Hydraulic Fluid Replacement or More

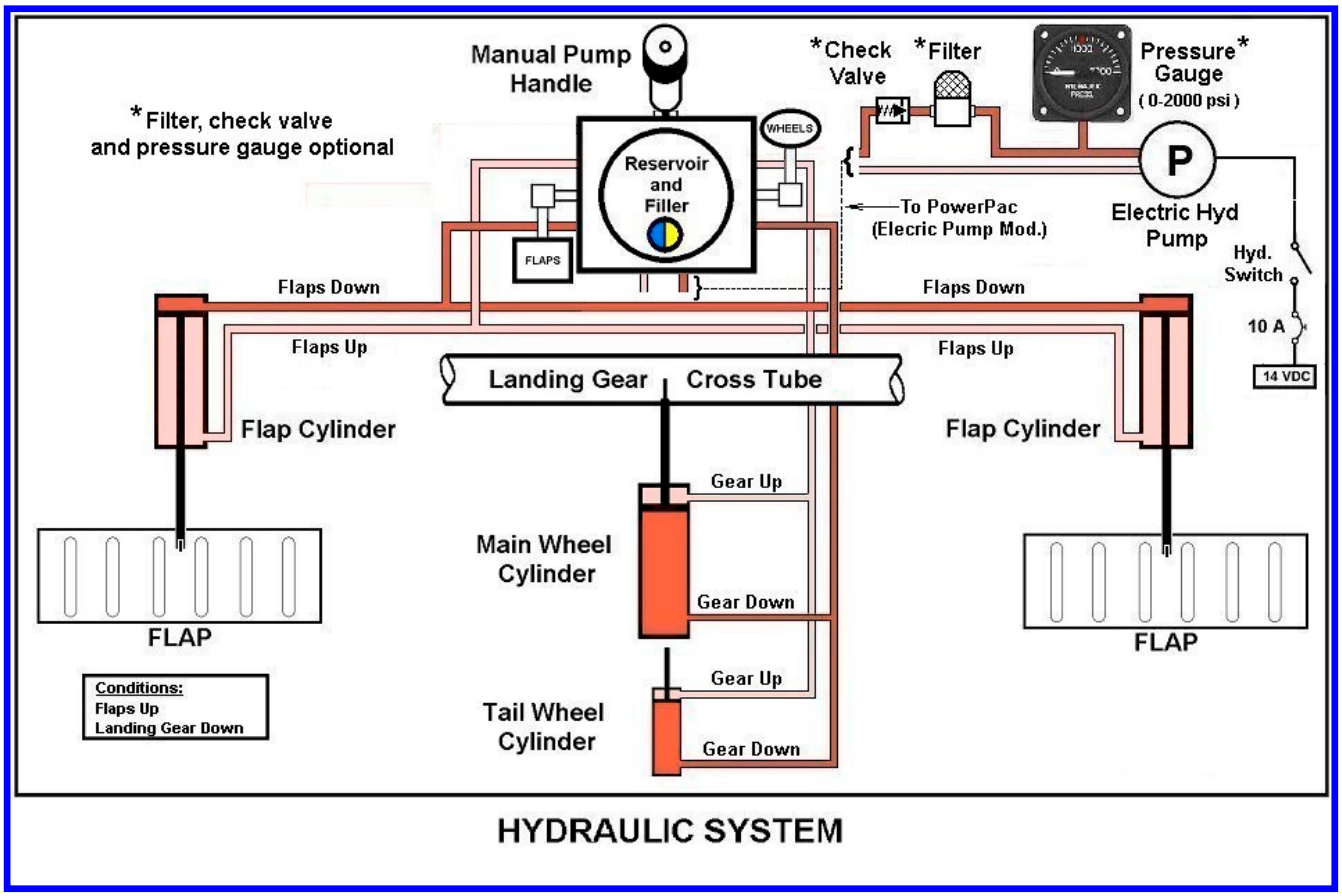
(a 3 part series)

Note: You must have the approval of a certified aircraft mechanic (A&P) to perform this procedure. A logbook entry by your mechanic is required.

