

Pump Stack

Pumpstack Installation, Operation and Maintenance



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Pumpstack Installation

There are three models of Pumpstack pumps, PP21, PP31 and PP48. The installation of each pump is very similar so all pump models follow the same guide, when there are differences it will be noted in the individual step.

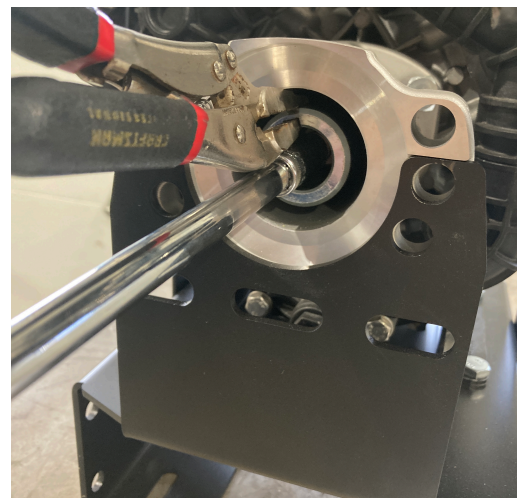
Step 1:

Install the shaft coupling kit and hydraulic motor Note: The pump can be turned in either direction for operation.

- a: Check inside of the hydraulic motor mount to ensure the key is in place on the PP21 and PP31 pumps. The PP48 is a splined shaft and does not have a key.

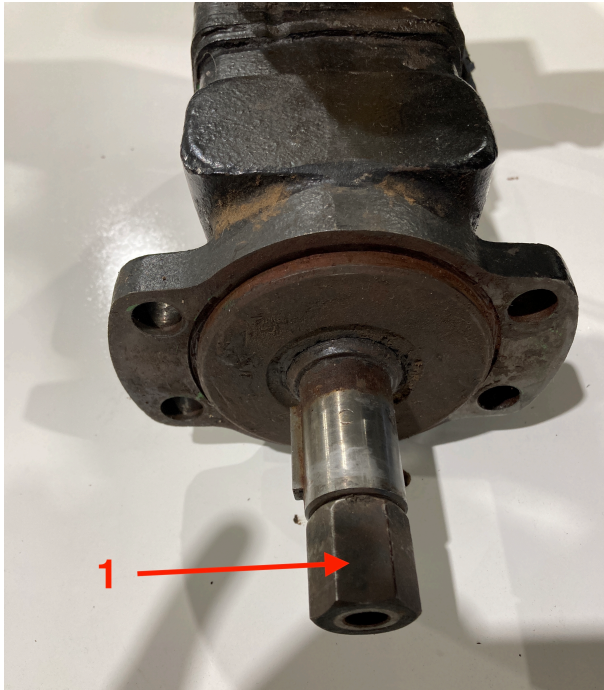


- b: The shaft coupling has different diameter ends to fit the pump and the hydraulic motor. Find the end that matches the pump and orient towards the pump. Install the shaft coupling, lining up the keyway with the pump. (PP21 and PP31 only) Using a 10mm socket, install the bolt with pre-applied blue locktite patch and torque to 88 in-lb (7 ft-lb). It may be necessary to hold the coupling with needle nose pliers or a similar tool while tightening the bolt. Note: PP48 is a splined shaft and does not have a bolt to hold it on.



- c: Install the hydraulic motor.
1. PP21 will need the hydraulic block of the motor oriented downward for clearance to the plumbing. PP31 can have the hydraulic block of the motor oriented either upward or downward. PP48 will need the speed sensor block oriented downward, the hydraulic block can be upward or downward.
 2. John Deere motor only. Remove the speed sensor adapter from the shaft of the motor (1). Install the speed sensor block included in the shaft coupling kit (2), ensuring the correct orientation. It should be oriented with the cut-out area towards the motor. If a speed sensor is

needed for feedback to the rate controller, remove the speed sensor cover and install the Precision Planting hydraulic motor speed sensor (part number 727048).



3. Using a 10mm socket and the bolt that attached the shaft coupling to the pump, turn the coupling to line up the keyway to the hydraulic motor keyway.
4. Check that a key is installed on the hydraulic motor output shaft. Install the shaft key, speed sensor block and hydraulic motor to the coupling. (PP21 shown below)



5. Secure the hydraulic motor to the coupling with the four provided M12-1.75x75mm bolts and self locking nuts. Tighten with a 19mm or 3/4" wrench.

Step 2:

Install the inlet and outlet fittings, shut off valve, and system filter.

It is recommended that the inlet and outlet hoses are sized appropriately for the volume of flow needed, length of hose and product viscosity. Larger hoses should be used as flow rate increases, length increases and product viscosity increases. If you are not sure, a larger inlet and outlet hose is generally better.

Recommendations for minimum inlet size:

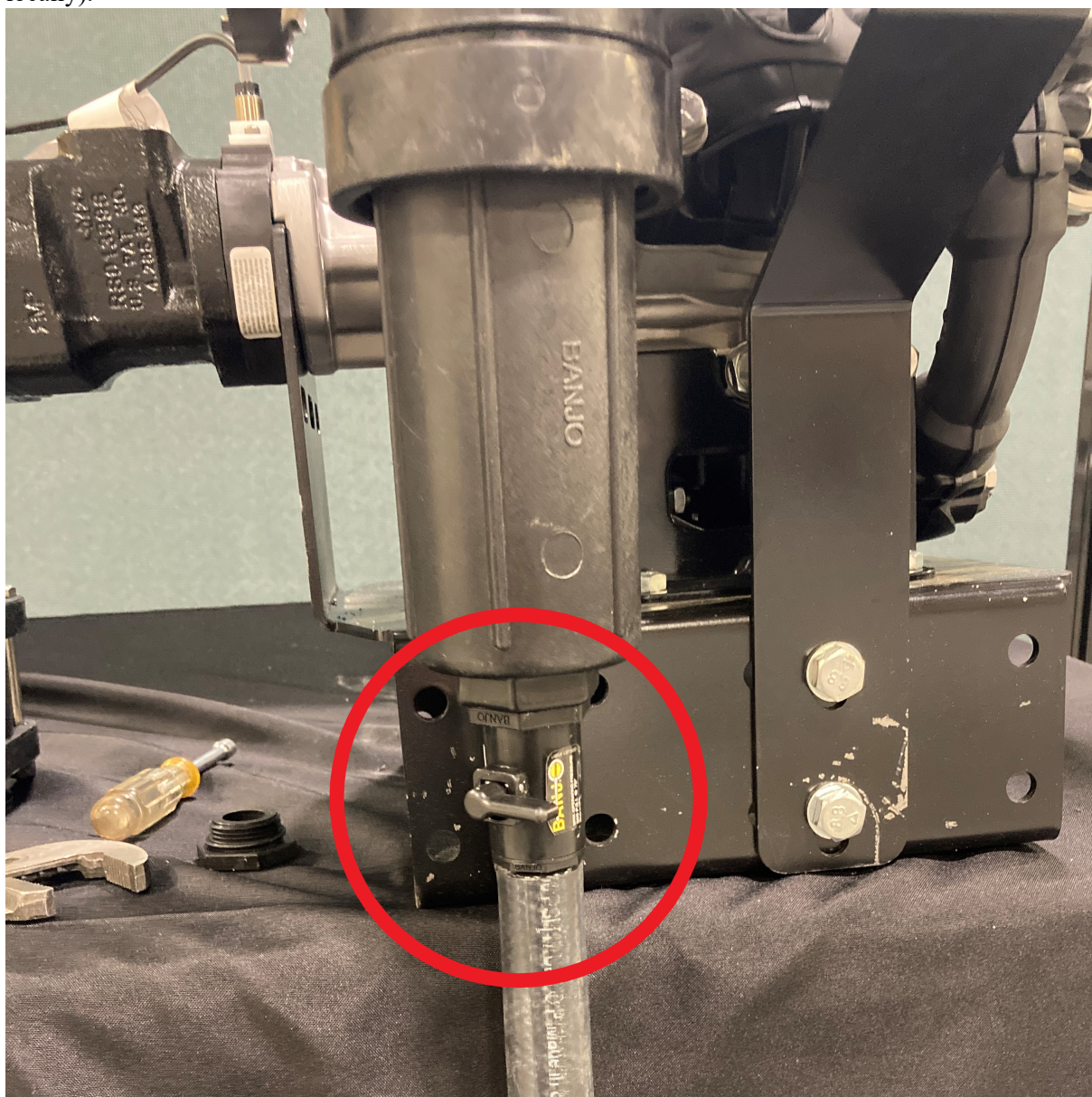
Pump model	Minimum inlet size
PP21	1.5"
PP31	1.5"
PP48	2"

Recommendations for minimum outlet size:

Pump model	Minimum outlet size
PP21	1"
PP31	1"
PP48	1.5"

- Remove the plug from the bottom of the inlet filter housing and install the filter flush valve and hose. (early 2022 year pumps did not include this kit, if desired, the installer will need to source this

