Electrol Hydraulic PowerPac Overhaul

Note: The following procedure is a tricky one. It takes time and a good understanding of how the PowerPac is put together. Ask you're A&P if you need his/her blessing to overhaul this wonder of hydraulics.

This article is dedicated to the late Richie Brumm. He was our go-to guy when it came to the Electrol PowerPac overhaul and I often asked him (more than a dozen times) how he overhauled these Electrol pumps and due to his secretive nature his techniques were never revealed to me (or anyone else). After many years of working with these pumps and finding bits and pieces of information from various sources, I finally have the procedure down pretty well. I must worn you, this procedure is not for the faint of heart; It requires patience, a steady hand and a little luck. The condition of the pump before disassembly must be noted as corrosion and years of neglect can eliminate the need for this article. I have come across PowerPacs that were too far-gone to be serviceable regardless of the tools at hand. So, proceed if you dare…

First some terminology:

Valve Body – Is the large part of the PowerPac with all the valves, check balls, o-rings and the thing the landing gear lever and flap lever are attached to.
Reservoir – The top part of the PowerPac that holds the hydraulic fluid.
Plungers – These are small pushrods inside the valve body that control where the fluid goes to operate the landing gear and/or flaps. These are pushed into position with the landing gear and flap levers. Spring tension returns them to the closed position. There are eight of them. There are eight of them.
Snap-rings – Otherwise known as circlips. These retain the plugs that cover the plunger orifice and the piston-retaining ring on the front of the PowerPac.
Plug Covers – Although Electrol did not install these until much later, they are required to prevent the plunger plugs from coming out causing a total hydraulic failure. This can happen if the snap-rings holding the plugs in place let go allowing the plug to become dislodged. This has happened more than once.
Check Balls – These are steel balls used as check valves in numerous locations in the PowerPac. There are only two sizes in the PowerPac; 1/4" and 3/16".
O-Rings – These are the round seals that prevent fluid from entering an unwanted area. They are standard Nitrile o-rings-nothing fancy. You could use Viton orings.
C1 and/or C2 – These are the inlets/outlets on the side of the pump body.

Tools you will need

Screw driver – Flat blade
Snap-ring pliers – Very fine tipped ones and larger ones for the piston snap-ring
5/8" open end wrench
7/16" or 1/2" deep well socket – to remove the C-1 and C-2 fittings on the side of the pump
1/8", 3/32" and 3/16" Clecos – one each to remove check valve caps
Very small light source – Like a flexible LED inspection light; <1/2" in diameter.

Pump holder – Fabricate from aluminum angle.
Four outlet vents – made from AN fittings and aluminum tubing (see below).
Special plunger installation tools – See photo below.
1/8" Aluminum welding rod – to fabricate journal rods.
Four AN929-4 fitting caps for outlets – For pressure checking and final assembly.


Special Plunger Installation Tools

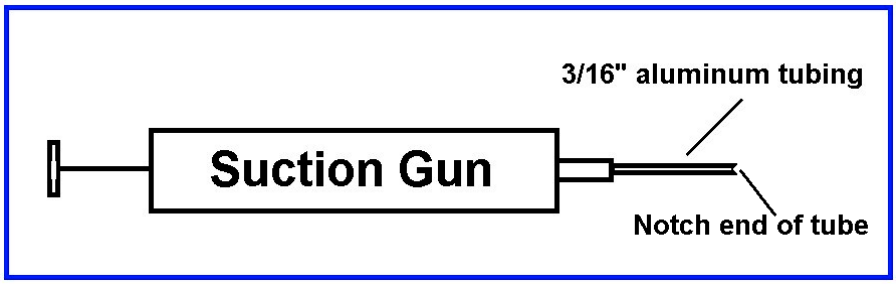
Description

The Electrol PowerPac is a wonder to behold (The designer should get the Nobel Peace Prize for his accomplishment). It is a simple piece of equipment with a very complex series of chambers and journals to guide the fluid in the right direction. There is a two-way piston that pressurizes the fluid when the pump handle is either pushed or pulled. This allows pressure to the landing gear and flaps in both directions of the pump handle essentially making half the work for us when operating the landing gear and flaps. The reservoir, when filled, provides a constant supply of fluid to the chambers that require it. The total fluid in the Seabee hydraulic system is approximately 3-1/2 pints. The reservoir, however, only holds about a half-pint. Fill to the bottom of the filler screen with fresh, clean fluid every annual inspection and your pump should last a long time.

When either the flap or landing gear levers are moved out of the center (neutral) position, the respective plungers are pushed and the fluid is allowed to flow to the selected position. When the levers are in the neutral position, no fluid will flow at all and you should feel resistance when the pump handle is moved in either direction. A slight movement is okay but if the handle moves easily in either direction there could be a problem with the check valves or plunger orings.
The pump handle pushes the large piston in and out to provide pressure to the selected flaps or landing gear. It takes about 10 pumps to lower the flaps to the full position and 28 pumps to retract the landing gear. It's a good idea to leave the handle forward after operating a system to keep the large piston at the bottom end of the handle covered to prevent corrosion or dirt from accumulating.

Procedure: Disassembly

The hydraulic fluid in the system should be kept clean. Most PowerPac failures are due to dirty fluid. Remove the reservoir, clean the pump body and change the fluid in the reservoir each annual inspection. You will be surprised at what accumulates on the top of the pump body. A suction gun with a 3/16" tube at the end works well to suck out the fluid through the reservoir retaining bolt on the top of the reservoir. Remove the bolt and insert the suction gun making sure the tube goes all the way down to the bottom of the reservoir. There is a baffle in the reservoir about half way down that could be misconstrued as the bottom. Go through the baffle hole as well to reach the bottom. See image below:



Suction gun with aluminum tubing that will fit through the reservoir bolt hole

You may have to put some rags behind the base of the reservoir to catch the remaining fluid as you remove the reservoir. There will be a slight amount that the suction gun cannot remove.

Alternate method prior to removing the reservoir:
1-Place a small container under the pump through the anchor compartment.
2-Remove either the forward flap or forward landing gear "B" nut on the side of the pump.
3-Select the respective lever and point it at the removed "B" nut.
4-Keep the opposite lever in neutral!
5-Pump the hand pump until the reservoir is empty, now proceed…

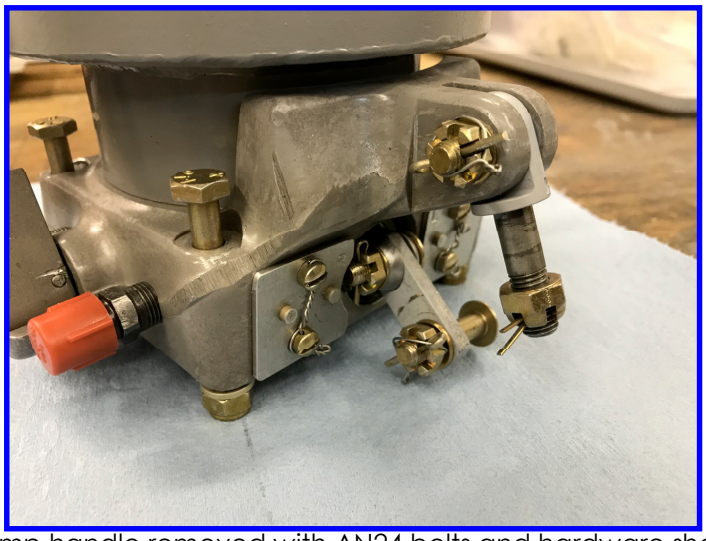
Disconnect the four hydraulic lines and put them aside. Cap the hydraulic lines in the Seabee to prevent fluid loss. Remove the four bolts holding the pump in place at the base and spread the control cables apart slightly to remove the pump from the airplane. Take the pump to your CLEAN workbench. Not sterile but clean.


Removing reservoir bolt


Pry forward edge to loosen Reservoir


Reservoir removed

Remove the pump handle and all the associated hardware. The bolts holding the handle and parts should be AN24 clevis bolts with the heads facing the left side of the pump as regular AN4 bolts will cause interference against the pump body.

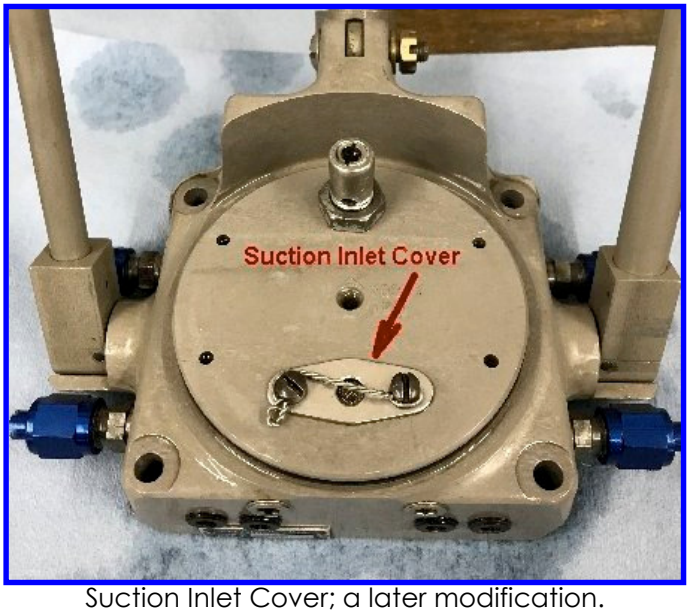


Pump handle removed with AN24 bolts and hardware shown

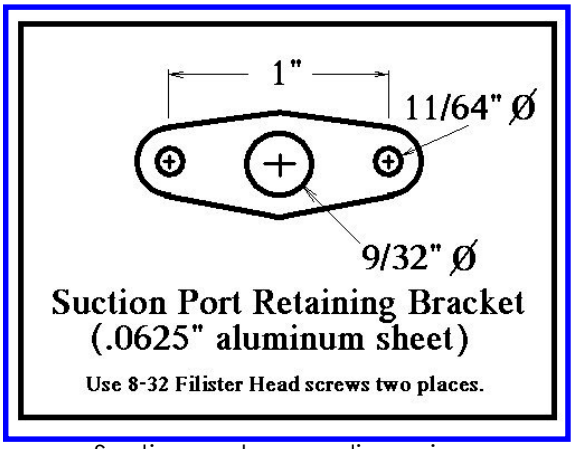
Remove the four C-1 and C-2 AN fittings (#4 fittings; red capped fittings above) on the sides of the pump. These may be difficult to remove if they have been in there for a while. Carefully put the pump body in a vise (with padding; i.e. a thick rag or wood) and using a 7/16" or 1/2" deep well socket, remove the four fittings. If they are a little stubborn, heat can be used from a propane torch (NOT ACETYLENE) to heat up the fittings and they should come right out. Once the fittings are out check to see if you have fine mesh screens in each inlet. If you do, take them out with a straight pin and throw them away. These screens tend to get blocked very easily and if you use clean fluid you don't need them anyway.

