mixtures (source: Geo-Flo Calculator apps, www.geo-flo.com)

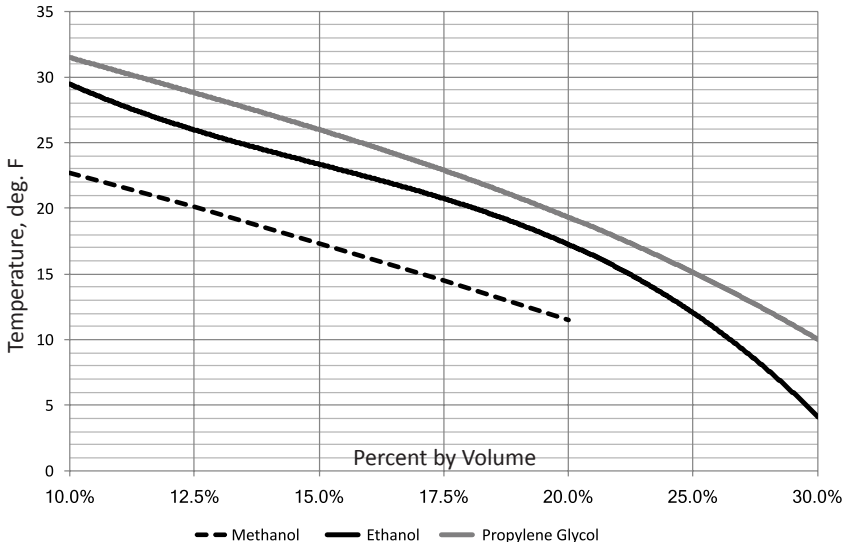


Figure 17: Specific gravity for alcohol-based antifreezes over a range of freeze protection temperatures (source: Geo-Flo Calculator apps, www.geo-flo.com)

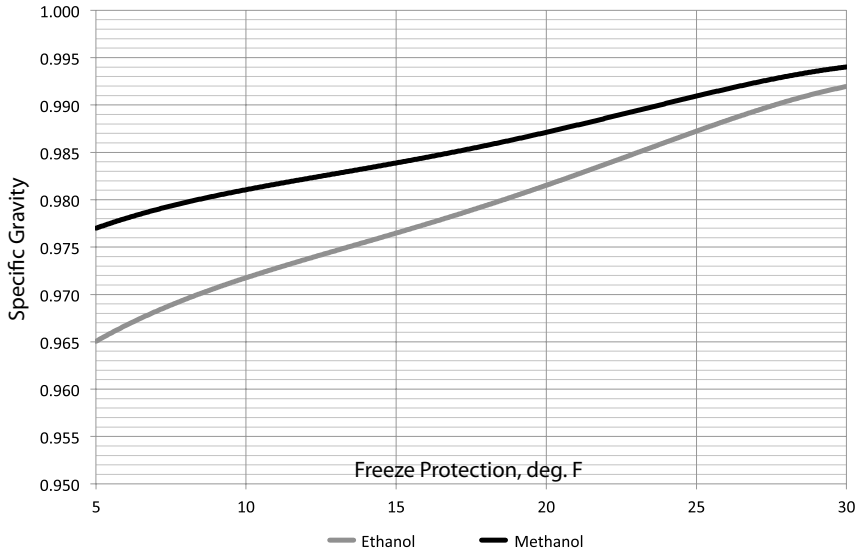
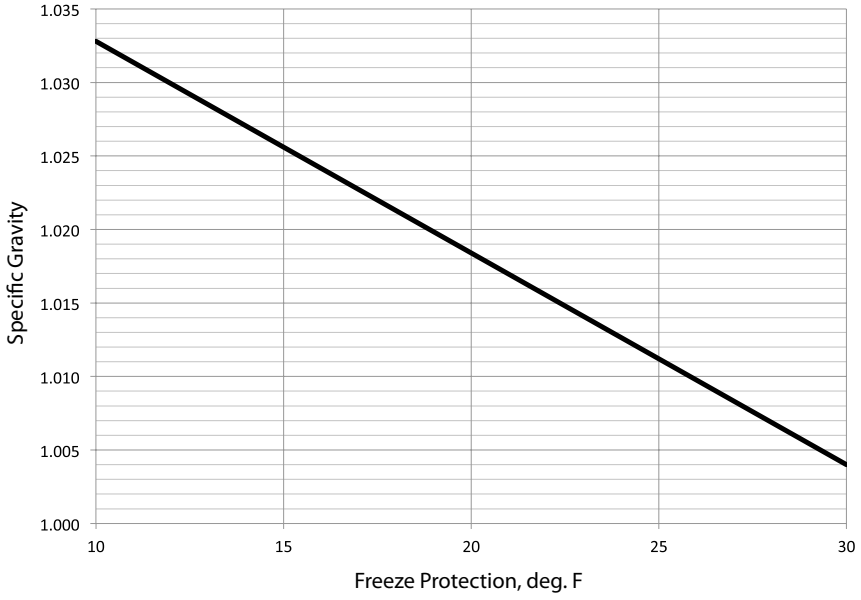