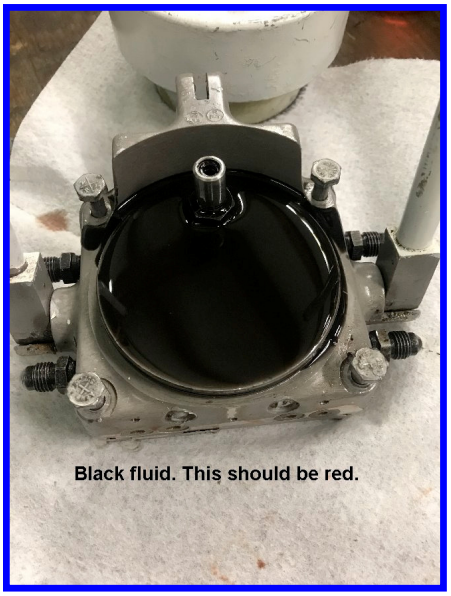
Description:

On more than one occasion the PowerPac (manual hydraulic pump) and actuators have been seen with very dirty hydraulic fluid and residue that could be detrimental to the safe operation of our hydraulic systems. The fluid in at least the reservoir should be changed each annual inspection or 100 hours. There are numerous black Nitrile o-rings in the system that leave their "droppings" in the fluid and components, which may cause blockages in the system. If you have an electric hydraulic pump this problem could cause early failures of the pump due to foreign material scrubbing away at the pump innards. Over time the o-rings are worn and develop a flat edge that compromises the system integrity. Clean hydraulic fluid is a must for good system operation. Hydraulic fluid does last quite awhile but will eventually turn into jelly if fresh fluid is not added occasionally.

This is a 3 part series; Part 1- Annual Inspection Reservoir Fluid Replacement, Part 2 – Total Fluid Replacement, and Part 3 – Changing lines (hoses) and Servicing Actuators

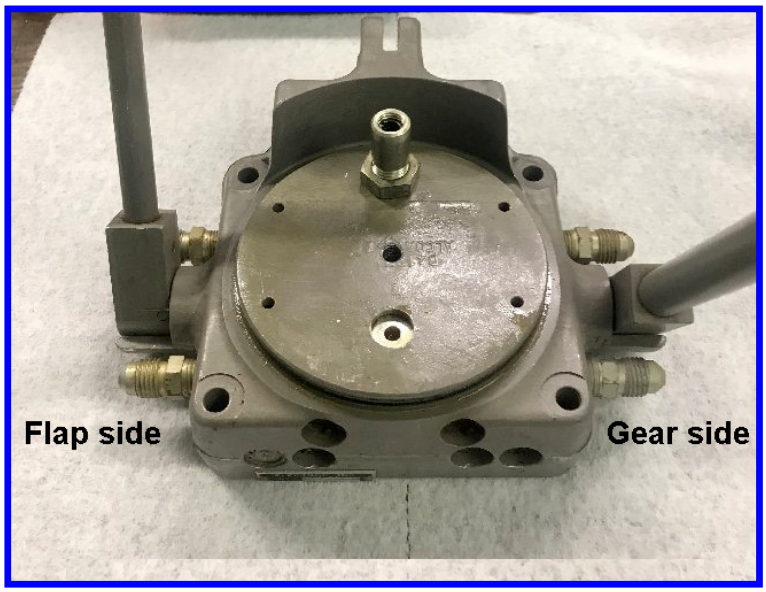


Hydraulic system schematic
(Flap and tail wheel actuators are identical except for rod length and rod end)



Top of newly opened PowerPac

Dirt on the suction screen



PowerPac-Reservoir removed

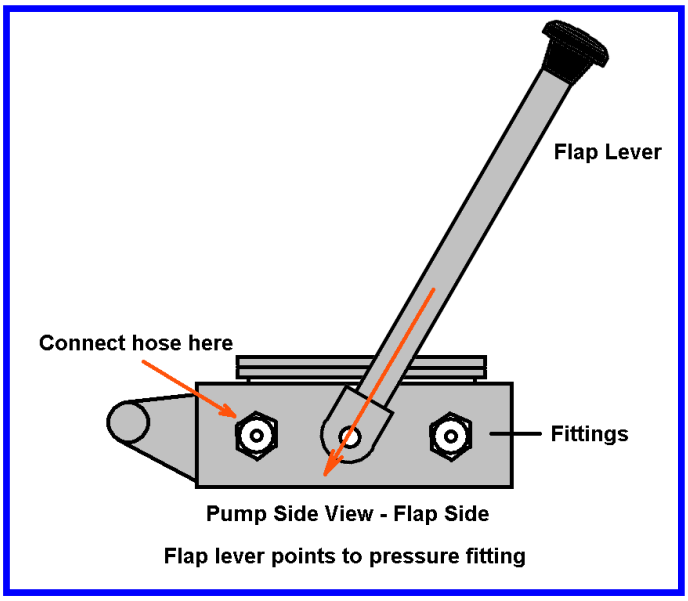
Before anything, ensure the landing gear lever is DOWN. There is no need to place the Seabee on hull stands for these procedures as everything can be done as it sits but do chock the wheels.