Now is the time to put a couple of clean paper towels on your clean workbench to organize the parts. As you take the parts off the pump body put them on the paper towel in the order they came out and keep them away from the work area. You will thank me later.

Remove the suction cover on the aft end of the top of the pump. If you don't have a cover, shown below, make one and install it (covered later in this article).



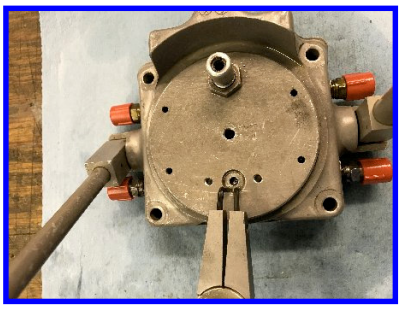
Suction Inlet Cover; a later modification.



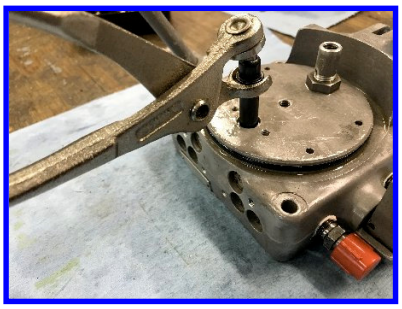
Suction port cover dimensions

Remove the safety wire and screws then put the cover on your paper towel organizer. Remove the screen and snap-ring under the cover and using a 5/32" (black) Cleco, remove the check ball orifice. Remove the Cleco pliers and pull very gently on the Cleco. If you pull too hard the check ball seat could be distorted.

Alternate method: You can also replace the reservoir and pump handle temporarily and fill the reservoir with a small amount of fluid keeping the levers in the neutral position. With the suction screen and snap ring removed you can pump the handle to dislodge the check ball orifice. Drain the remaining fluid and remove the reservoir to expose the suction orifice. Remove it and place it on your paper towel.



Removing snap-ring



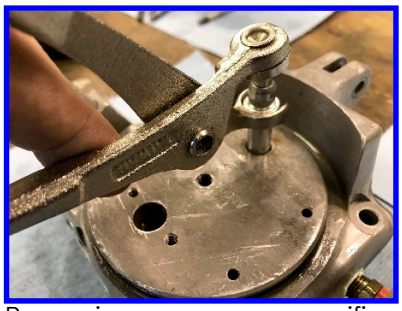
Removing check valve

Parts on paper towel

Using a 5/8 open-end wrench, loosen the pressure relief valve lock nut. Turn the pressure relief valve by hand and count the turns to remove it. It should be around 4-5 turns. Write that down, as you will have to replace it with the same amount of turns. Remove the spring and ball and put on the paper towel in the same order they came out of the orifice. The ball is 3/16" diameter and will probably have to be replaced. No need to take the outlet valve itself apart unless deformity is noticed.

Under the pressure relief valve is a small orifice that needs to be removed. Use a 3/32" (silver) Cleco to remove it as you did with the suction valve. There is an oring under the orifice that needs to be removed and replaced (MS28775-010).

> **Caution**: Never reuse any removed o-ring. They are cheap and their sealing ability may be compromised if used again.



Removing over-pressure orifice

Next, remove the large o-ring from the reservoir flange. See below…

Using a dental tool, remove the reservoir o-ring

This next step is the hardest part of disassembly. You must remove the 10 retaining caps that hold the plunger check balls in place. These are the 1/2" round caps you see on the front and back of the pump body. If you are lucky enough to have one of these…

…it will be an easy job to remove them. Using a 3/16" Allen wrench or Allen socket, remove the caps to expose the spring and ball inside. If you don't have the above pump body, you probably have one of these…

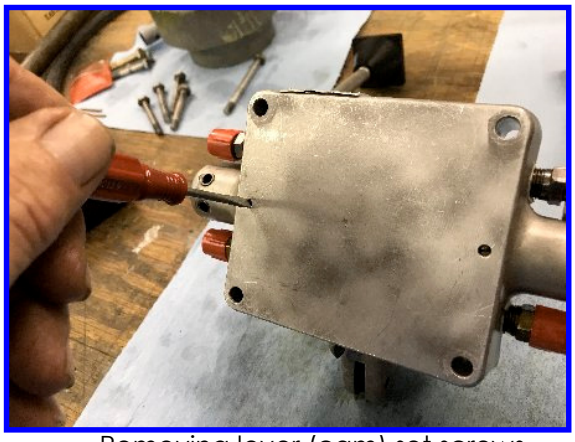
Front view of pump body with snap-rings

The snap-rings, plunger caps and springs must be removed before the landing gear and flap lever can be removed. Put the valve body in a vise (with padding) and, using snap-ring pliers, remove the snap-rings shown above. Once the snap-rings are removed, if you are really lucky, the plunger caps might pop out slightly so you can get them out. If they don't pop up take a 1/4" dowel and push down on the caps and release the dowel quickly so the cap springs push up and hopefully out. If that fails, you can drill two 1/16" holes in the caps as shown above. Drill them at a slight angle so you can get the modified snap-ring pliers on them and pull gently. Don't drill too deep, as this will ruin the cap.

Modified snap-ring pliers to remove plunger caps (About $2 on eBay)

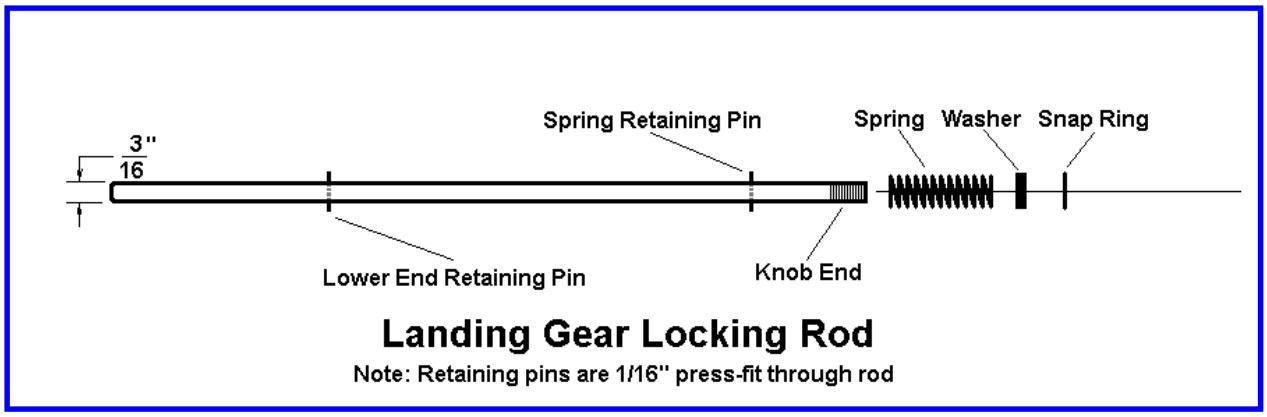
After the caps are removed, use tweezers to remove the springs and place them on the paper towel organizer (short springs go with the long plungers and long springs go with the short plungers). Carefully remove the check balls under each spring. Carefully remove the pump body from the vise and pour the check balls into your hand. You should see four of them on each side.

On the bottom of the pump body are two setscrews (see below) that hold the flap and gear handles in place. Using a small flat-blade screwdriver, remove the setscrews and place them on the paper towel. Once the eight plunger caps are out and the setscrews are removed, cycle the levers a couple of times to push the plungers out of the way. You can pull the flap and gear handles out. The flap handle has a steel ball that is used for the flap detent on the valve body. Use caution when removing the flap handle as the ball is spring-loaded and may disappear onto your hangar somewhere. The landing gear knob must be pulled up to disengage the locking rod. It too is spring-loaded but nothing should come out when it is removed. Some handles have orings installed on the cam end of the lever. You don't need them as leakage around the gear and flap handles are a good indication the plungers are leaking. You can replace them but it isn't necessary.


Removing lever (cam) set screws


Removing the gear lever

The landing gear lever has a spring-loaded locking rod that runs the full length of the lever and has a tendency to bend or break if the proper operating technique is not observed. To move the gear handle, lift straight up on the knob and move it to the desired position. It should lock in place in either the UP or DOWN position when the knob is released. If you try to move it without lifting the knob the locking rod will break or at least bend. If your rod is bent or broken it can cause the rod to jam or even cause a gear up landing if there is any pressure in the system.