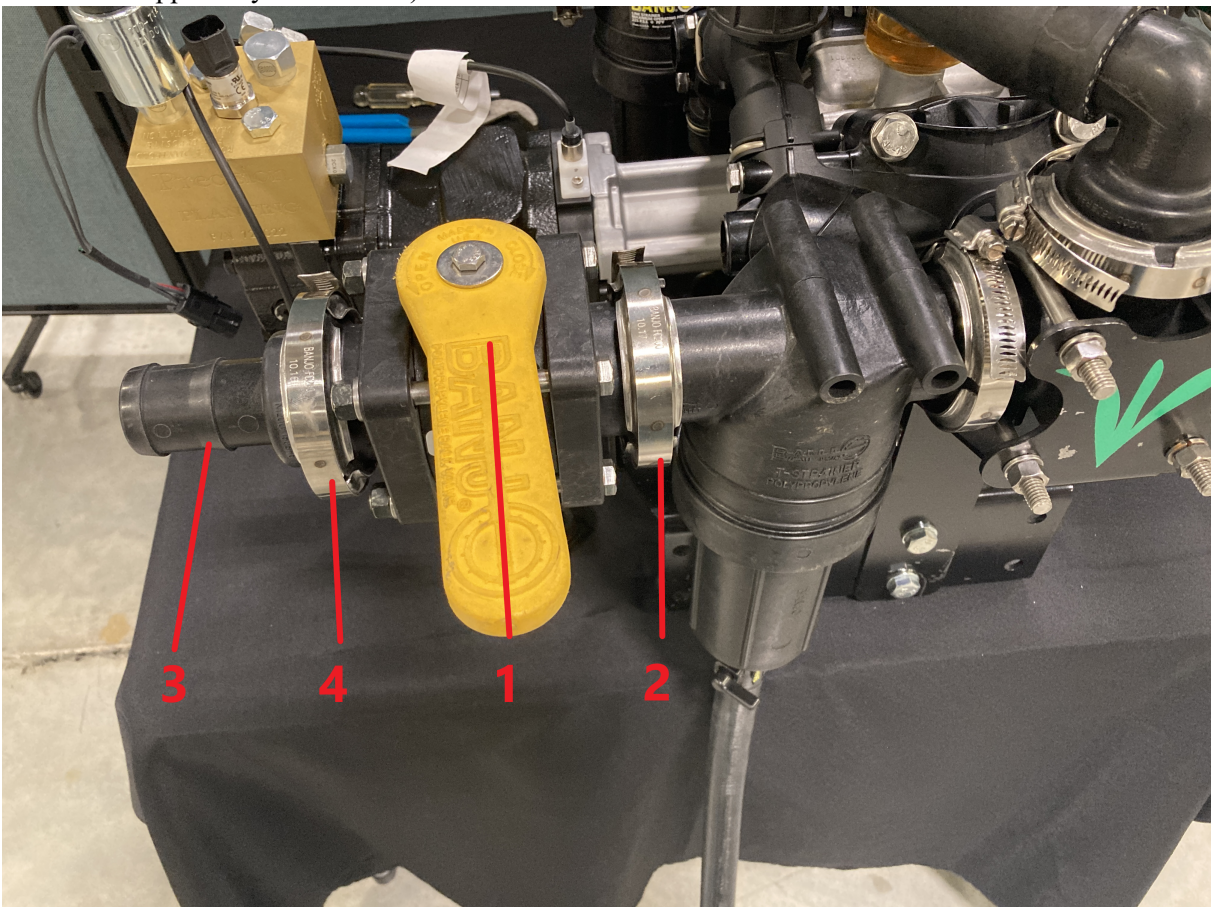
locally).



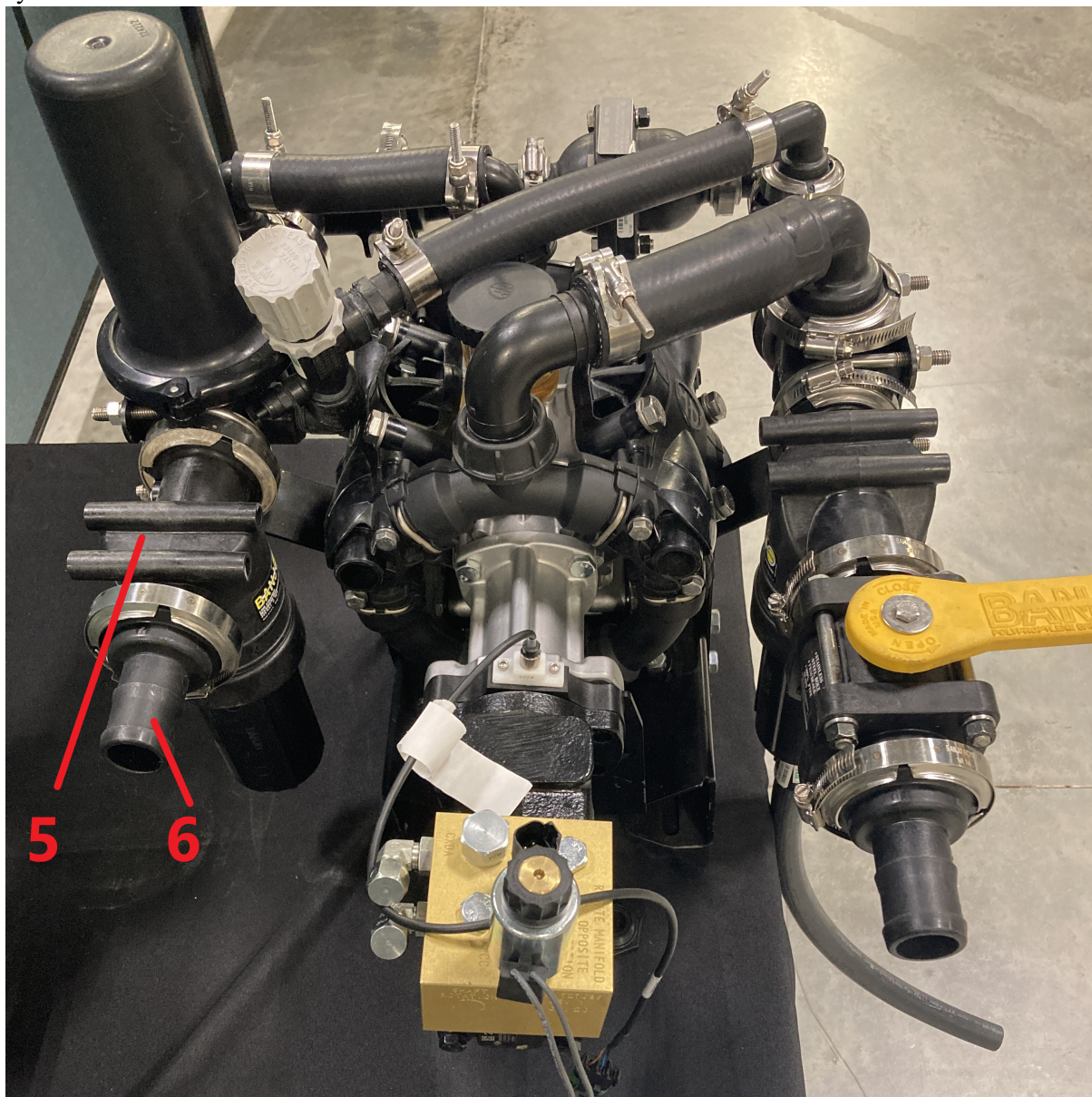
- Remove the inlet and outlet plugs that ship in the Pumpstack plumbing.



- Install the shut-off valve (1) before the inlet filter using the gasket and clamp (2). Tighten the clamp bolt ensuring the gasket stays properly positioned. (early 2022 pumps did not include this kit, it will have to be supplied by the installer).



- Install the inlet fitting (3) using the gasket and clamp (4) to the shut off valve. Tighten the clamp bolt ensuring the gasket stays properly positioned.
- (vApplyHD or FlowSense turbine based systems only) Install the 80 mesh system filter kit (5) after the pump. It is not required to be directly after the accumulator, but it can be. This kit is ordered with the vApplyHD system and therefore is NOT included with the pumpstack. This is NOT required for systems without turbines.



- Install the outlet gasket, clamp and fitting (6) after the accumulator (or system filter). Tighten the clamp bolt ensuring the gasket stays properly positioned.

Recommendations for customers using very thick (viscous) liquids.

It is important to avoid cavitation to prevent damage to the pump. Use a large diameter suction hose and have the tank high in relation to the pump inlet (up to 10' higher). Size the pump larger than needed so that the pump rotation speed is lower.

Step 3:

Determine the mounting location on the implement

The pump inlet should be no more than 10 feet above or 10 feet below the tank outlet.

The pump should be mounted within 5 degrees of level with the planter lowered.

There are various optional mounts available from Precision Planting for use with pumpstack, see the Pumpstack mounting bracket installation guide if you have chosen one of these options.

Clearances needed for the pumpstack mounting

	PP21	PP31	PP48
Overall length w/motor installed	27"	30"	26"
Overall width	21"	22.5"	19"
Overall height	23.5"	23.5"	30.5"
Base dimensions	11" x 10.25"	11" x 10.25"	14" x 11"

Step 4:

Mount the pump to the implement.