Figure 18: Specific gravity for propylene glycol over a range of freeze protection temperatures (source: Geo-Flo Calculator apps, www.geo-flo.com)



areas of concern, namely:

- **Suspended Solids**: Suspended solids can include dirt, silt, sand, biological growth, insoluble organic matter, and iron. Suspended solids act like sandpaper in the system. *It is common to see examples of suspended solids in pump tear-down analyses of warranty returns.*
- **System Insufficiently Purged of Air**: Oxygen in the system attacks ferrous materials (cast iron volutes, steel piping in commercial buildings, etc.).
- **pH level**: As the pH of the system water increases (moves toward the alkaline side of the scale), the corrosiveness of the water decreases. However, as the pH of the water increases, the formation of scale increases. Low pH is acidic; high pH is alkaline. According the *2011 ASHRAE Handbook -- HVAC Applications*, normal system pH should be in the 6.5 to 9.0 range.
- **Hardness**: As the hardness of the system water increases, the corrosiveness of the water decreases. However, as the hardness of the system water increases, the formation of scale increases.

Poor water quality can affect pumps and system components in a number of ways. Heat pump heat exchanger failure or pump volute corrosion is typically a result of low system pH level. However, water hardness is also a problem with regard to pump bearing failure, plugging of valves/orifices, and coating of system surfaces (decreased heat exchange).

Determining water quality requires testing a sample. In most cases, contractors only need to do two to three water quality tests to get a general feel for the water quality in the area. For example, if most of the geothermal applications are in a 30 mile radius, there may only be two to three municipal water systems in the service area.

Table 5 provides water quality guidelines to help protect the loop pump(s) from premature failure, assuming that all debris is filtered from the system fluid. However, following these guidelines will also help protect the heat pump heat exchanger and other system components.

In certain parts of North America, bronze or stainless steel volutes are popular. In most cases, water treatment or the use of antifreeze (with corrosion inhibitors) at start up is significantly less expensive over time than installing a more corrosion-resistant material, even if antifreeze is not needed for freeze protection (Southern climates). Selection of bronze or stainless steel will prolong the service life of the pump volute, but there are other components in the system that will be attacked by the harsh system water.

For the most part, there are two solutions to providing good system water quality, namely: 1) treatment of local water; or 2) transportation of water to the job site. In fact, most antifreeze manufacturers require de-ionized or distilled water as part of their warranty policy.

The type of antifreeze may also determine the amount of treatment needed if any. For example, pure methanol does not include corrosion inhibitors. Purchase of a pre-mix antifreeze could significantly improve system

Measurement	Limits	Source
Hardness	< 14 gr/gal	Grundfos
Total dissolved solids	filtered for max. of 1 micron	See Table 2
pH	6.5 - 9.0	ASHRAE
Iron	< 50 ppm	Fernox
Chloride	< 125 ppm	Fernox

Table 5: Water quality guidelines

Grains per gallon = ppm divided by 17.14
mg/L = ppm

Soil Type	Grain Size*
Gravel	2,000 to 75,000 microns
Course Sand	425 to 2,000 microns
Fine Sand	75 to 425 microns
Silt-Clay	< 75 microns*
Clay	< 2 microns*