Landing Gear Locking Rod
(Goes through the Landing Gear Lever)

To take the landing gear lever apart remove the "Wheels" knob. Remove the lock nut if installed. Remove the small snap ring (very small) at the top of the lever. There should be a washer, spring and rod that can be removed through the top of the lever. You will notice the rod has two strategically placed pins (or a collar) that act as a spring guard and a lower rod stop. If your rod is broken a new one can be fabricated fairly easily.

Piston and Collar removal - Using larger snap-ring pliers, remove the large snap-ring holding the power piston in place. Put the valve body in a vise (with padding) and using a small (1/4") Phillips head screwdriver or small drift and pull the piston out. In unusual cases the collar around the piston may not come out due to the deformity of the pump body. A small file around the piston collar opening can be used to make the opening round again. Remove the collar and place it on the paper towel along with the power piston.


Removing power piston and collar

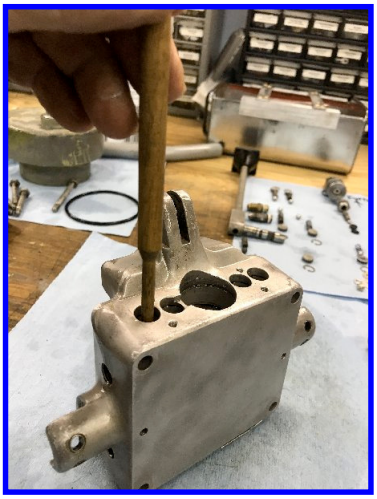

Piston removed (collar is round part on top)

Remove the collar from the piston and remove all orings from the piston and collar. There should be two orings on the collar and one on the piston. Remove the snap-ring holding the check valve and check ball in the rear of the piston. Remove the check valve seat with a 1/8" (copper) Cleco. There should be one oring on the check valve. The ball and spring should be removed and placed on the paper towel. Check the piston and valve body for scratches along the inside

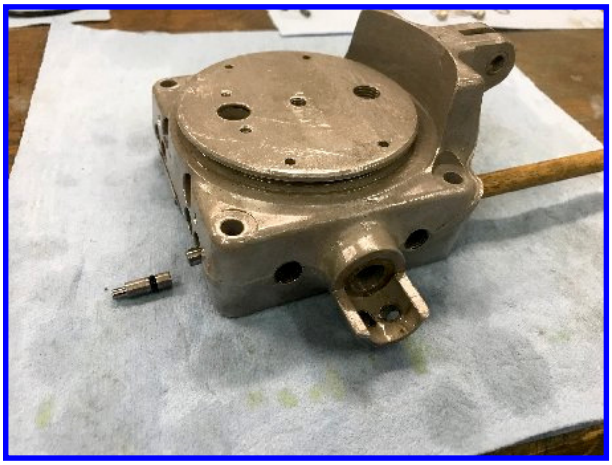
where the piston rides. Any scratches can be removed from the valve body by using a fine hone. The piston scratches can be removed with crocus cloth.

Remember: Keep your parts organized!

Plunger Removal - Next, remove the eight plungers from the valve body. Using a 1/8" wooden dowel push the small (outer) plungers into the cam opening on the valve body. They are small enough to fall into the hole and can be removed from the flap and/or gear lever hole on the sides of the valve body. The larger (inner) plungers can be pushed all the way through to the other side of the valve body using the same 1/8" dowel.

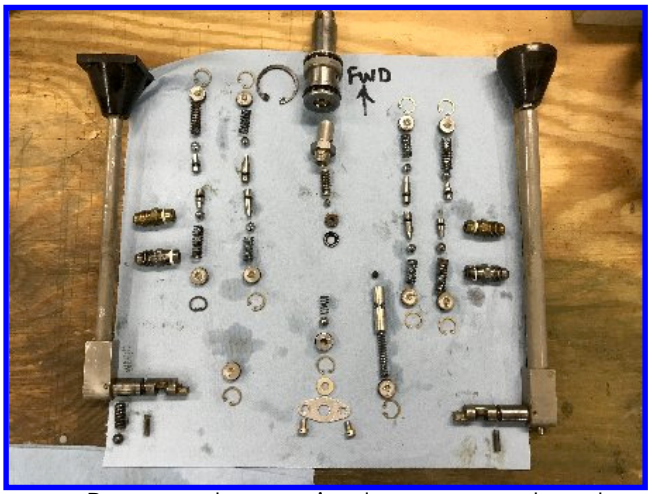


Removing small plungers into cam opening.

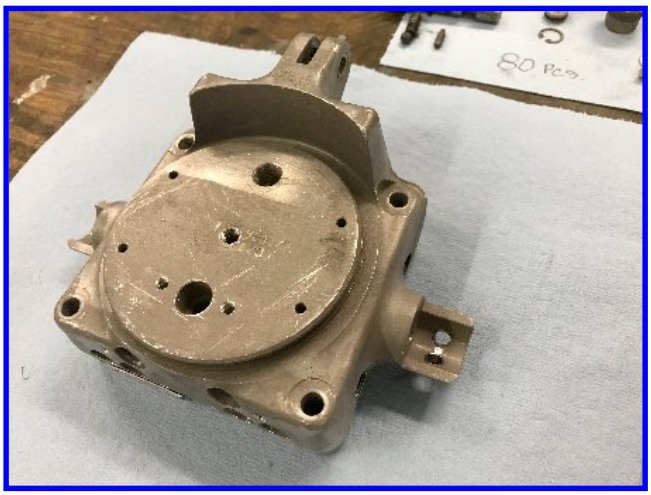


Removing large plungers

You should now have the pump completely apart with the parts laid out on your paper towel in their respective order! Like this…



Pump parts organized on a paper towel



"Naked" valve body

Cleaning and Inspecting -Now you should have the basic "naked" valve body ready for cleaning. Soak the valve body in lacquer thinner and blow the orifices out with air. Using a magnifying glass inspect the check ball seats and general condition of the valve body. If you notice any pitting around the check ball seats they may have to be re-ground. This can be done with a 1/4" ball epoxied on the end of a 3/16" aluminum tube. Using grinding compound (the fine grit stuff) you can grind the seats down until smooth again. If you have a good machine shop close by you can have them do it with a little better results.

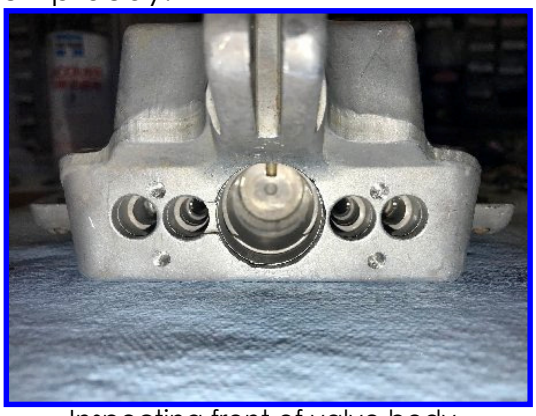
As you soak the valve body, use a pipe cleaner to clean the small inlets on the top of the valve body.

Cleaning the inlets on the valve body with a pipe cleaner

Note: It is imperative that you replace the check balls. They are cheap; about 4 cents a piece and are available at McMaster-Carr (www.mcmaster.com). Get the "Bearing" quality balls. Only trouble is you have to buy 100 of them!

Inspect the inside of the plunger openings for corrosion. Each opening is about 3/16" in diameter and can be cleaned and polished using a 3/16" fine grit hone. Light machine oil can be used on the hone but don't use too much. Just a couple of passes through the opening should clean and polish it really well. If there is major corrosion you may have to scrap the pump body!

Inspecting rear of pump body



Inspecting front of valve body

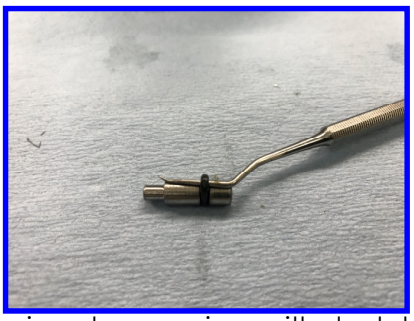
Starting honing of plunger opening

Passing hone through to rear plunger opening

After honing, rinse with lacquer thinner and use air once again to clean the valve body of any residue. Once the valve body is clean, set it aside and inspect the remaining parts. The plungers are especially susceptible to corrosion. Any corrosion on the plungers is an indication they may need to be replaced. There have been plungers I've seen that were in two pieces due to corrosion and they were split right at the o-ring slot.

Eight plungers; 4 short and 4 long

Remove all orings from the various parts. Special care should be taken with the plunger orings. They are very small and a sharp removal tool should be used carefully. A dental pick works great and now soak plungers in lacquer thinner.



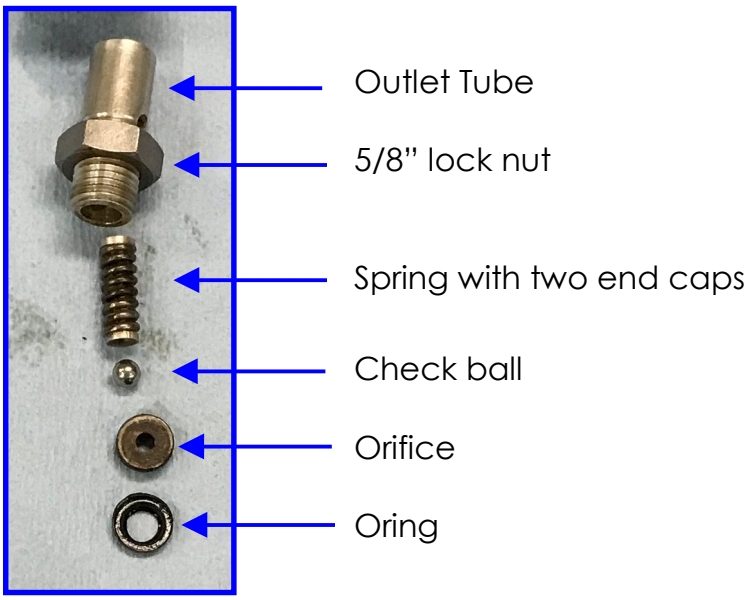
Removing plunger orings with dental pick

DO NOT REUSE ANY ORING! Some of the orings may be very hard from years of exposure to nothing but air. These may be difficult to remove so be careful. Use the same dental tool on the remaining orings. There are orings on the piston, piston collar, plunger caps, reservoir, some check valves and plungers. Make sure you get them all and throw them away.