Use hardware to mount the pump securely. The Pumpstack is designed to mount directly to a 7x7" bar or 8" draft tube. There are optional mounts available from Precision Planting for other mounting locations, if you are using an optional mount, follow the instructions included with the mount to secure it properly to the implement prior to installation of the pump on the mount.

Step 5:

Connect the hydraulic hoses. Note: PP48 will likely need a 90 degree fitting at the hydraulic motor block for clearance to plumbing components.

3/8" or larger supply hose should be used for the RowFlow or John Deere seeding drives. These drives will use a maximum of 6 GPM of hydraulic flow.

Option 1: Dedicated SCV. If you have an open remote available, plumb the pressure and return hoses directly to the tractor pressure and return.

Option 2: Power beyond hydraulics

Option 3: Tied into DeltaForce. The supply hoses to the DeltaForce lift manifold must be sized to handle the required flow for all attached devices. See the hydraulic hose sizing guide and hydraulic requirements documents in the Precision Planting Cloud under DeltaForce - Installation for sizing of the supply hoses.

Step 6:

Connect the inlet hose. Note: It is recommended to have a shutoff valve installed prior to the pump plumbing to enable cleaning of the inlet filter.

The inlet hose should be coil reinforced to be used in a suction circuit.

The pump should NOT be fed with pressurized liquid.

It can be helpful to coat the interior of the hose and exterior of the fitting with liquid dish soap or similar lubricant to install the hose.

Secure with an appropriately sized hose clamp.

Step 7:

Connect the outlet hose.

The outlet hose should be rated to a minimum of 150psi, recommended is 200psi or more.

It can be helpful to coat the interior of the hose and exterior of the fitting with liquid dish soap or similar lubricant to install the hose.

Secure with an appropriately sized hose clamp.

Note: If pumpstack is used with a Precision Planting product that uses turbines (vApplyHD or FlowSense) then it is recommended to install AFTER the pump an 80 mesh filter. It is not recommended to change the inlet filter to 80 mesh as this could result in cavitation of the pump.

Note: PumpStack Oil Requirement: SAE-30 non-detergent.

Pumpstack Operation

Intended use

The pump is designed to be used with agricultural machinery including planters, sidedress or strip till systems.

Do NOT use the pump with flammable liquids, liquified gasses or products with solids in suspension (small suspended particles are ok).

Do NOT use the pump with liquids at temperatures above 122 degrees fahrenheit or below 41 degrees fahrenheit.

WARNING - Cavitation

Cavitation is when vapor forms inside of a liquid due to localized change in pressure. Cavitation will cause damage to the pump valves. Cavitation will occur if the inlet filter becomes clogged, therefore **inspect and clean the inlet filter daily**.

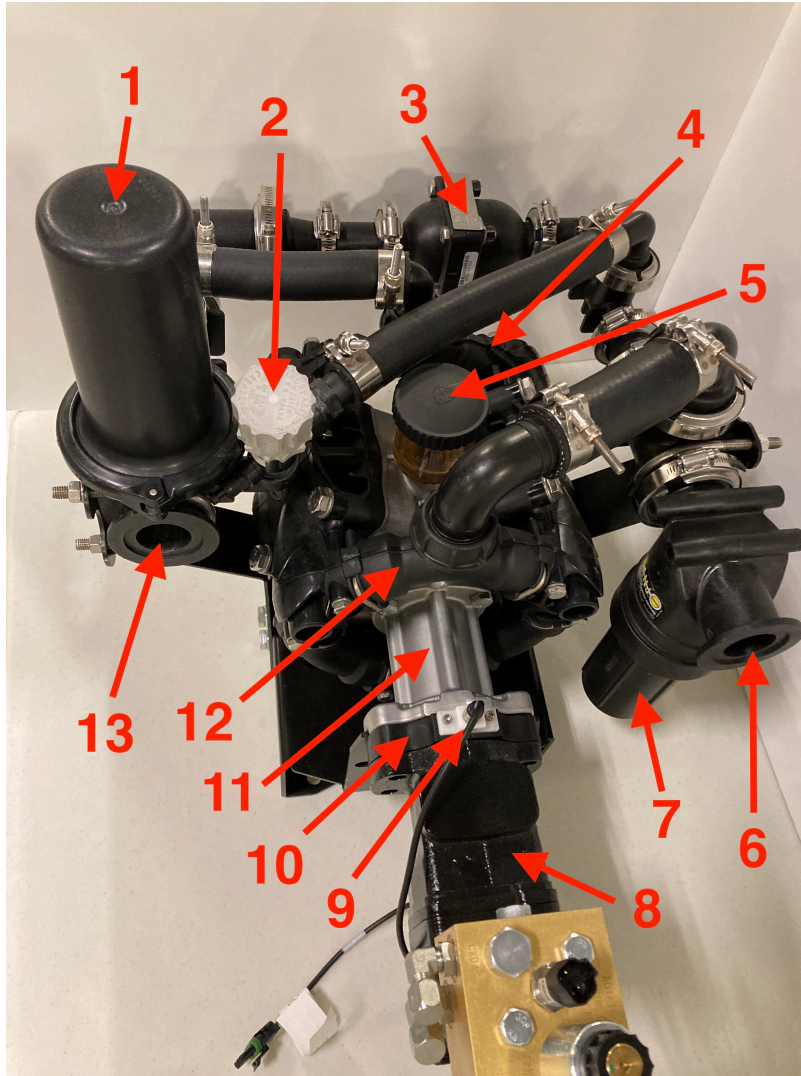
Cavitation is more likely to occur with thicker (higher viscosity) liquids. To avoid cavitation with thicker liquids, use a large diameter suction hose and have the tank as high as possible in relation to the pump inlet. Size the pump larger than needed so that the pump rotation speed (and therefore fluid velocity) is lower. It is also recommended to change the inlet filter to 20 mesh when pumping higher viscosity liquids.

Cavitation produces a distinctive sound. If the pump sounds like it is hammering or rocks tumbling around inside or bubbles popping, the pump should be slowed or stopped and plumbing changes made to prevent cavitation.

Note: The pumpstack also has a safety “Spike” pressure relief that will activate at 125psi and also sound like hammering when it activates. If the spike valve is activated, pressure should be reduced, it is not recommended to run the pump consistently with the spike valve actuating.

Pumpstack component identification

PP31 model shown here



1.	Accumulator
2.	Pressure relief bypass valve (adjustable) Note: PP48 includes qty 2 of this valve
3.	Safety “spike” pressure relief (125 psi)
4.	Outlet manifold
5.	Oil reservoir
6.	Inlet
7.	Inlet filter
8.	Hydraulic drive motor
9.	Shaft speed sensor
10.	Speed sensor mounting block
11.	Motor coupling (outside) and shaft coupling (inside)

12.	Inlet manifold
13.	Outlet

General operation instructions

The Pumpstack is rated at a maximum of 550 RPM. Normal operation should be from 25-550 RPM. Diaphragm and valve lifespan is directly affected by pump speed. The pump should never be operated above 550 RPM and lower RPMs will extend the life of the pump components.

The Pumpstack is designed to be driven by a hydraulic motor. The Precision Planting “RowFlow” motor can be used to drive the pump and will result in a maximum of 400 RPM. The John Deere hydraulic seeding motor can also be used to drive the pump and will result in a maximum of 360 RPM. Expected maximum output of each pump model by hydraulic motor used can be found below.

Pump Model	Pump Rating (550 RPM)	Rowflow Motor Max GPM	John Deere Motor Max GPM
PP21	21.1 GPM	15.3 GPM	13.8 GPM
PP31	31.7 GPM	23.1 GPM	20.7 GPM
PP48	48.8 GPM	35.5 GPM	31.9 GPM
		(400 RPM max)	(360 RPM max)

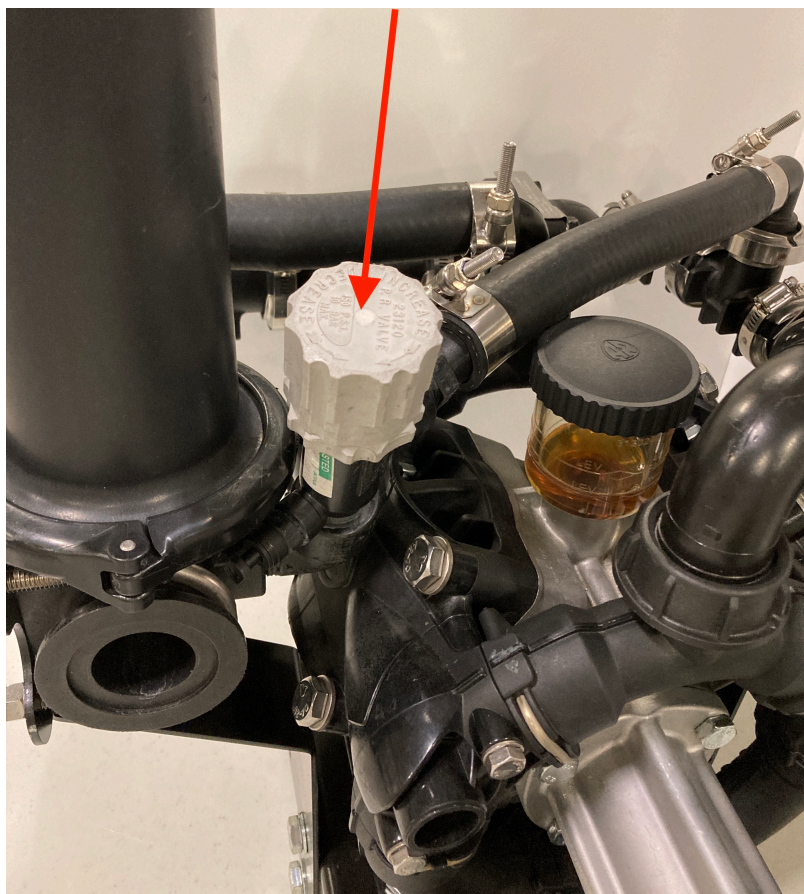
Since these pumps are positive displacement, expected output is directly proportional to RPM. Therefore expected output can be calculated by taking the gallons/revolution multiplied by the current RPM. Below is the gallons per revolution for each pump model.