NOTE: Now is a really good time to check the integrity of the hoses. They should be flexible with no tendency for cracking when bent slightly. Check for leaking as well especially around the fittings on both ends. If in doubt, change them. Aeroquip™ recommends changing 303 hoses every 10 years. If a total system fluid replacement is necessary, it may be a very good idea to replace the actuator o-rings and check for scoring inside each cylinder. It should be obvious if the cylinders are satisfactory. A smooth surface inside the cylinder is necessary for a tight system. (See procedure Part 3 below) If you're going this deep, It may also be wise to overhaul the PowerPac hydraulic pump if it's been a really long time since this was done. This is covered the separate article. PowerPac Overhaul.

Annual Procedure (Part 1):

Start by removing the hydraulic fluid in the reservoir. There is more than one way to remove it but the least messy way is to make a long hose that fits over the flap outlet fittings (usually a 303–4 hose with the appropriate "B" nut-AN818-4, on the end). See photo below. Place the flap lever in the middle position (neutral) to prevent leakage. Remove one of the lines going to the flap side of the PowerPac and plug it (see Caplugs below) then connect the hose to it. Put the other end of the hose in a bucket strategically placed away from anything important. Move the flap lever so it points to the hose. For example; if you removed the forward line on the flap side of the PowerPac, move the flap lever aft (see drawing below). Now start pumping the PowerPac handle. Fluid will begin to drain into the bucket and eventually air will be heard coming out of the hose. If the color of the fluid is not a bright red further exploration may be necessary (see note below).

303-4 hose for draining the system



Position of flap lever to drain reservoir

The reservoir is now empty but the system lines are not. Put everything back together and refill the reservoir with NEW, clean hydraulic fluid. Never refill with used hydraulic fluid! Throw it away (or recycle it responsibly). This will complete the "Annual" fluid change There is no need to "bleed" the system, as it is self-bleeding and all the components still have fluid in them. When all is well cycle the flaps a few times and that should expel any air. Have a good day!

Total Fluid Replacement Procedure (Part 2)

If during the annual procedure above you find the fluid is real dirty you can continue to purge the lines. With fresh fluid in the reservoir, remove the hoses at each actuator one at time, make sure to plug the actuator to keep it neat, The drain hose and bucket that was used above can be adapted to attach to each line for draining, position the correct lever (flaps or landing gear) and pump the PowerPac handle until fresh fluid is draining from the line. Reconnect the line when you

see fresh red fluid. Repeat the process for each line (4 lines for the flaps and 4 lines for the landing gear). Voila! You're done.

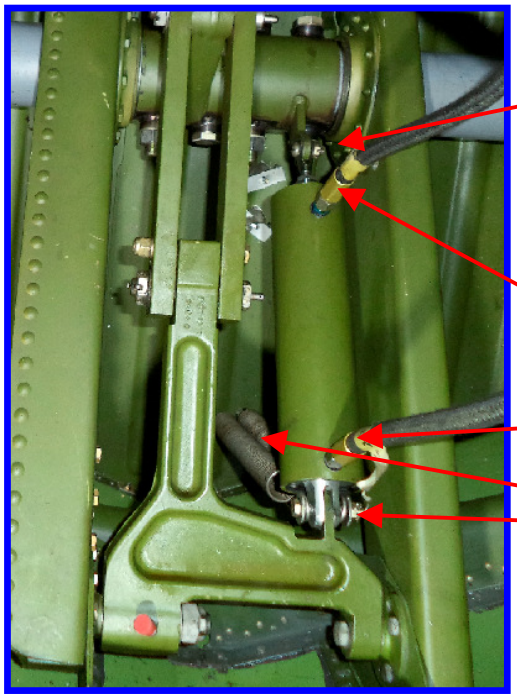
Note: If a total system fluid replacement was necessary it is a very good idea to replace the actuator o-rings and check for scoring inside each cylinder. It should be obvious if the cylinders are satisfactory. A smooth surface inside the cylinder is necessary for a tight system. It would even be wise to overhaul the PowerPac if it's been a really long time since it was done. (See Link P. 2)

Line replacement and Actuator Service (Part 3)

In short, you will be removing the hoses going to each of the eight-actuator fittings (two for each actuator) and capping the actuator fittings and plugging the hose fittings as you go. Two people will make short work of this so have your helper keep the reservoir full of fluid during the purging process. Have the caps and plugs ready to minimize the mess. Keep track of how the hoses are connected to the actuators! Taking pictures before disconnecting anything helps a lot. See drawing below. As you do this procedure, remember that the actuators are going to be full of fluid and must be removed and drained to get ALL the fluid out of the system.