Procedure: Assembly

A word about oring installation; REPLACE ALL ORINGS WITH NEW ONES! All orings and the part they attach to should be coated with a light-weight grease or Parker O-lube. Parker O-lube costs about $8 and will last you a lifetime. This will make installation much easier. If an oring is cut or damaged, throw it away and use another new oring. The part with the oring and the surface it is riding on must be clean and free of dirt, dust or any other substance that could compromise the sealing ability.

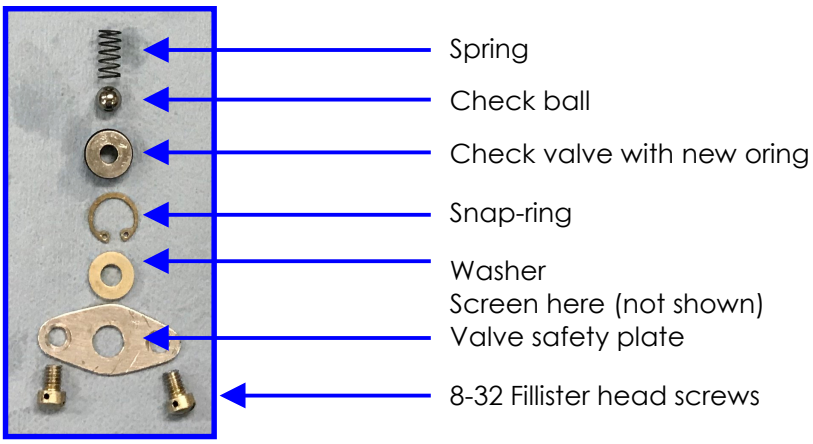
Parker O-lube



Over-pressure valve parts

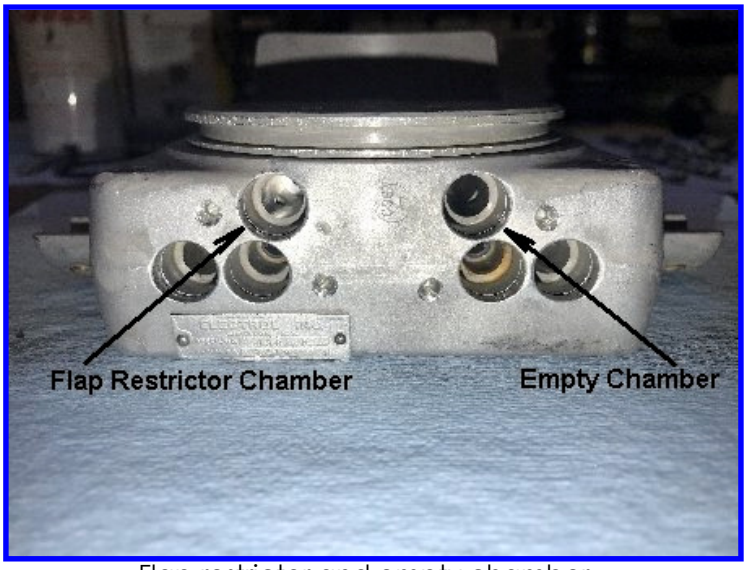
Start with the easy part; replace the inlet suction parts and the over-pressure relief valve on the top of the valve body. Remember to look at the amount of turns it took to take out the over-pressure valve and install it. The over-pressure valve parts are shown above. Install them in this order; Oring, orifice (small diameter down), check ball, spring with end caps and outlet tube. Tighten the 5/8" lock nut snugly.

Next is the suction valve. It may need a little attention before you install it. If your pump body does not have a valve safety plate, make one and put it in. See page 5 for the plate drawing. Drill the holes in the pump body for the plate no more than 3/8" deep and use a bottoming tap for threading. The Fillister head screws are only 1/4" long at the thread so be careful and don't drill too deep. Install it in the order shown below with one exception; the small screen is not shown in the photo. The screen goes in after the snap-ring and is sandwiched by the washer. This is a small-mesh screen similar to a tea bag strainer (available at most general stores for cheap).



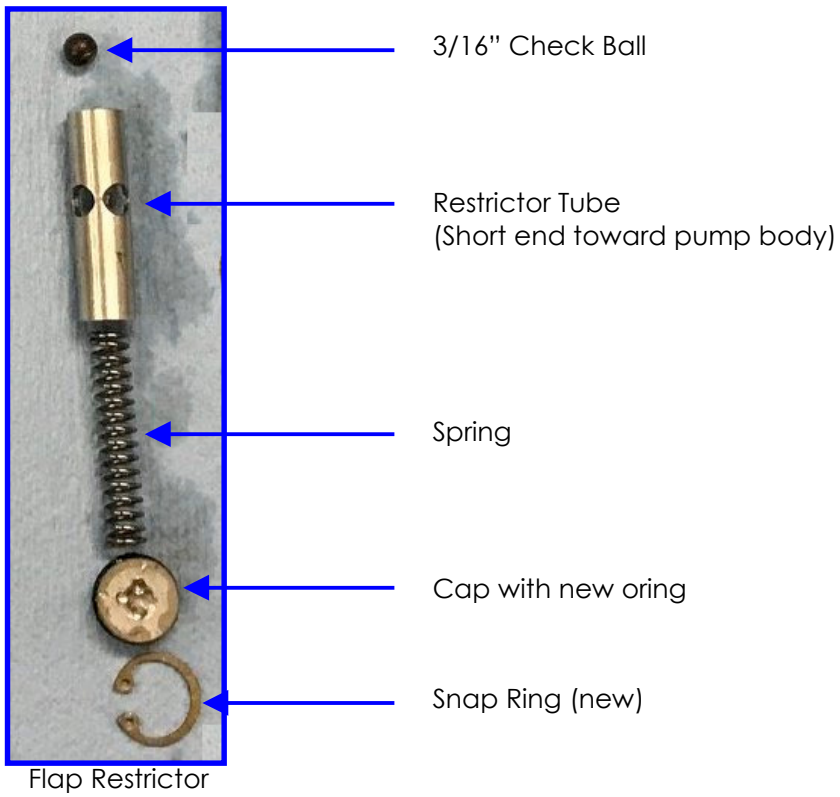
Suction Valve Parts

There are two canals on the rear of the pump body that are fairly simple to install. Facing the rear of the pump body they are located above the four plunger canals. See photo below:



Flap restrictor and empty chamber

The "Empty chamber" is simply capped with a chamber cap and snap ring. It does fill with hydraulic fluid once the pump is pressurized so make sure you install a new oring on the cap before installation. The Flap Restrictor chamber is a little different; it requires a check ball, spring and restrictor tube. Install the restrictor tube first with the holes in the tube toward the pump body. See below:

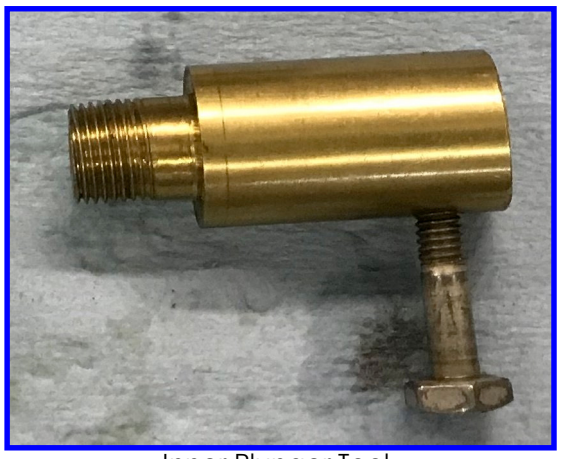


Flap Restrictor

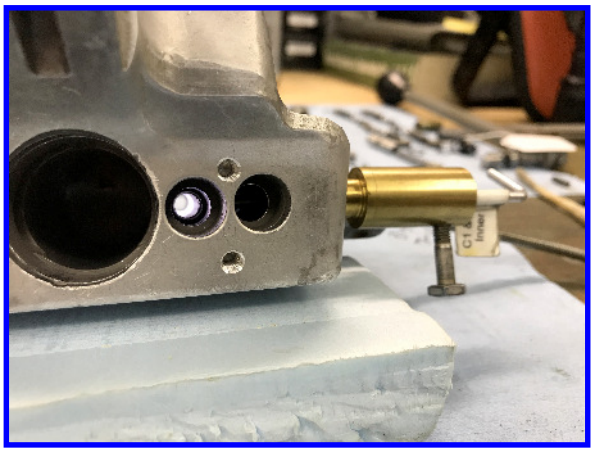
With the Restrictor Tube installed, install the ball, spring, cap (with new oring) and finally the snap ring. Again, install the snap ring with the sharper edge out to provide more grip.

Plunger Installation - This is the trickiest part of the assembly and I would highly recommend downloading "***Electrol 430 Plunger Installation.pdf***" on the Seabee Club website. From the home page scroll down and click on the "***Maintenance and Reference Materials***" link then scroll down to "***Hydraulic Maintenance***" and click on "***Electrol 430 Plunger Installation.pdf***". This will save about 8 pages in this article!

Install the INNER plungers first. If you install the outer plungers first you won't be able to get the inner plungers installed. Assuming you have all the special tools required for the installation, start by installing one plunger at a time.