- PP21 = 0.0382 gallons/revolution
- PP31 = 0.0564 gallons/revolution
- PP48 = 0.0873 gallons/revolution

Pump startup procedure

Priming the pump

When priming the pump there needs to be no pressure on the outlet of the pump. You may have to adjust the pressure relief bypass valve to the minimum (out) setting to get all of the air out of the pump. If you are still having difficulty priming the pump, it can also help to vent air from after the pump by removing or opening a line to allow air out and run the pump slowly until all air is removed and the pump is primed.



Set the pressure relief bypass valve

To set the system pressure, follow the steps below

Step 1:

Run the pump at a good speed.

Step 2:

Turn the bypass in watching the system pressure. Once the desired system pressure is reached, hold the knob in place and tighten the locking ring. This setting should be below 100 psi for most systems to ensure the pressure “spike” valve is not continuously activate

- If the pumpstack is used for vApplyBase, the pressure relief bypass should be turned in to the maximum setting so that all flow is going out to the rows.
- For the PP48 model, there are two bypass valves installed. It is recommended to “walk” them in together. It is recommended to turn one in a bit until pressure is no longer increasing, then turn the other in until pressure no longer increases and repeat, alternating valves, until the desired system pressure is achieved.

Pump control

The control of the pump speed will be accomplished by the rate controller that is connected to the hydraulic motor. If the system is controlled by a 20|20 monitor, see the operations instructions for that specific system.

Inlet Filter

The inlet filter should be inspected daily for any tears, rips, cracks or punctures. If there is damage it should be replaced. The filter should also be cleaned by flushing with clean water.

The supplied filter is 50 mesh. If required for a specific fertilizer, the user can replace the stock filter with a 20 or 30 mesh filter. Any larger opening filter is not recommended to prevent plugging of the valves.

Pressure damper

The PP48 pump has a pressure damper attached to the outlet manifold. The pressure inside of this damper should be charged by the user and checked every 100 hours of operation. There is a sticker on the damper that shows the pressure in bar for system pressure on the left side and recommended damper pressure on the right side.

Precision Planting recommends 15 psi in the damper for all liquid fertilizer systems.

The volume of air in the damper is extremely small. Therefore it is recommended to charge the damper with air regulated to the desired final pressure. This can be accomplished by a regulator on the air line set to the desired pressure, or a portable air tank charged to the desired pressure.



The pressure damper has a diaphragm inside that can be replaced if damaged.

To inspect and/or replace the diaphragm follow the steps below.

Step 1:

Release all pressure from the damper by pushing the needle on the valve until all air is vented.

Step 2:

Remove the bolts from the cover and remove the cover.

Step 3:

Inspect and/or replace the diaphragm.

Step 4:

Install the cover and bolts. Torque bolts to 177 in-lbs. (14.75 lb-ft).

Step 5:

Charge the pressure damper to 15 psi.

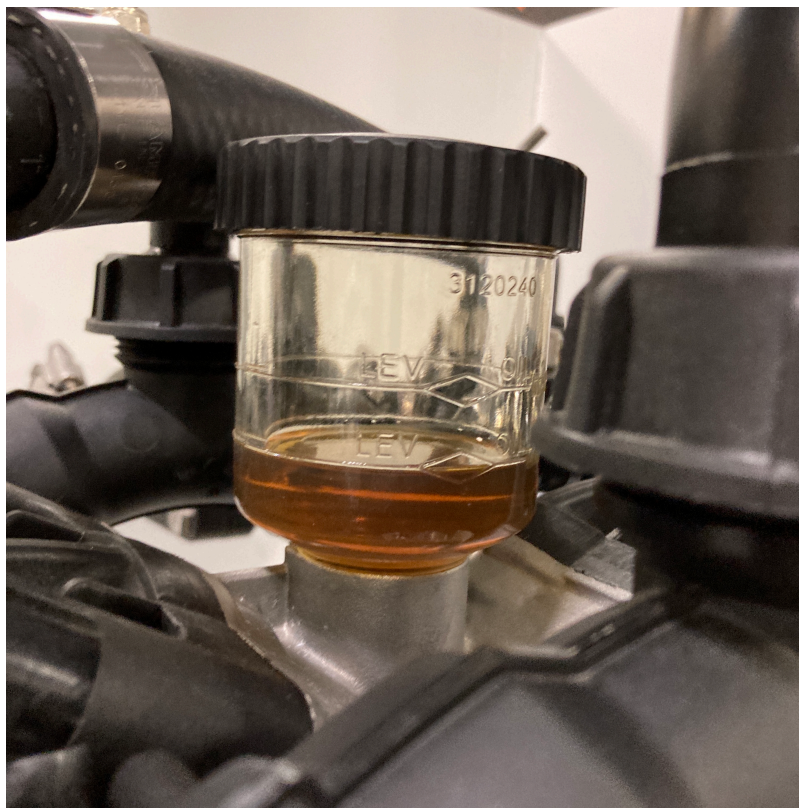
Lubrication

The mechanical components inside of the pump are lubricated with AR Pump oil - Precision Planting part number 724738.

Checking the oil level and color

Check the oil with the pump level and off, after running the pump for a minimum of 5 minutes in normal conditions and then stop the pump.

If the oil is not visible in the reservoir or to the minimum level mark, add oil until it is between the minimum and maximum marks on the reservoir. Start the pump and verify that the oil level does not go below the minimum mark.



When the pump is new the oil is a clear yellowish color. After a few hours of operation the oil will turn a dark color. This is normal and expected.

If the oil turns a light grey or milky color, stop using the pump immediately to avoid permanent damage. This is an indication that one or more diaphragms have been damaged. The pump must be repaired immediately according to the instructions below for replacing damaged diaphragms.



Pump Storage

If the pump is not going to be used for an extended period of time, it is recommended to flush the pump with clean water as some products can be corrosive. After flushing with water, if the pump will not be winterized yet, remove the inlet hose and run the pump slowly to empty the water from the pump. If it will be winterized, see the winterization section below.

Winterization

It is recommended to flush the liquid system with clean water first. Then use an RV antifreeze to winterize the system by pumping enough volume through that all water has been removed and RV antifreeze is flowing from every fertilizer exit point.

If the system has vApplyHD modules installed the vApplyHD modules **MUST** open to a ball position of 40 degrees to open all flow paths to antifreeze. See the 955731 vApply Service and Maintenance manual for specific instructions on vApplyHD winterization.

Pumpstack Maintenance

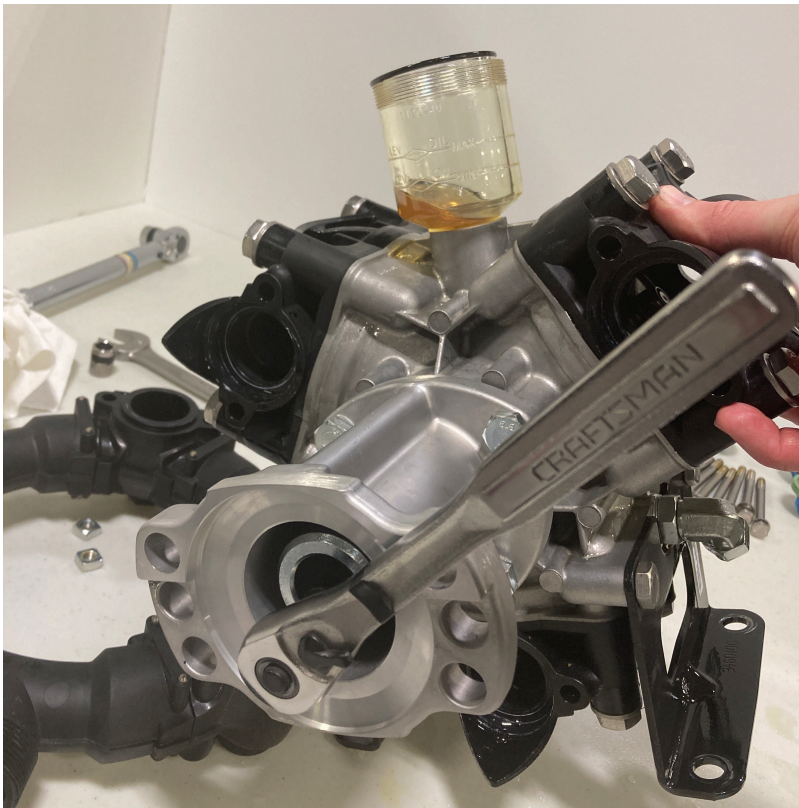
Scheduled Maintenance Table		
Frequency	Component	Procedure
Daily	Filter	Inspect and clean
	Pump	Check oil level and color
	Plumbing connections	Inspect for damage or loose connectors
After first 50 hours	Pump	Change oil
Every 100 hours	Pressure damper (PP48 only)	Check inflation pressure
	Pump	Check mounting hardware
Annually or 500 hours (whichever is first)	Pump	Change oil
Every 500 hours	Pump	Replace diaphragms
Every 1000 hours	Pump	Replace valves