Table 6: Grain size

* Grain size is defined by the AASHTO soil classification system for the U.S. Bureau of Public Roads (now the Federal Highway Administration). Silt-Clay is the smallest grain size considered in the AASHTO system. ISO 14688-1 includes clay particles in the 2 micron and smaller range.

reliability if the water quality is controlled and there are additives in the mixture to inhibit corrosion. Another example is propylene glycol. Most brands require a 30% concentration to provide enough corrosion inhibitors. However, at 30%, propylene glycol is very viscous at low temperatures, and will add to the system pressure drop, potentially increasing pump sizing. At 20% to 25%, there may not be enough inhibitors to protect the pump volutes and heat pump. Additives such as Fernox's F1 inhibitor can be added to systems without inhibitors or systems with less inhibitors than required (20% to 25% propylene glycol), bringing the loop fluid to an acceptable level of protection. The Fernox F1 inhibitor also corrects for both low and high pH level, as well as hardness, and other chemical imbalances.

When using a pre-mix water/antifreeze solution, extreme care must be exercised to keep dirt and debris out of the system. Since the fluid that will be used to fill/flush the ground loop will be the final system fluid, every attempt should made to cap pipes and keep debris out of the system during loop installation. Note that the standard 100 micron filter on the Geo-Flo flush cart is acceptable for capturing relatively large debris such as pipe shavings, gravel, and medium sand particles but is not capable of catching very small particles. Geo-Flo provides a one micron filter for the flush cart that may be used for final clean-up once air is purged from the loop (see "Fluid Filtering" section). Table 5 provides particle size of various soil types, showing the value of utilizing a one micron filter.

If particulate matter is a concern, it may be advantageous to use local water for purging air and filtering debris from the system, and then use the "pump and dump" method for replacing the purging water with the pre-mix antifreeze solution. Consideration of water quality can eliminate many system failures and help maintain satisfied customers.

Verifying Fluid Velocity

Every section of the ground loop must have a minimum fluid velocity of 2 feet per second to purge all air from the loop. To determine the flow rate, complete the following steps:

1. Measure total head at discharge of flush cart pump.

2. Convert PSIG to Feet of head (Ft-Hd=PSIG X 2.31).

3. Use flush cart pump curve to determine flow rate at this head loss.

4. Divide flow rate by number of parallel circuits to determine the flow rate per circuit.

5. Compare to minimum flow rate required for each pipe section.

Example

1. Measure pressure drop at discharge of pump while pump is running

2. Convert: 45 psig X 2.31ft-hd/psig = 104 ft-hd

3. Find flow rate from your flush cart pump curve, ~38

4. Divide flow rate by number of parallel circuits to determine the flow rate per circuit.

   38 GPM/5 Circuits= 7.6 GPM/Circuit

5. Compare to chart to verify 2 ft/sec

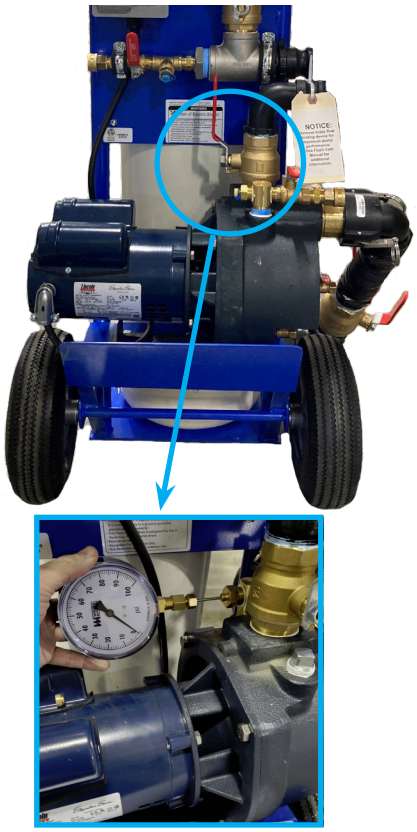


Figure 19: Measuring pressure drop

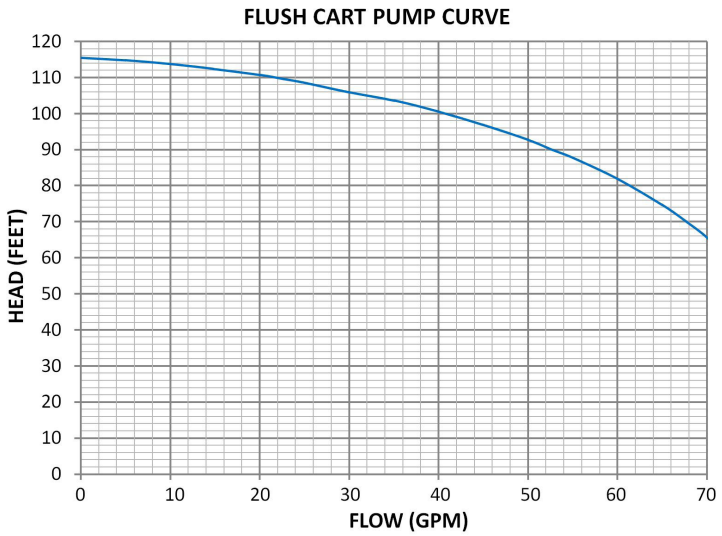


Figure 20: Munro Pump- Pump Curve

FLUSHING FLOW RATE FOR HDPE PIPE (2 ft/sec fluid velocity)		
Nominal Pipe Size (IN)	Flow rate, DR 11 (GPM)*	Flow rate, DR 13.5 (GPM)*
3/4	3.6	3.9
1	5.7	6.1
1-1/4	9	9.8
1-1/2	11.8	12.8
2	18.5	20
3	40.1	43.5
4	66.4	71.9
6	144	155.9
8	244	264.3
10	379	410.6
12	533	577.5

*Flushing flow rate calculated based on the minimum wall thickness (OD-2(OD/DR)) of pipe which results in largest pipe cross sectional area and therefore worst case scenario. Using the average pipe ID results in a lower flow rate to achieve 2 ft/s.

Table 7: Flushing Flow Rate for HDPE Pipe

Figure 21: Remove electrical box from cart.

Removing Pump from Cart

In many cases, it may be advantageous to remove the pump assembly from the cart. For example, if a single person is moving the flush cart into a truck bed, or into a difficult to access location, breaking the weight of the entire assembly into two more manageable pieces is helpful. Complete the following steps to remove the pump from the assembly.

1) Disconnect the electrical box with switch from the cart (Figure 21). NOTE: If you wish to leave the electrical box connected, field upgrade the cart using PN 4985 (see image below).

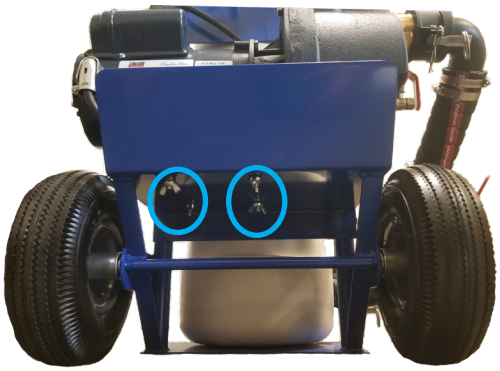


Figure 22: Remove wing nuts to remove pump from cart

2) Remove the wing nuts (Figure 22)

3) Disconnect the pump suction hose assembly (Figure 23).

4) Lift pump from cart.

Figure 23: Disconnect the pump suction hose assembly. Shown removed

Replacing Pump Gaskets

In order to replace the pump gaskets follow the steps below.