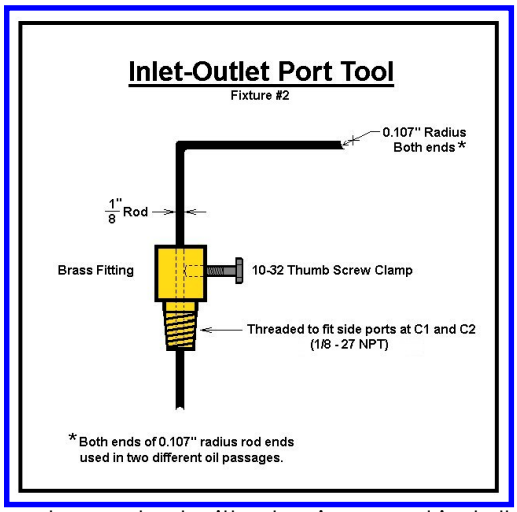


Inner Plunger Tool



Installing Inner Plungers

The tool on the left above is screwed into the C1 and C2 inlets to guide the aluminum rod into the pump body. The photo to the right shows the tool installed and the aluminum rod in position to install the plunger. The end of the aluminum rod is curved to match the inside of the plunger canal; about 0.107" radius.



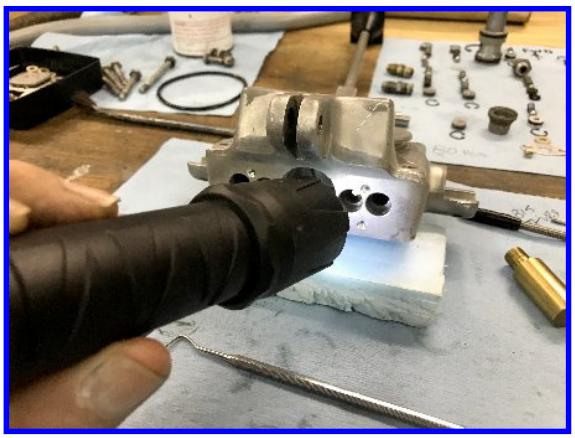
Inner plunger tool with aluminum rod installed

Hint: To make the curved ends of the aluminum rods, drill a 3/16" hole through a square rod of aluminum. Drill 1/8" hole at 90-degrees to the first hole. Place the 1/8" aluminum rod into the 1/8" hole until it sticks through into the 3/16" hole slightly and using a 3/16" drill, drill through the 3/16" hole to make the curved end of the aluminum rod. This should give the correct radius for the inner plunger canal. Smooth out the curved end of the rod with a polishing wheel to prevent any sharp edges cutting the orings as they go through the plunger canal. You must make at least two aluminum rods for the different shapes of the plunger canals. There will be some trial and error involved.

After screwing in the tool for the inner plungers, slide the aluminum rod through the tool hole and using a small LED light through the Gear or Flap lever hole turn the aluminum rod until it is perfectly flush with the inside of the plunger canal. Lock the rod in place with the locking bolt.

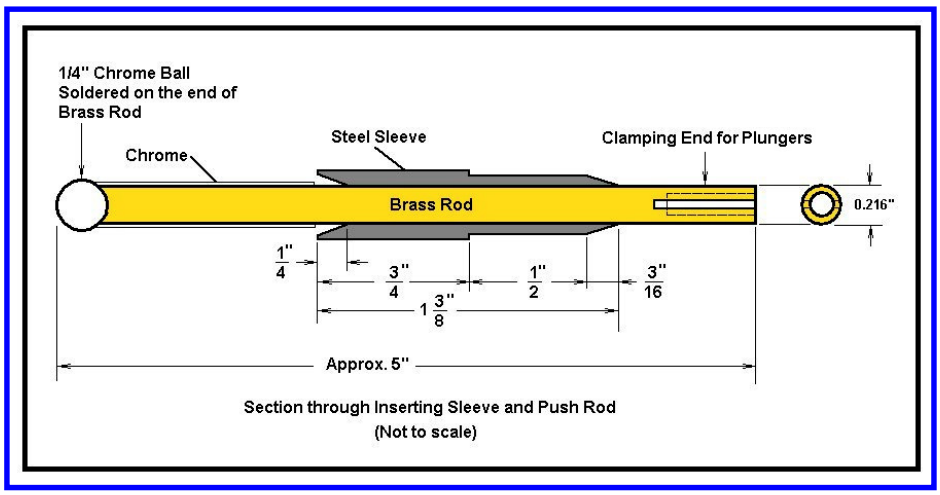
Lubricate the LONG plunger and small oring. Using a small 1/8" dowel, put some Parker O-Lube on the end of the dowel and lubricate the inside of the plunger canal.

Plunger installed in brass tool with Parker O-Lube



Looking for anything "black"

Use the tool listed below to install the plungers by removing the steel sleeve, lubricate the inside of the steel sleeve with Parker O-Lube and placing a plunger (with new oring) on the end of the brass rod. Carefully insert the steel sleeve into the plunger canal. Slide the brass rod with the plunger through the steel sleeve very carefully and slowly. This will compress the oring and guide the plunger into position. Push it in far enough to clear the aluminum rod. You can see if it's far enough by looking into the Gear or Flap lever hole. Don't go too far, as the plunger will drop into the lever hole and you'll have to start over. You can use a 3/8" dowel inside the lever hole to prevent the plunger from going in too far. Pull the steel sleeve out of the plunger canal and slowly pull the brass tool out making sure the plunger stays in place. You can wiggle the tool from side to side slightly to aid removal.

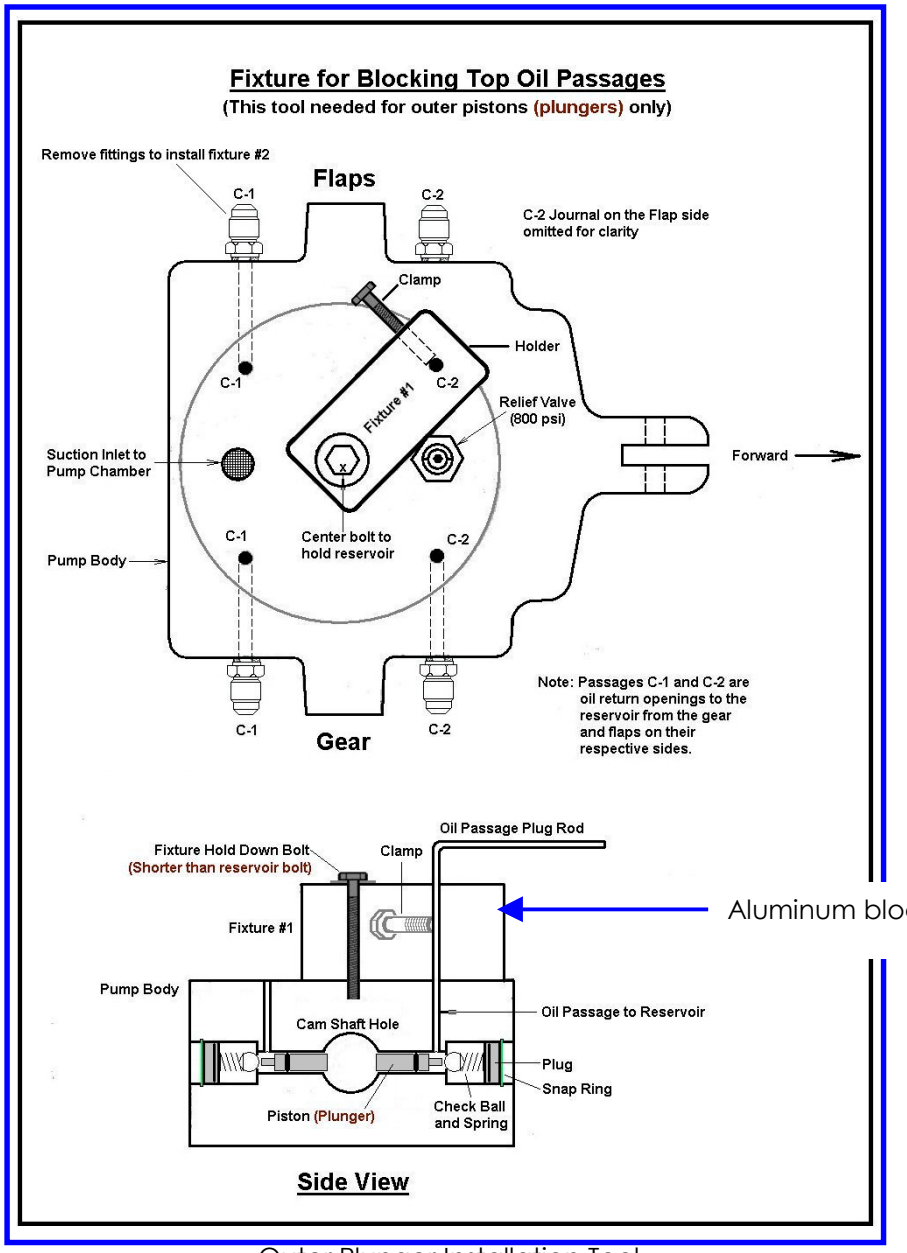


Plunger installation tools

Repeat this procedure three more times for the inner (LONG) plungers. The outer plungers are different as described below.

> **NOTE:** The chrome ball on the end of the brass rod is used to seat the plunger in position AFTER the Gear and Flap levers are installed and in the center-neutral position.

The outer, SHORT plungers use a different tool in a much different location. A square aluminum block is used to hold the matching aluminum rod in place through the top of the pump body. A bolt holds the block in place. There is a locking bolt through the block to hold the aluminum rod similar to the locking bolt in the plunger tool above. See illustration below for details.