Service Parts							
Pump	Dia-phragm Kit	Valve Kit	O-ring Kit (needed only for complete rebuild)	Oil capacity	P/N for oil quart	P/N for Inlet:	P/N for Outlet:
PP21	724611	724612	724613	13 oz	724738	724774	724778
PP31	724614	724612	724615	28 oz	724738	724774	724782
PP48	724616	724617	724618	56 oz	724738	724789	724792

Changing pump oil

1. To change the oil, loosen the cap on the oil reservoir.

2. Remove the oil drain plug from the side of the pump (PP21 and PP31) or the bottom of the pump (PP48).
3. Drain the old oil. It is recommended to turn the pump shaft to remove as much oil as possible. Likely the hydraulic motor will have to be removed to turn the pump shaft. It can be helpful to turn the pump with a socket on the bolt holding the motor coupling to the pump crankshaft (PP21 or PP31). PP48 you can remove the shaft cover from the other side of the pump to use to turn the crankshaft.
4. Replace the drain plug and torque to 180 in-lb (15 ft-lb)
5. Measure out the amount of oil needed for your pump model. See the chart below.
6. Fill the pump from the oil reservoir, turning the pump shaft by hand.
7. Keep adding oil and turning the pump shaft until all air is vented from the pump (no more bubbles coming out of the pump) and all of the oil has been added. Ensure the oil level is between the min and max marks on the reservoir. It is recommended to tilt the pump at various angles and directions when turning the crankshaft to help vent any air inside the pump. CAUTION: If air remains in the pump diaphragms will be damaged!



8. Replace the oil reservoir cap.

Pump model	Oil capacity
PP21	13 oz

Table 3 (continued)

PP31	28 oz
PP48	56 oz

Diaphragm and valve replacement

There are two primary pumping components, the diaphragms and inlet/outlet valves. It is recommended that the diaphragms are replaced every 500 hours and valves are replaced every 1000 hours or every 2-3 years. If the pump is regularly used near maximum RPM or for a high amount of hours, it is recommended to replace them annually. It is a small job that will ensure reliable operation during use.

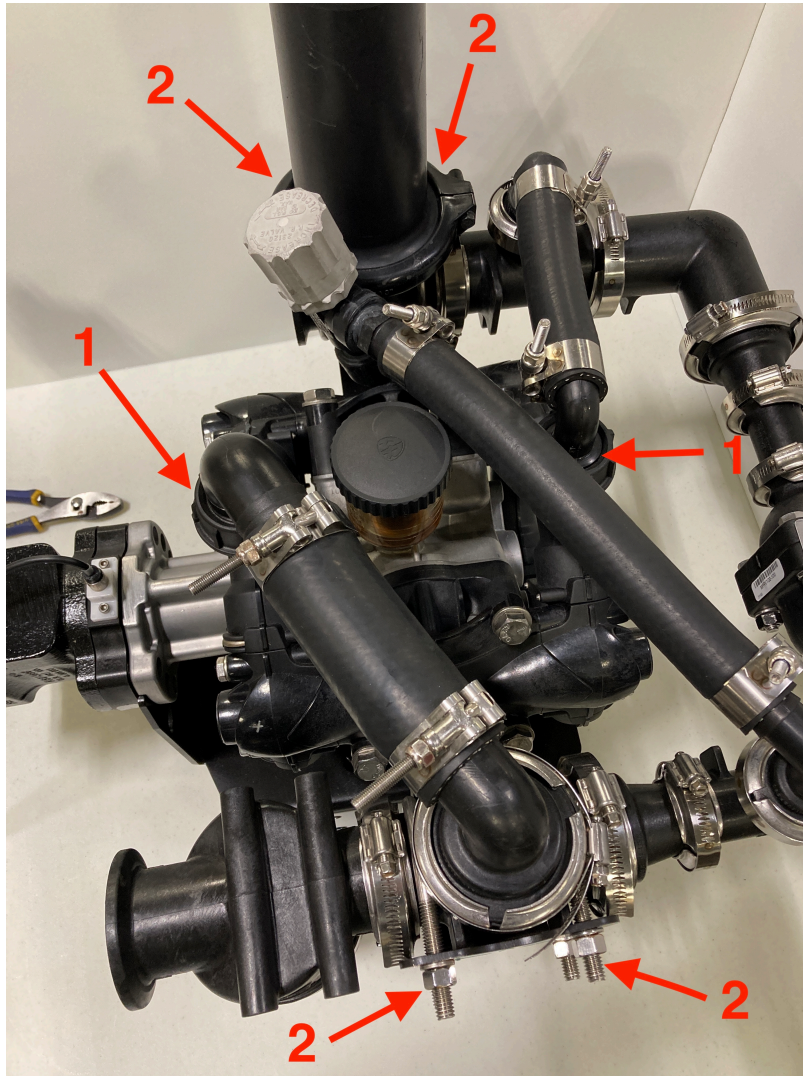
There are videos on the Precision Planting support website showing how to perform this maintenance as well as the step by step instructions below.

It is recommended to NOT use impact wrenches when removing hardware from the pump itself.

Replacing valves

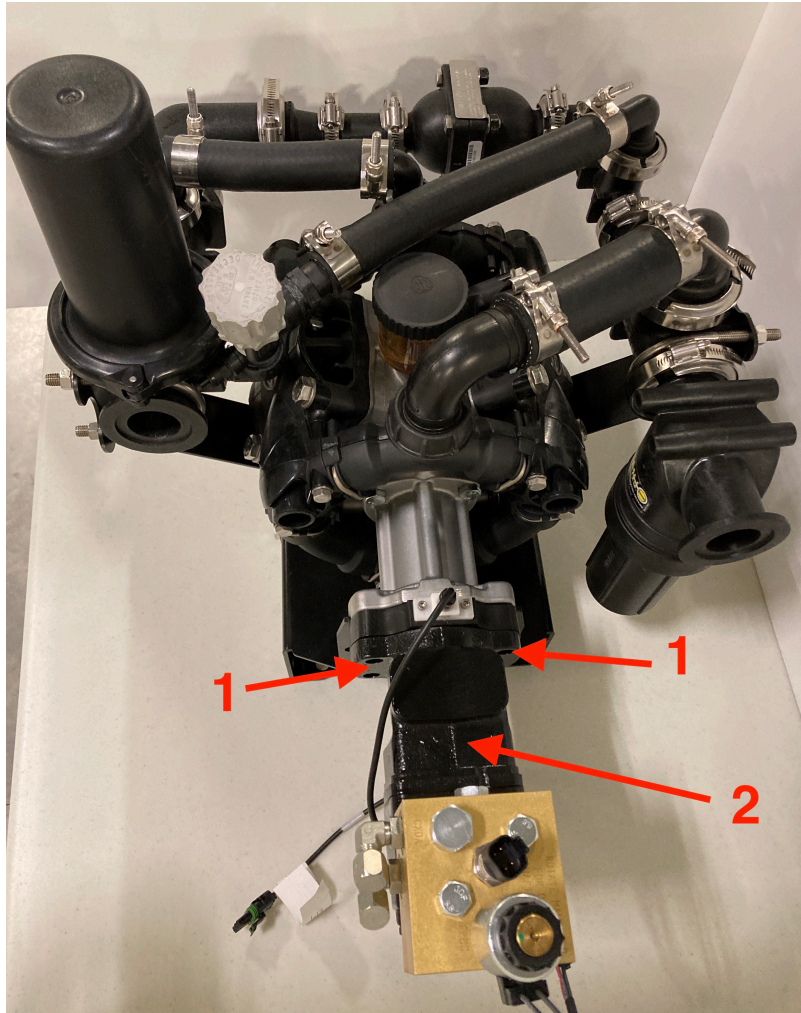
Step 1:

Remove the inlet and outlet plumbing from the top of the pump manifolds by loosening the screw on collar (1). Remove the u-bolts (2) connecting the plumbing assembly to the mount, then lift off the plumbing assembly from the pump.



Step 2:

Remove the bolts securing the hydraulic motor to the pump mount (1) and then remove the hydraulic motor and speed sensor mount (2).