1. Remove (four) bolts to remove pump motor from the pump body. (Figure 24)

2. Pull pump motor from base to expose gaskets to be replaced.

3. Remove and replace gaskets.

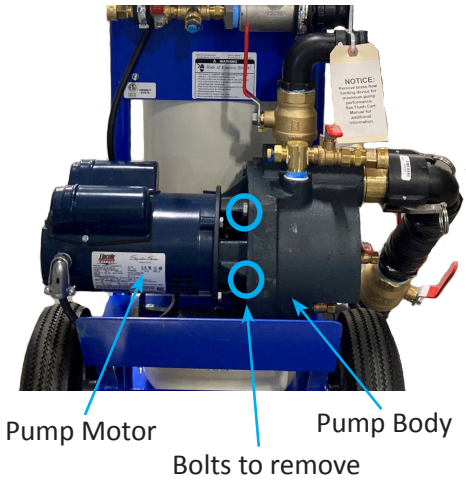
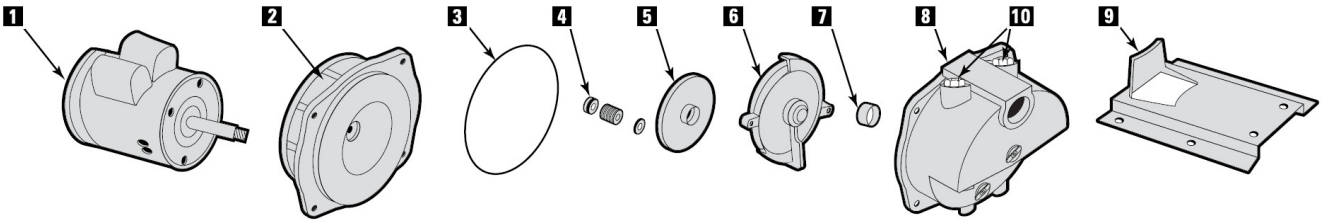


Figure 24: Remove bolts so motor can be pulled from body

Pump Replacement Parts



ITEM	DESCRIPTION	MUNRO PN	GEO-FLO PN
1	Motor, Nema J - 1 Phase	MLP26143	4967
2	Mounting Ring	MLP1300	N/A
3	Square Cut Gasket	MLPG001	**4968****
4	Seal, Rotary w/Spring	SCC800	**5179*****
5	Impeller, Brass “B” Models	MLP1415	N/A
6	Diffuser	MLP1201	N/A
7	Rubber Diffuser Gasket	MLPG002	**4969****
8	Pump Body	MLP1100	N/A
9	Base	MLP1548	N/A
10	3/4” Priming Plug	standard hardware item	

**Square and Diffuser gaskets are sold as a kit (PN 4970) and are recommended should be replaced at the same time.

***Replacing rotary seal requires removing the impeller and then the motor from the housing. Note that the impeller is a left-hand thread and a thin spanner style wrench is necessary to secure the motor shaft while removing the impeller since there is limited space between the mounting ring (Item 2) and impeller. Geo-Flo recommends removing the motor and inspecting shaft for wear prior to ordering the seal. If there is wear on the shaft, the entire motor should be replaced along with the seal.

Table 8: Replacement parts part numbers

Emptying the Tank

After the flushing/purging procedure is complete, fluid will remain in the flush cart. This fluid must be disposed of in an environmentally friendly way and must follow state/provincial and local codes.

1. Connect a garden or transfer hose to the 1/2” power drain valve (Figure 25) on the pump. Direct the other end of the hose to an appropriate disposal area or storage tank.
2. Close the 1-1/2” supply valve (Figure 25).
3. Open the 1/2” power drain valve (Figure 25).
4. Energize the pump until nearly all fluid is emptied from the tank.
5. Position the flush cart near an acceptable drain and disconnect the 2” cam fitting.