Outer Plunger Installation Tool

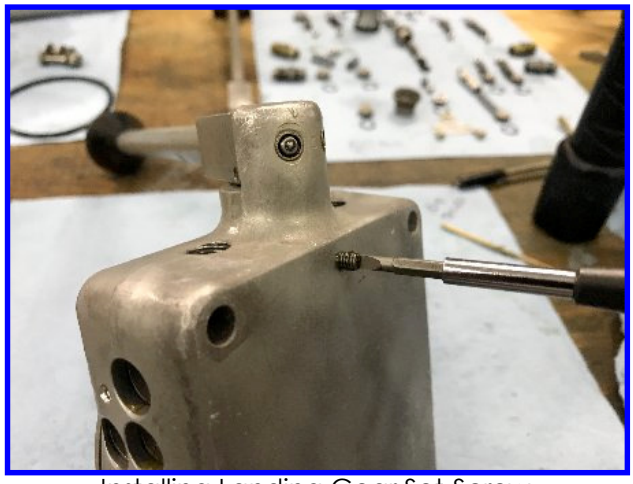
After fabricating "Fixture #1" above, make another aluminum rod with the end curved as before (about 0.107" radius) shown in the side view although it may be at a slightly different angle (See illustration on page 16). Install Fixture #1 onto the pump body as shown. You may have to make the hole in the center of the fixture a little larger than the hold-down bolt to allow for a slight adjustment when the aluminum rod is installed. Use the LED light again in the Gear or Flap lever hole to make sure the aluminum rod is flush with the inside of the plunger canal. Just as before, lubricate the inside of the plunger canal, steel sleeve and plunger (with new oring) with Parker O-Lube. Put the lubricated steel sleeve into an outer plunger canal. Place a plunger into the end of the brass rod and slowly insert the plunger into one of the outer plunger canals. Remove the steel sleeve and brass

rod as before making sure the plunger oring is past the aluminum rod. Repeat three more times for the other plungers.

> **CAUTION:** After each plunger installation, whether inner or outer plunger, use an eye loop or magnifying glass and check for anything black inside the plunger canals. If you see ANYTHTING black it probably means the oring has been sliced and the oring must be replaced. Repeat plunger installation as necessary.

Landing Gear and Flap Levers - Now you can install the Landing Gear and Flap levers. Make sure the plungers are not sticking out into the lever holes (Electrol calls it a Cam Hole). If they are protruding use your 3/8" wooden dowel to push them back in, out of the way. Lubricate the lever shaft with a light coat of grease and insert the Landing Gear lever into the right side cam hole. As it goes in pull up on the landing gear knob to retract the locking pin on the bottom of the lever. Push the lever all the way in and secure it with the small setscrew on the bottom of the pump body.

Installing Landing Gear Lever



Installing Landing Gear Set-Screw

To install the Flap lever, grease the shaft and use a small aluminum block to push the spring and ball into place as you push in on the Flap lever. The spring is quite strong so much force will be required to seat the ball and get the Flap lever all the way in. See photo below:

Flap lever parts

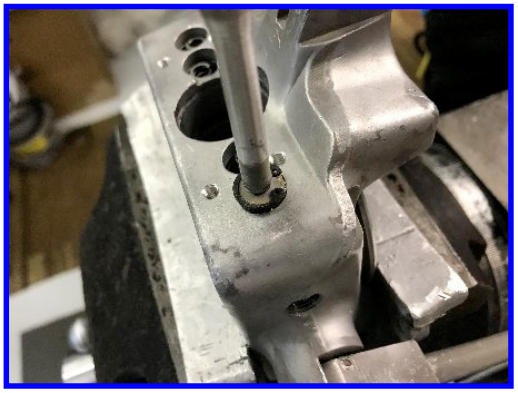
Installing Flap Lever Detent Ball

Pushing Flap Lever ball in place

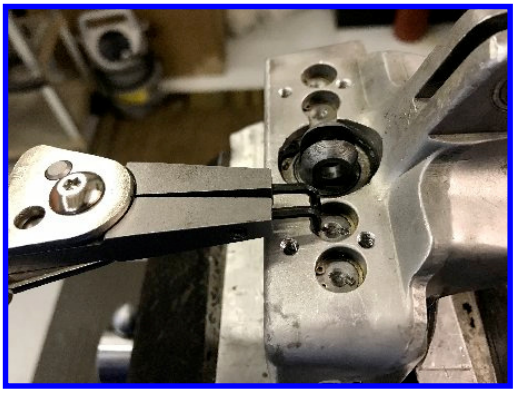
Install the Flap lever setscrew on the bottom of the pump body as you did with the Landing Gear lever (see photo on page 19). Move both levers back and forth a few times to insure there is no binding. Also pull out on the levers slightly to be sure they are locked in place.

Plunger Springs and Balls - Once the levers are in place you can install the check balls and springs into the plunger canals. Working from one side or the other, install four new 1/4" check balls; one in each plunger canal. Install the LONG springs in the OUTER plunger canals and the SHORT springs in the INNER plunger canals. Put new orings on the plunger caps and lubricate the caps and inside the plunger canals.

To install the caps, place a snap ring over the cap with the sharp edge facing out and use a 1/4" dowel or the ball end of the brass plunger tool to press the cap in place. Insert your snap ring pliers into the snap ring and press in on the cap with your 1/4" dowel. There is a slight inward movement of the cap as you overcome the spring tension. Hold the dowel in as you install the snap ring. See photos below:



Pushing in on cap. Note snap ring position



Installing snap ring (dowel not shown for clarity)

Check to be sure that the snap rings are firmly in place. They should all look the same, that is, the space between the snap ring holes should be identical. If they are not, push down on the ones that are not in to re-seat the snap ring. Now turn the pump body over to do the other side (four caps with snap rings).

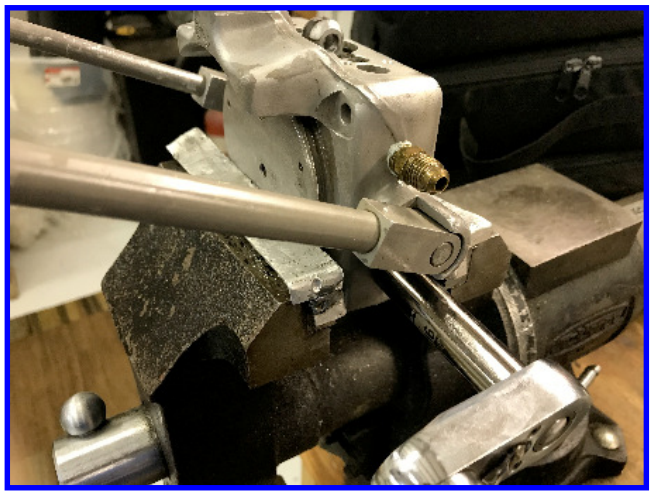
Okay, it's all down hill from here. You just need to install the power piston and collar and the nipples at C1 and C2 and you are done except for testing.

The collar around the power piston has two orings; one around the outside and one on the inside that the piston rides over. Install these orings like you did the others…lots of Parker O-Lube. Lubricate the piston and slide it into the collar. The collar goes on with the oring closer to the outside of the pump body (large flange in)

Installing power piston and collar (collar shown installed on piston)

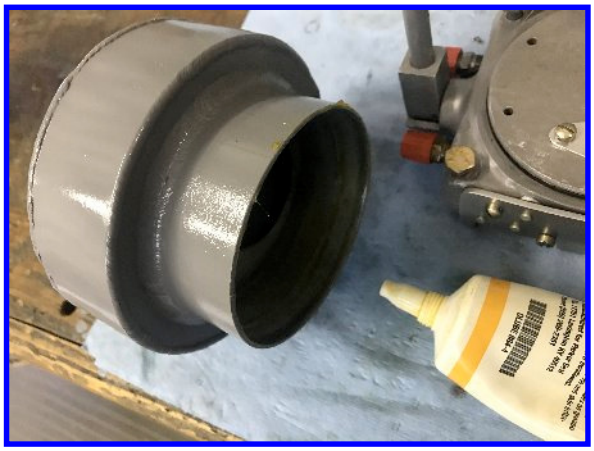
Push down on the collar with a wooden dowel to seat it into the pump body. Install a new large snap ring, again, with the sharp edge of the snap ring out.

Install the four C1 and C2 steel nipples. You can use a Teflon pipe sealer (NOT Teflon tape) if you like but use it sparingly and only on the center of the threads. Don't get any sealer on the opening of the nipple. Tighten them down very snugly. These are pipe thread nipples and once they are hand-tight, another turn or so should be tight enough.



Installing steel nipples at C1 and C2

Reservoir - Lubricate and install the reservoir oring. Use Parker O-Lube around the inside of the reservoir where the oring makes contact. Do not install the reservoir just yet. Put the pump on the test stand (below) before installing the reservoir as the mounting bolts won't clear the reservoir. After the pump is bolted to the stand, push the reservoir down slowly and evenly until it seats on the top of the pump body. Install the reservoir hold down bolt, with oring, and tighten just snug. It doesn't have to be very tight; just enough to keep it from shifting. The filler port goes toward the back of the pump body.