**Step 3:**

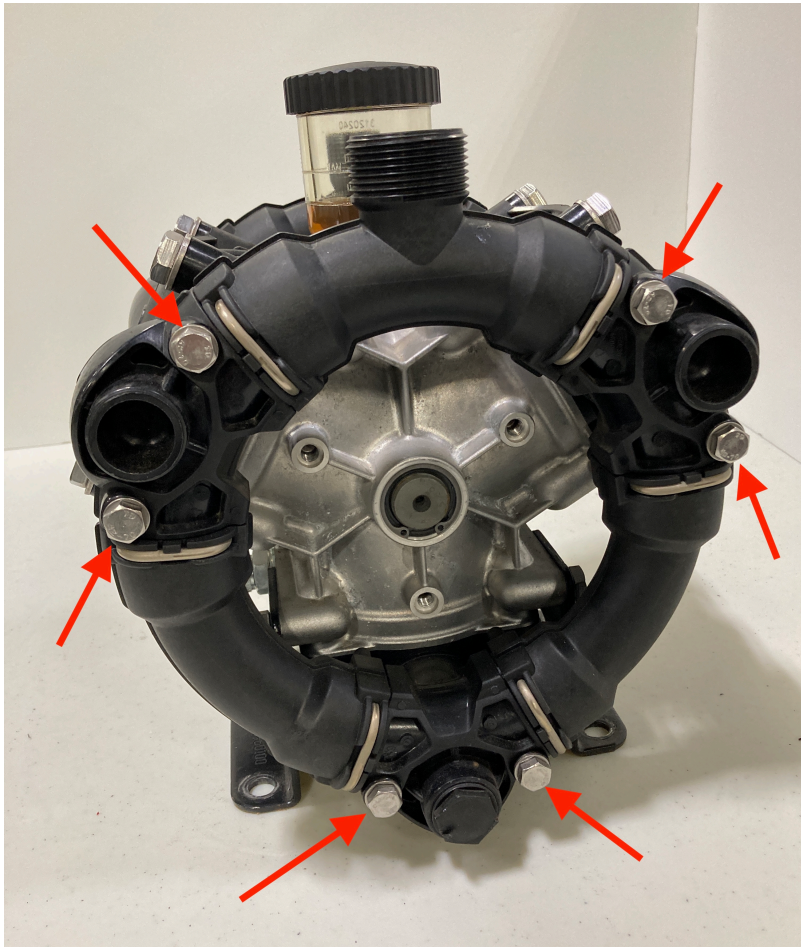
Remove the bolts securing the pump to the base and take just the pump to a work table.

Step 4:

Clean the exterior of the pump to prevent contamination.

Step 5:

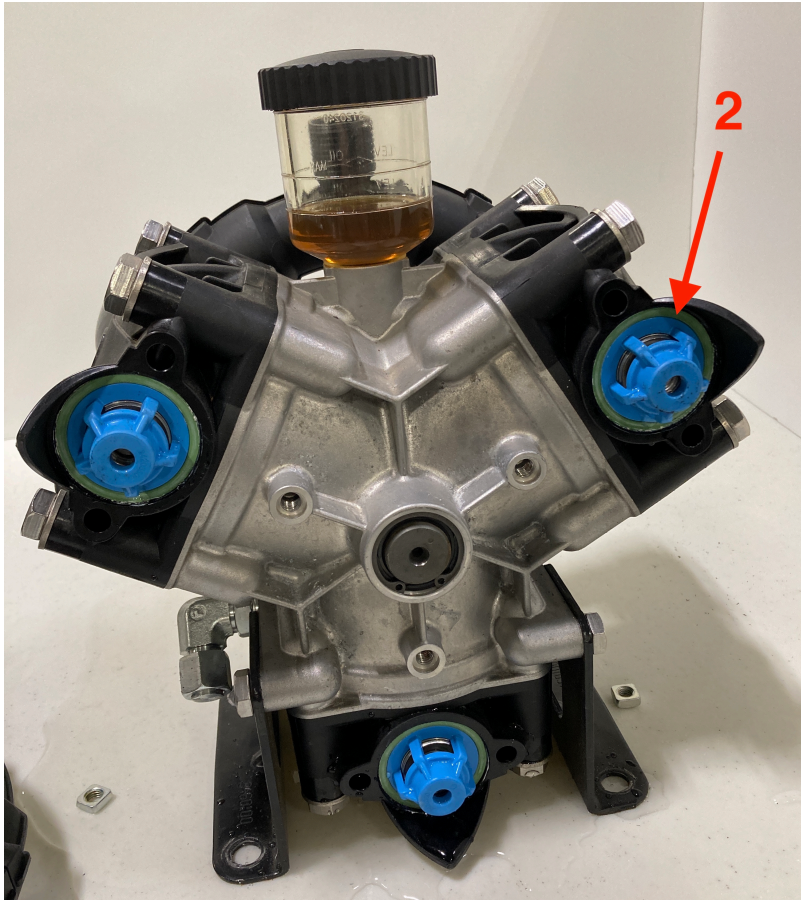
Remove the bolts securing the inlet and outlet manifolds to the pump (hand tools only). Take care to not lose the nuts from the pump heads. Some pump models have 6 bolts per manifold, some have 9 bolts per manifold.

**Step 6:**

Remove the valves and seals from the manifold noting location and orientation of inlet vs. outlet valves. If needed use a pick to remove the seal and valve pliers to remove the valves.

Step 7:

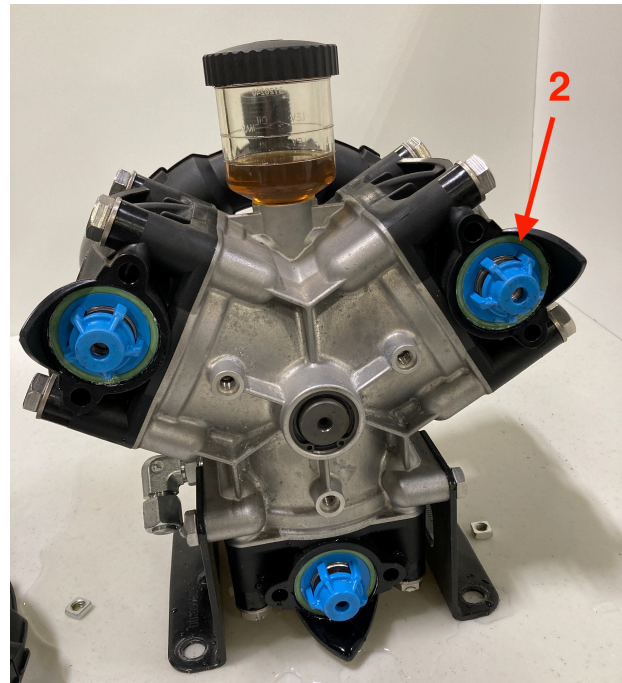
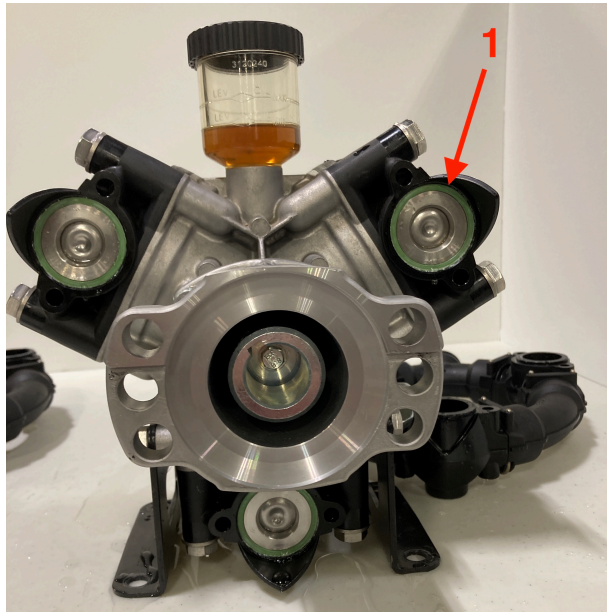
Inspect the valves for damaged springs pitting in the seats and cracks in the housing. Clean or replace valves.

**Step 8:**

If inspecting and replacing the diaphragms, move to “Replacing Diaphragms” below prior to reassembly of the manifolds to the pump.