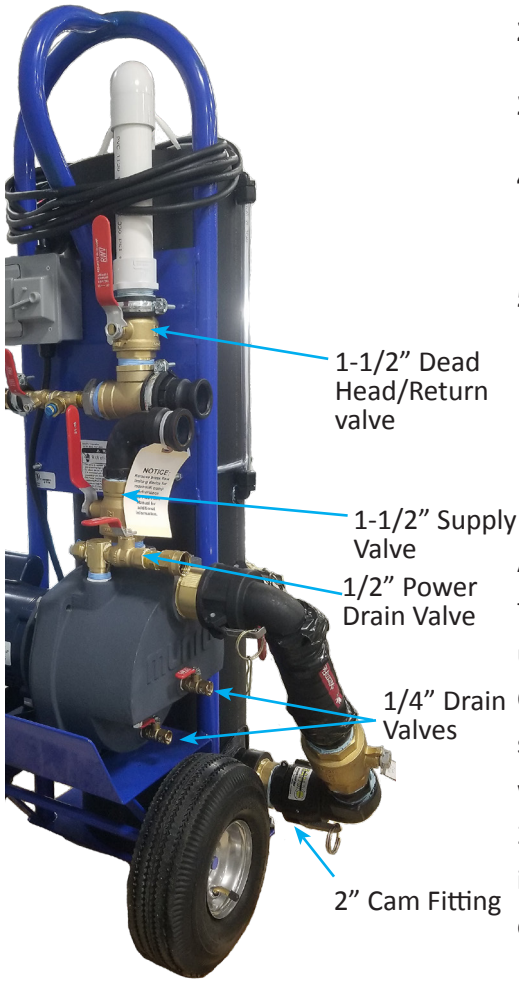


Figure 25: Flush Cart Valves in emptying the tank

Maintenance

After each use, thoroughly clean the 100 micron (standard) bag filter and tank with clean water. The 100 micron bag can be reused until fluid no longer flows freely through it, or it develops a hole. Optional 1 micron filter (PN 3832) is typically a 1 time use filter. Be sure that all debris is cleaned from the tank and hoses. Drain all water from the tank and pump. Open both 1/4” drain valves (Figure 25) on the pump to ensure that all fluid has exited the pump housing. Failure to complete this step could result in the pump housing cracking if the fluid inside freezes.

The flexible site tube can be replaced by loosening the two compression nuts and removing the tube. This may be necessary if the tube becomes badly stained. Be sure to reinstall the O-ring marker if the site tube is replaced.

Troubleshooting

Problem	Possible Cause	Solution
Pump shuts off during operation	Thermal overload has opened circuit (motor oer-amping) Pump operating outside of its range (70 GPM max)	Allow motor to cool. Before restarting turn the 1½" supply valve approx. ⅔ of the way closed. Restart the pump and slowly open the supply valve while monitoring the discharge pressure until the necessary flow is achieved.
Pump will not start or run.	Blown fuse or open circuit breaker.	Check circuit breaker for outlet in which flush cart is connected. Remove all other electrical loads on this circuit until flushing is complete.
	GFCI trip.	Investigate and correct cause for GFCI tripping. Reset GFCI. Replace GFCI if necessary.
	Loose or broken wiring.	Tighten connections. Replace broken wiring.
	Motor shorted out	Replace motor. PN 4967
	Thermal overload has opened circuit.	Allow pump to cool. Restart after reason for overload has been determined and corrected.
Pump leaks at shaft (between pump motor and cast iron housing).	Worn mechanical seal.	Replace Rotary Seal Assembly.*OR Pump (PN 9424)
Pump Housing Leaks	Bad Seal	Replace Seals PN 4970
Flow rate seems very low, or no flow.	Flow regulator installed.	Remove flow regulator from 1-1/2" cam supply fitting on discharge of pump.
	Supply and/or discharge valves closed.	Open supply and discharge valves.
	Pump not primed.	Open 1/2" power drain valve and allow a small amount of water to escape to ensure pump housing is full.
	Hole or leak in suction line.	Repair suction line.
	Casing/pump housing gasket leaking.	Replace gasket.*
	Plugged Impeller or damaged impeller.	Clean impeller. Replace if damaged.*
	System head too high.	Check ground loop design to verify this flush cart will work.

*Refer to Munro LP Series IOM for details.

Excessive pump vibration.	Debris in pump.	Disassemble pump and clean.*
	Impeller damaged.	Replace Impeller.*
	Worn motor bearings.	Replace bearings.*
Cannot purge all the air from the loop.	Unusual loop configuration.	Perform power flushing procedure. Reverse flow in the loop by disconnecting and reconnecting hoses.
Hoses will not reach my flow center.	Flow center located in a location with limited access.	Extend hoses using Geo-Flo P/N 3793.
Flush cart tank leaks.	Cracked tank.	Replace tank.

GEO-FLO PRODUCTS CORPORATION
905 Williams Park Drive
Bedford, Indiana 47421
(812) 275-8513

GEO-FLO

GEO-FLO FLUSH CART
TERMS OF LIMITED WARRANTY

ANY IMPLIED WARRANTIES ARE LIMITED TO THE DURATION OF THIS WARRANTY.