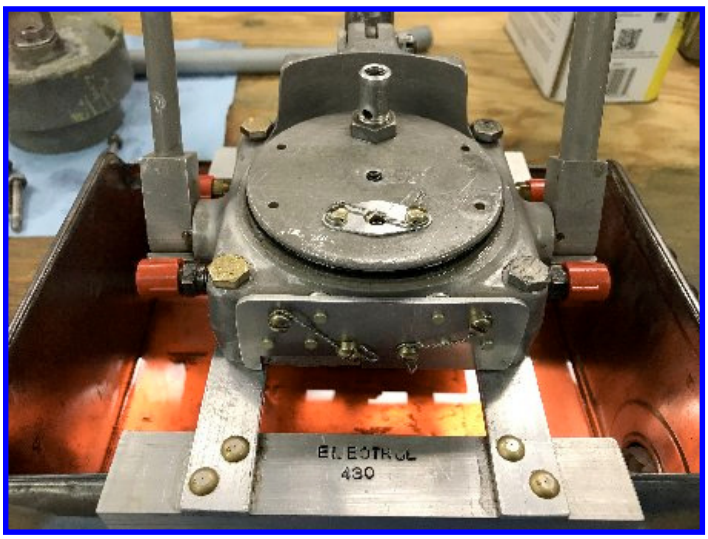
Lubricating Reservoir

Tightening Reservoir Bolt

Procedure: Testing

To test the pump you will need a support of some sort. You can make one from a 1-gallon tin can and the support can be made from aluminum angle and straps. The pump attach bolts are a little shorter than the bolts that attach it to the airframe. Install the pump handle and associated hardware. See photo below:

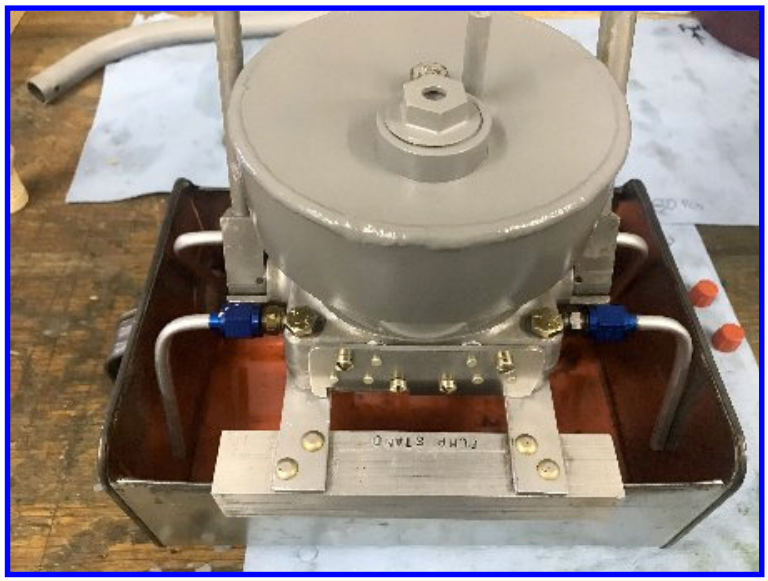
Test Stand and Tin Can



Test Stand with Pump Attached

Notice the four hold down bolts are installed before the reservoir is put in place. After the pump body is in place, install the reservoir.

Make four outlet tubes for the C1 and C2 steel nipples. These are simply 1/4" aluminum (soft 3003) tubes bent at a 90-degree angle. Use four AN818-4 nuts and AN819-4 sleeves to secure the tubes to C1 and C2 outlets. See photo below:



Pump on test stand with tubes at C1 and C2 outlets

Place the Landing Gear and Flap levers in the center "off" position. This will check the integrity of the plunger orings. Fill the reservoir half way with mineral spirits. DO NOT USE LACQUER THINNER OR ACETONE as It will melt the orings. Always use mineral spirits. Pump the handle until you feel resistance and check the plugs, levers and piston for leaks. If you see leaks fix them now.

Place the landing gear lever aft (up). Do not pressurize the pump just yet. You should see fluid coming out of the C2 (forward) outlet (Hint: The levers point to the outlet that opens). Very little fluid, if any, should be coming from the C1 (aft) outlet. Place the landing gear lever in the forward position. Fluid should now be flowing from the C1 outlet and very little from the C2 outlet. If all is well, place the landing gear lever in the neutral position. Repeat this procedure for the Flap lever. Check for proper flow from C1 and C2 on the Flap side.

Fill the reservoir again with mineral spirits and do the same procedure only this time move the pump handle to pressurize the pump (DO NOT REUSE THE OLD MINERAL SPIRITS! Throw it away). Just a pump or two in each position is sufficient to check flow from C1 and C2. This also serves to flush the pump out to eliminate any small foreign objects that may be lurking inside the pump. Use the pump handle and empty out the reservoir.

Remove the AN nuts and tubes from the C1 and C2 outlets. Place AN929-4 caps on C1 and C2 outlets and tighten. Fill the reservoir with new hydraulic fluid. Keeping the levers in the neutral position, pump the pump handle in each position of the Landing Gear and Flap levers. This checks the integrity of the piston check valve and the suction check valve. There should be very little movement of the pump handle if all is well. If the handle moves easily with the caps installed, you have a leak bypassing the check balls at the check valves in the piston or suction port.

You can pressure test the C1 and C2 outlets by using a pressure gauge and a short piece of 303-4 hose. See photo below:

Testing pressure at C1 and C2

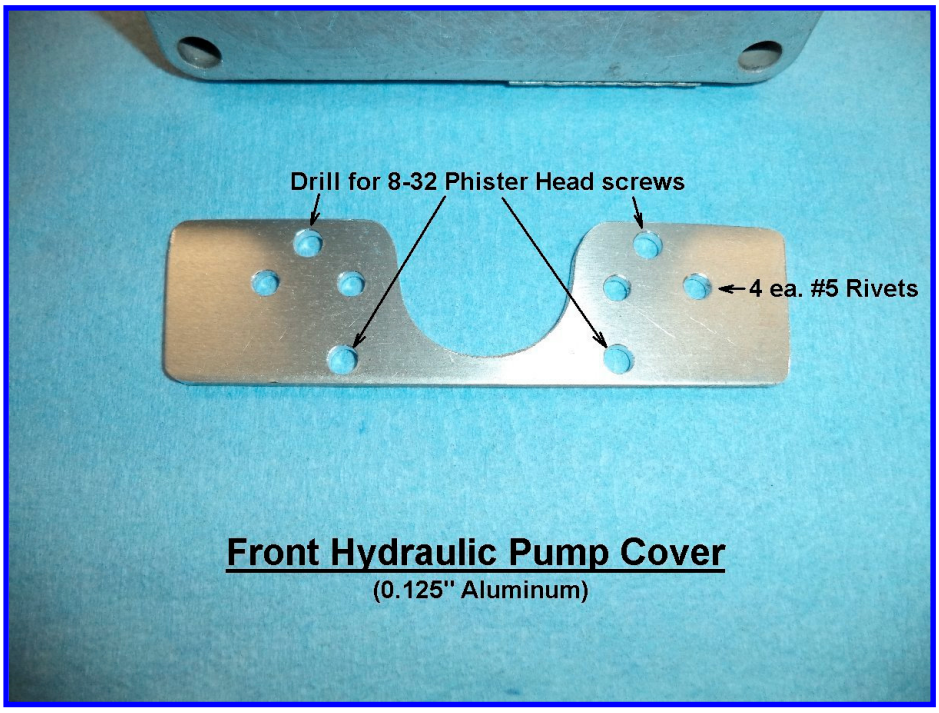
If you do the above test, pressurize the pump and check for positive pressure (about 200-300 psi). It will be difficult to check the over-pressure valve (1000 psi). Check each C1 and C2 outlet.

> **Note**: This test is not necessary unless you have doubts about the pressure during the above tests. Once installed in the Seabee if the Gear and Flaps move correctly and stay put when the handle is not moved, you will be good to go.

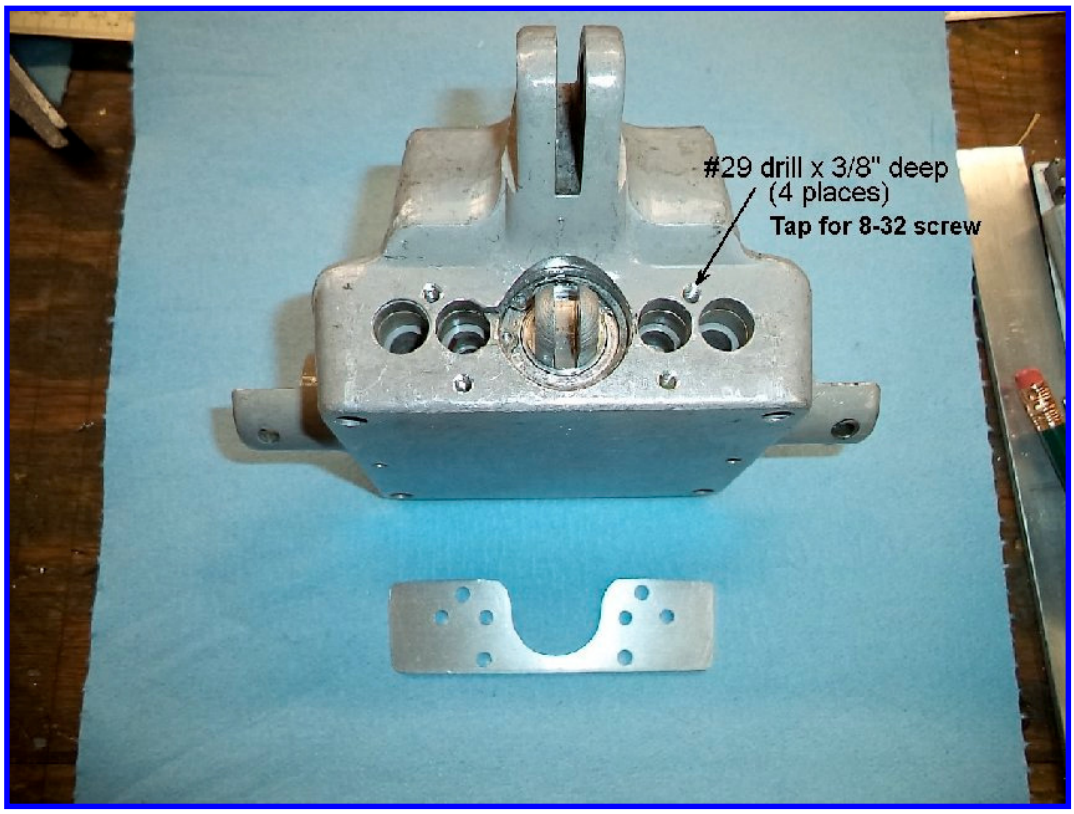
Plug Guards - More than one Seabee has lost all the hydraulic fluid from a dislodged plunger cap. This modification, if you don't have it, will prevent that from ever happening. Small plates on the front and rear of the pump body will cover the plunger plugs so no matter if the caps come loose you won't lose your hydraulic fluid.