Step 9:

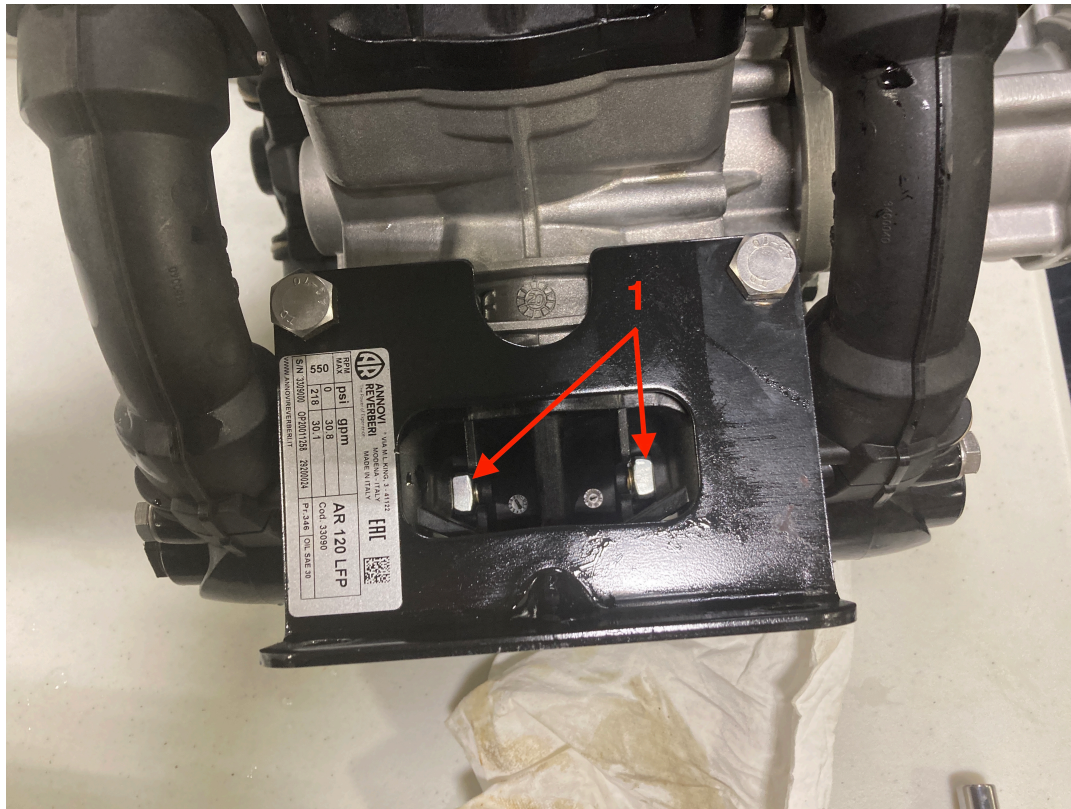
Install the valves into the pump along with the valve seals. The inlet valves are larger and will be installed with the spring into the pump head (1), the outlet valves are smaller and installed with the spring out of the pump head (2).

**Step 10:**

Install the manifolds by pushing onto the pump securely. Inlet manifold has larger holes and inlet fitting is larger, outlet manifold has smaller holes and outlet fitting is smaller.

Step 11:

Install the nuts into the head (1) and install the bolts hand-tight.

**Step 12:**

Tighten the manifold bolts using a criss-cross pattern. Torque specs below.

- PP21 - Short bolts M8x55 = 105 in-lb (8.75 ft-lb), Long bolts M8x75 = 90 in-lb (7.5 ft-lb)
- PP31- M8x100 = 105 in-lb (8.75 ft-lb)
- PP48 - M8x100 = 88 in-lb (7.3 ft-lb)

Step 13:

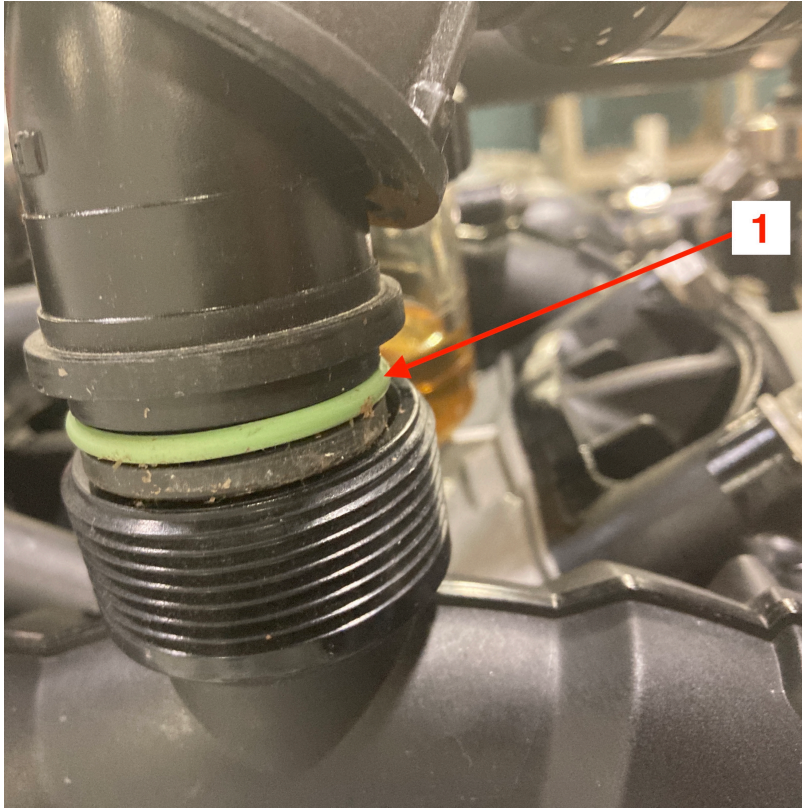
Install the pump onto the pump bracket and install the 4 bolts and hardware. Prior to tightening the hardware, check the alignment of the hydraulic motor mount to the bracket. The curve of the bracket and hydraulic motor mount need to be lined up so that the hydraulic motor will line up. Leave the hardware loose until the hydraulic motor is installed.

Step 14:

Install the hydraulic motor back to the pump. Ensure that all components come together in alignment. Secure with the 4 bolts and hardware and tighten. After the hydraulic motor mounts are tightened, then tighten the pump to bracket hardware.

Step 15:

Install the plumbing assembly onto the pump. Lubricate the inlet and outlet o-rings with dish soap or similar to help the o-ring go into place without rolling (1). Tighten the inlet and outlet collars and secure the plumbing assembly with the U-bolts and hardware.



Replacing diaphragms

Step 1:

First follow steps 1-7 for “Replacing valves”

Step 2:

Remove the oil from the pump following the section “Changing pump oil” steps 1-3.

Step 3:

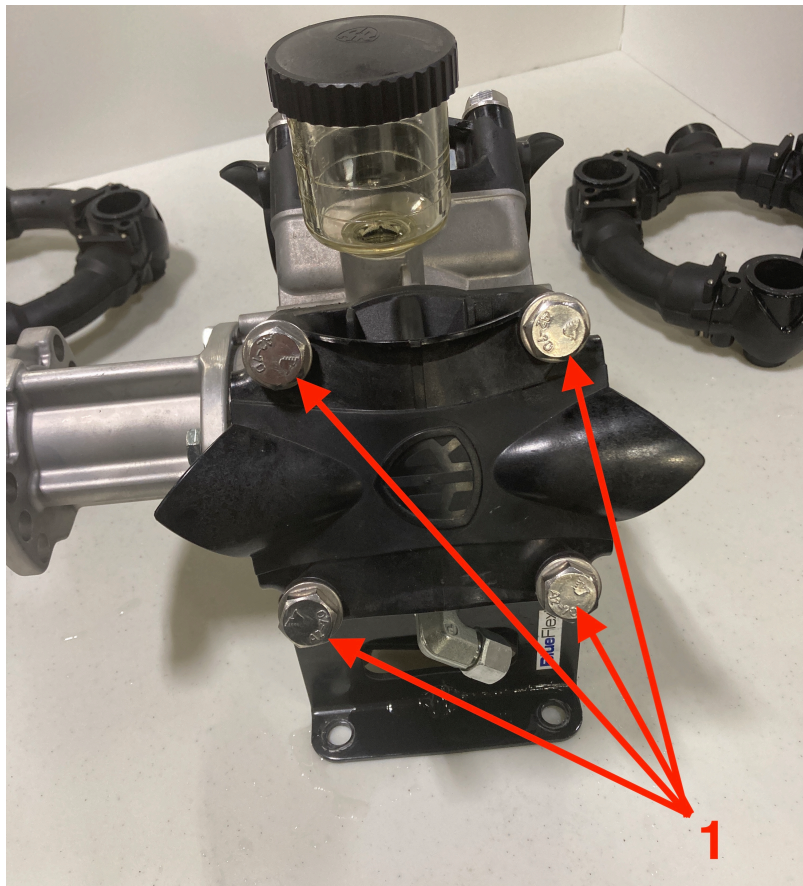
Work on one pump head at a time.

Step 4:

Turn the pump so that the head you are working on is vertical to minimize oil spillage between the diaphragm and the piston.