TERMS OF LIMITED WARRANTY

Geo-Flo Products Corporation (Geo-Flo) warrants flush carts to be free from defects in material and workmanship under normal use and maintenance for one (1) year from date of shipment from factory. Geo-Flo will furnish, from factory or recognized distributor or parts depot, to a factory recognized dealer, contractor or service organization, a new or rebuilt part in exchange for the part which has failed because of a defect in material or workmanship.

WHAT GEO-FLO PRODUCTS DOES NOT PROVIDE

REPLACEMENTS - Complete unit replacements are not covered under the Geo-Flo Limited Warranty. Geo-Flo will provide parts and offer assistance to assure proper operation of Geo-Flo flush carts.

TRANSPORTATION - Transportation costs of the defective part from the installation site to Geo-Flo are not covered under the Geo-Flo Limited Warranty.

LABOR - Labor costs for replacing parts is not covered under the Geo-Flo Limited Warranty.

APPLICABILITY

This warranty is applicable only to products that are purchased and retained in the United States and Canada. This warranty does not apply to:

(1) Items subject to replacement under normal operating conditions such as the bag filter and sight tube unless damaged upon receipt.
(2) Misuse of the product or use of the product in a manner not outlined in the Flush Cart Installation, Operation, and Maintenance (I.O.M.) manual.
(3) Any portion of the flush cart not supplied by Geo-Flo.
(4) Products on which the unit tags have been removed or defaced.
(5) Products on which payment is or has been in default.
(6) Products which have defects or damage which result from improper handling, wiring, electrical imbalance characteristics or maintenance; or caused by accident, misuse or abuse, fire, flood, alteration, misapplication of the product, default or delay in performance caused by war, government restrictions or restraints, strikes, material shortages beyond control of Geo-Flo, or acts of God.
(7) Products which have defects or damage which result from a contaminated or corrosive water circuit or supply, operation or storage at abnormal temperatures or pressures. This includes damage to the unit from freezing fluid due to improper storage of the product.

LIMITATIONS

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES. ANYTHING IN THE WARRANTY NOTWITHSTANDING, ANY IMPLIED WARRANTIES OF FITNESS FOR PARTICULAR PURPOSE AND MERCHANTABILITY SHALL BE LIMITED TO THE DURATION OF THIS EXPRESS WARRANTY. MANUFACTURER EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGE FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY.

NOTE: Some jurisdictions do not allow limitations on how long an implied warranty lasts, or the limitation or exclusion of consequential or incidental damages, so the foregoing exclusions and limitations may not apply to you.

This warranty applies to the Continental United States and Canada only.

OTHER

This warranty gives you specific legal rights, and you may also have other rights, which vary from jurisdiction to jurisdiction.

PLEASE REFER TO THE INSTALLATION, OPERATION, AND MAINTENANCE (I.O.M.) MANUAL FOR OPERATING AND MAINTENANCE INSTRUCTIONS.

Effective May 15, 2013

Manual Updates Table

Date	**Description of Changes**	Pages
22APR2025	Added Troubleshooting line Pump shuts off during operation	24
22OCT2024	Removed PN 3563 (OBSOLETE)	4
13NOV2023	Updated item PN 5179 in table and added in notes below table	22
10NOV2022	Updated Table 3 valves	14
04APR2022	New flush cart design. Updated manual instructions to reflect changes	All
	Added section “Removing Pump From Cart”	21
	Added sections “Replacing Pump Gaskets” and “Pump Replacement Parts”	22
	Updated photos with new flush cart design	All
08NOV2021	Added “Verifying Fluid Velocity” “Removing Pump from Cart” “Replacing Pump Gaskets” and “Pump Replacement Parts” sections	20, 21
08NOV2021	Updated flush cart design- updated images and stepped instructions.	All
10SEPT2020	Updated cover layout	Front/Back Covers
15MAY2018	Updated water quality section to the latest information	18
20MAR2017	Updated antifreeze freeze protection to latest IGSHPA data	14,16,17
13AUG2013	Corrected typo in step 27	10
25JUL2013	First published	All

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