Before you start, make a paper pattern from your pump body as to where the caps are and where the Fillister head bolts and rivets should go. Please use caution as there are many channels and journals that may be compromised if you drill too far or in the wrong place. The patterns below have been tried and true but ensure your hole placement BEFORE you drill any holes.

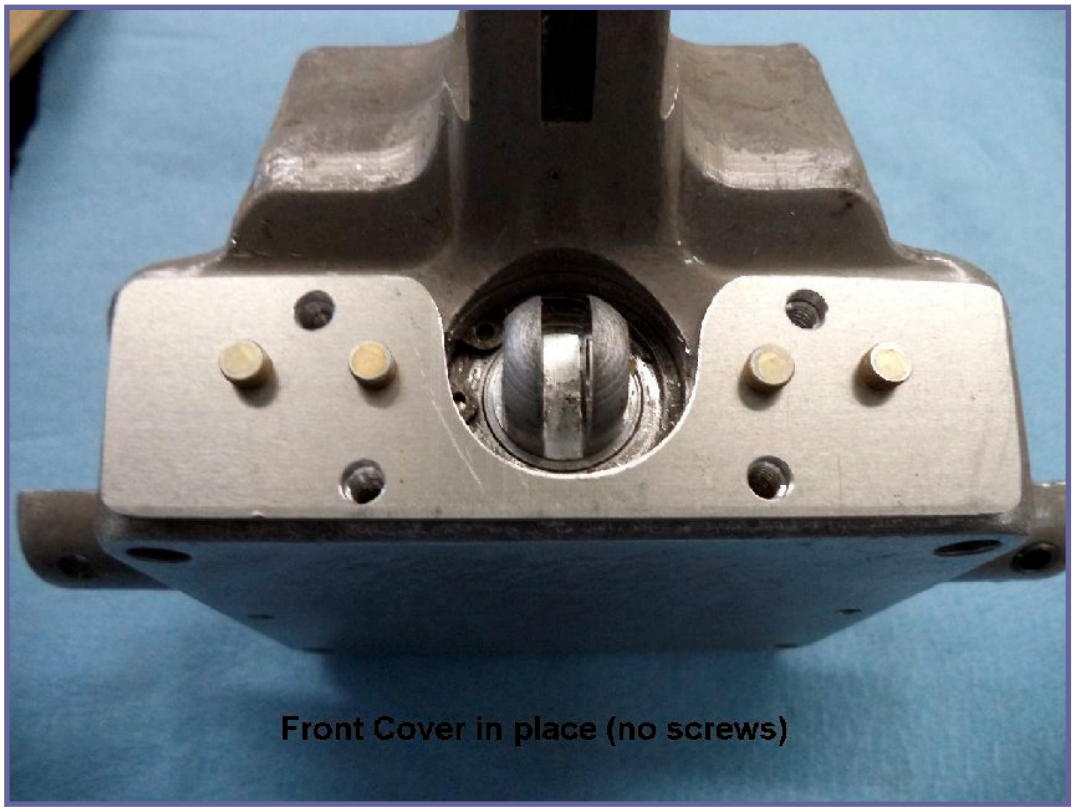
Make the following plates from .062" to .125" aluminum sheet. The small 5/32" holes are for AN470AD-5 rivets. Two AN960PD-10 aluminum washers are installed on top of each plunger cap then the safety plates are installed over those. The rivets will press against the washer/plunger caps and prevent any movement.



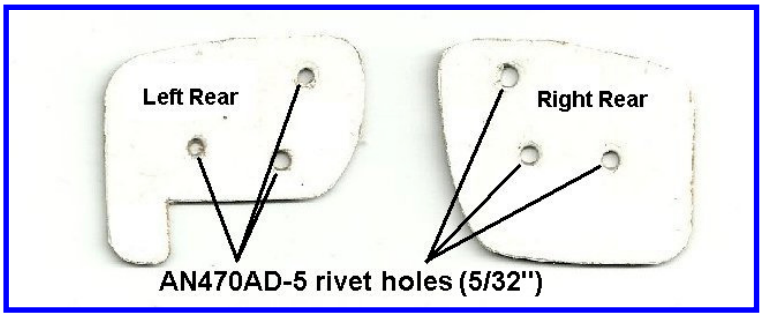
Front Plunger Cover - .062" to .125" Aluminum Sheet



Placement of 8-32 screw holes. Drill 3/8" deep and use a bottoming tap

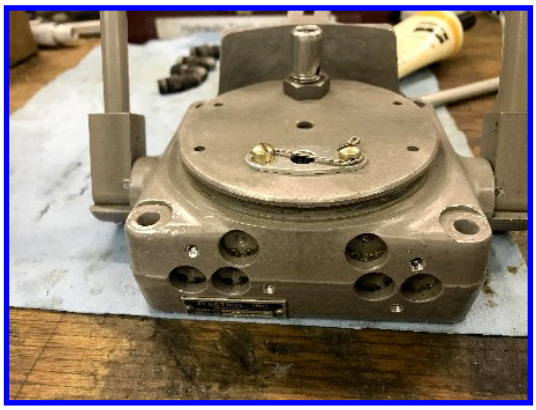


Front cover in place. Notice rivet placement over plunger plugs.

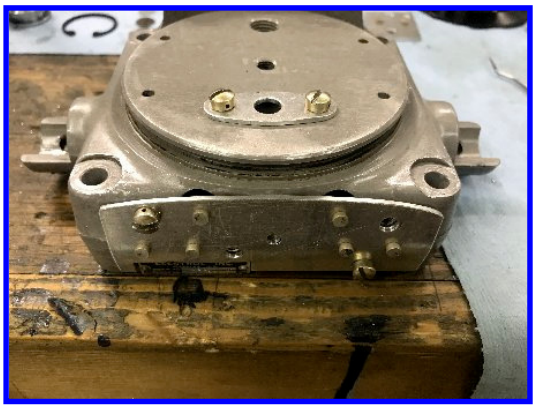


Rear plunger plug covers. 8-32 screw holes not shown.

Depending on your installation will determine what cover you will need for the rear plunger caps. Some pumps have been modified for an electric hydraulic pump and the rear of the pump may have the inlet/outlet plumbing for the electric pump. Your covers will have to be adjusted to fit. One option for the rear cover(s) is shown above. If your pump is not modified for an electric pump the rear cover can be a one-piece cover like the front if you like (shown below).



Rear holes for cover



Rear cover installed (not all screws installed)

For the cover screws make sure you use Fillister Head screws with the head drilled for safety wire. AN500-A8-4 or AN500-A8-6 is the Aircraft Spruce part number depending on the thickness of the aluminum used for the plates. Use .032" safety wire and safety the screws in pairs on each side of the pump. I.e., four pieces of safety wire.

Seabee Installation - Once all the testing is done, you can now install the pump in the Seabee. Remove the empty reservoir and place the pump onto the bracket in the airplane. Spread the control cables apart above the hydraulic pump bracket and slide it into position and install the four mounting bolts and secure it with new nylon locking nuts. The reservoir can then be installed. Tighten the center reservoir bolt just enough to hold it in position. Attach the four hydraulic fittings in the Seabee at C1 and C2 and tighten. Fill the reservoir with clean hydraulic fluid up to the bottom of the screen in the filler opening. Remove the screen (temporarily) after filling to insure the correct fluid level. Reinstall the screen.

Note: It is a good idea to have an overflow bottle attached to the vent on top of the reservoir. A vinyl tube going from the vent to a nearby plastic bottle works really well. Be sure the bottle is vented though. Also keep the filler cap on just finger tight. You never know when you might need to fill the reservoir in flight. Keep a small bottle of hydraulic fluid within arms reach in the Seabee.

If you capped the hydraulic lines in the Seabee before the overhaul, you probably won't need to bleed the system. The small amount of air will work its way out after a few cycles of the flaps and gear. However, if you suspect air in the gear or flap lines you can bleed the air out by loosening the fittings at the flap and gear actuators (one fitting at a time) and pumping the pump handle until all the air is removed from the lines. Keep plenty of rags available for the inevitable hydraulic fluid mess. Tighten the actuator fittings when you are done. Check the fluid level in the reservoir frequently and be sure to keep the reservoir full of clean hydraulic fluid during the test!

Place the Seabee on your hull stands and check the operation of the gear and flaps a few times to insure the pump is working properly. If you have an electric hydraulic pump cycle that a few times as well. Have your mechanic check your work and sign it off in the aircraft logbook.

That's all there is to it. If you are going to store your pump for long periods of time, remove it from the airplane. Drain the hydraulic fluid from the pump, rinse the inside of the pump with mineral spirits (pump it through the C1 and C2 outlets as before), spray a little LPS-2 in the reservoir and cap all the openings in the pump, including the vent on the top of the reservoir. Be sure to cap the fittings in the airplane as well. Wrap the pump in an airtight plastic bag and store it in a cool, dry place.

I hope this article helps you with your Electrol Hydraulic PowerPac. Remember, help is just a click away at **www.republicseabee.com!**