Step 5:

Remove the bolts securing the head to the pump. (hand tools only)

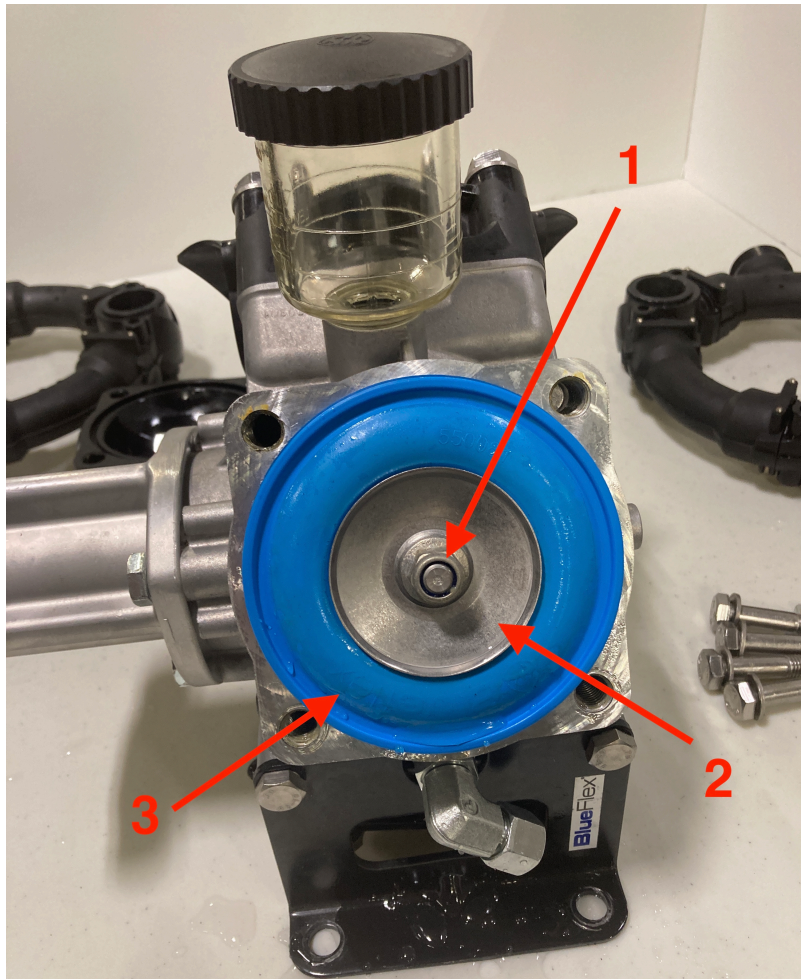


Step 6:

Remove the head and clean off any liquid present on the plate or diaphragm. Using a clean cloth clean the edges of the cylinder wiping off any excess liquid.

Step 7:

Remove the diaphragm retainer nut (1) and disc (2). Use hand tools only.

**Step 8:**

Remove the diaphragm (3). Try to not contaminate the piston side with water or other liquids. You can use a clean cloth to wipe off excess oil if you wish.

Step 9:

Inspect the piston for damage.

Step 10:

Install the new diaphragm with the side marked OIL towards the piston. Work the edges of the diaphragm into the edges of the cylinder.

**Step 11:**

Lubricate between the diaphragm and the retainer disc with moly grease.

Step 12:

Re-install the diaphragm retainer disc, rounded side toward the diaphragm.

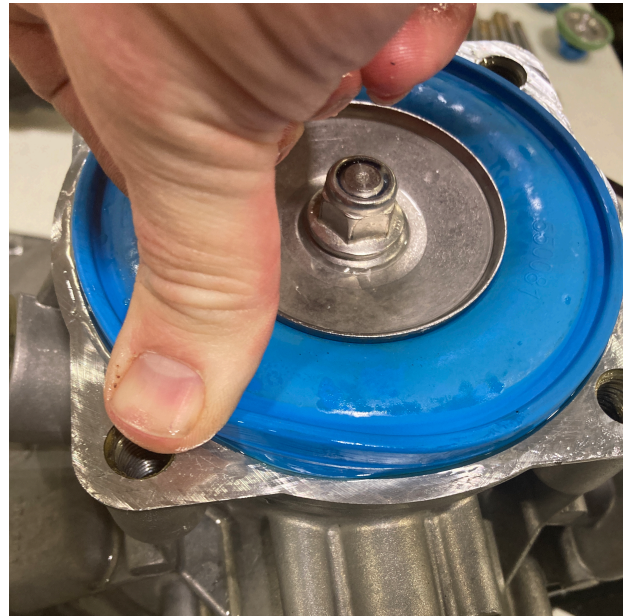
Step 13:

Re-install the diaphragm retainer nut, torque spec below.

- PP21, PP31, PP48 = 220 in-lb (18.3 ft-lb)

Step 14:

Rotate the crankshaft of the pump to pull the piston in. Work the edges of the diaphragm into the sleeve of the pump so that the head will not pinch the edge of the diaphragm when installed.

**Step 15:**

Re-install the head in the correct orientation for the inlet and outlet valves. Ensure that the head indexes into the diaphragm correctly and does not pinch the diaphragm.

Step 16:

Install the head bolts. Torque specs below.

- PP21 - M8x80 = 125 in-lb (10.4 ft-lb)
- PP31 - M12x70 = 310 in-lb (25.8 ft-lb)
- PP48 - M12x70 = 310 in-lb (25.8 ft-lb)

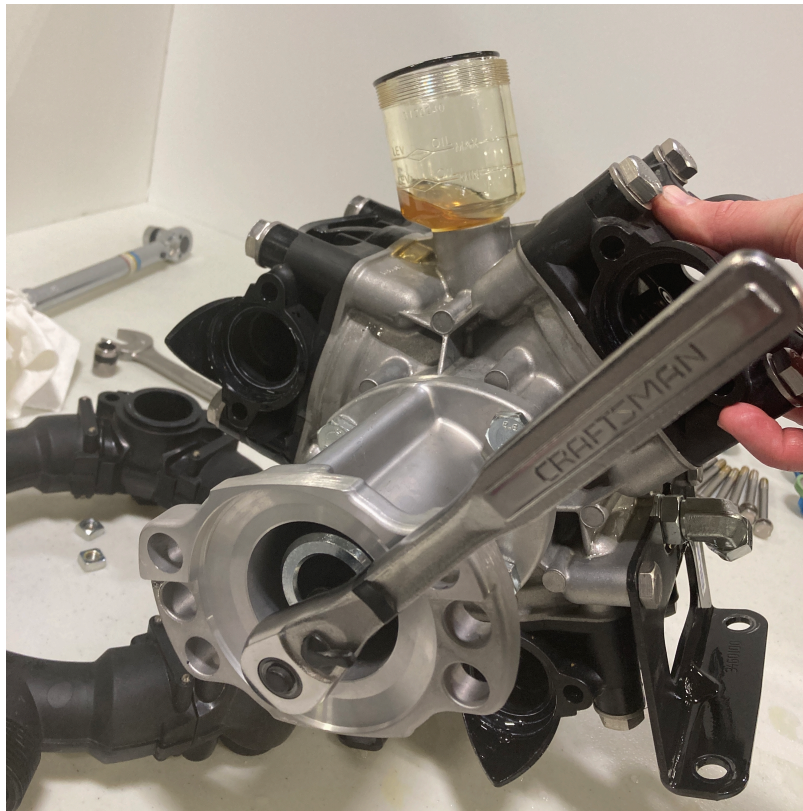
Step 17:

Repeat steps 4-16 for each diaphragm. PP21 and PP31 models have 3 diaphragms, PP48 models have 4 diaphragms.

Step 18:

Replace the oil in the pump following the section “Changing pump oil” steps 4-8.

Note: After replacing diaphragms, as much air as possible needs to be removed from the pump. Turn the pump shaft by hand or with a wrench and tilt the pump at various angles while turning the pump. When the entire amount of oil for the pump has been added, the oil level is between the minimum and maximum marks on the sight gauge and there are no longer any air bubbles coming out of the pump, then the pump has been vented correctly.

**Step 19:**

Return to the section “Replacing valves” and complete steps 9 and 10.

Replacing damaged diaphragms

Damage to a diaphragm results in contamination of the lubrication oil. It is recommended that this maintenance be performed by qualified technicians.

Step 1:

Drain the contaminated oil from the pump.

Step 2:

Follow the “Replacing valves” steps 1-7 and “Replacing diaphragms” steps 1-9, but remove all of the pump heads together.

Step 3:

Remove the sleeves, taking care not to damage the piston rings .

Step 4:

Wash out the internal mechanical parts thoroughly with diesel oil.

Step 5:

Replace the sleeves, taking care not to break the piston rings, and **place the vent holes vertical**, for optimal venting of the air inside. Trapped air can damage the diaphragms.

Step 6:

Install the new diaphragms as normal following “Replacing diaphragms” steps 10-17.

Step 7:

Vent all air from the pump as described in the “changing pump oil” section of this manual.

Pumpstack Troubleshooting

Problem	Cause	Resolution
Pump does not prime	Inlet circuit not airtight	Tighten fittings, repair or replace damaged hoses or fittings
	Too much pressure after pump	Open pressure relief bypass and/or open a downstream fitting to remove air in system.
Pump does not build enough pressure	Inlet filter dirty	Clean filter
	Restriction in inlet plumbing	Remove restriction
	Pressure relief bypass valve not adjusted properly	Adjust pressure relief bypass valve to desired pressure
	Intake and outlet valves worn or damaged	Replace worn/damaged valves
Pressure pulsating	Inlet circuit not airtight	Tighten fittings, repair or replace damaged hoses or fittings.
	Air trapped in delivery circuit	With the pump running, release the air by opening a ball valve or hose after the pump
	Valve stuck	Clean or replace intake or outlet valves.
	Pressure accumulator deflated (PP48 only)	Inflate accumulator to 15psi
Cavitation (increase in noise and drop in oil level)	Restriction in inlet plumbing	Clean inlet filter, remove restriction in plumbing, or increase inlet plumbing size
Oil leaking from pump	Oil seal on pump shaft damaged	Replace the damaged seal

Table 4 (continued)

	Oil pressure inside of pump too high	Remove oil until at the correct level
Pump using oil, oil overflowing reservoir and/or oil white or grey in color	One or more diaphragms damaged	STOP THE PUMP IMMEDIATELY and repair the damaged diaphragms.