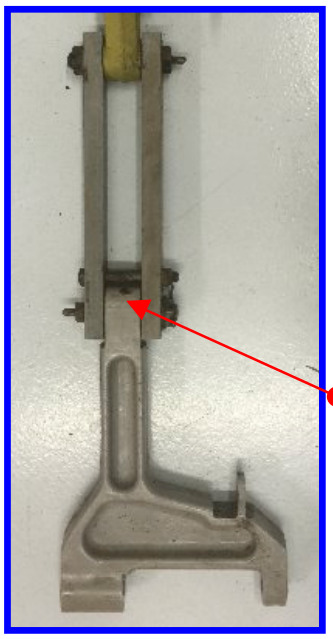
To gain access to the flap actuators, remove the pushrod bolt and let the flap hang down. Put a small droplight in one of the rear spar holes so you can see what you are doing. If the actuator is to be removed, remove the pivot hardware on the forward end of the actuator. Remove the actuator. Take it to the workbench for later scrutiny. Be sure to safety all the hardware when installation is complete.

Access to the main landing gear actuator is from the aft floor panels under the back seat, which will need to be removed. A droplight in the belly will be quite helpful. As a safety measure, tie a rope or clamp the "H" bracket (Part number 1112) so there is no potential for the main gear unlocking (but it won't. See photo). Remove the hoses going to the main gear actuator and plug them off. Cap off the actuator fittings to prevent leakage. Remove the fork end hardware and the lower pivot hardware. The lower pivot has two large, very strong, springs that need to be removed prior to removing the bolt. See photo and drawing below. Remove the actuator and take it to the workbench. Do not adjust the fork end unless there is a problem with the landing gear system!

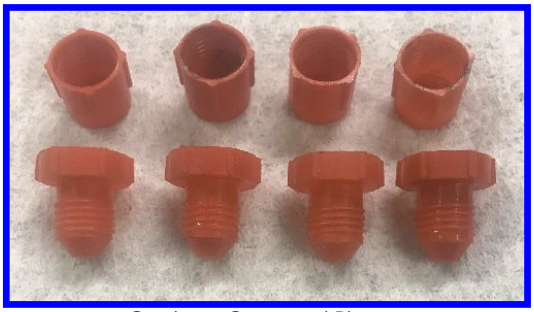


Removing Landing Gear Actuator

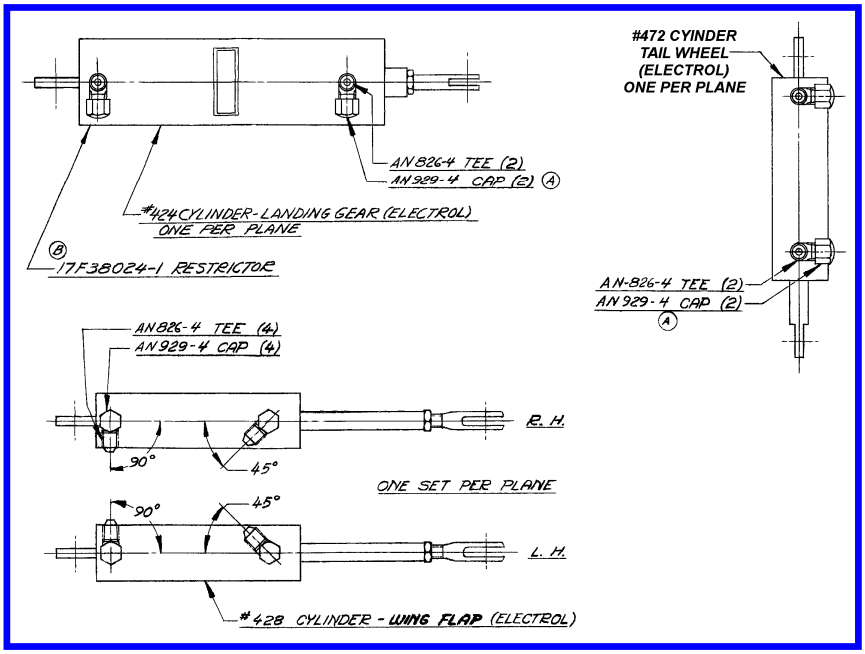
If the actuators are to be removed and the lines drained, make sure to cap or plug the airframe hoses and lines at the actuator. There are cheap plastic "Caplugs™" available that do quite nicely. Four caps and four plugs will be required for each system; flaps and landing gear. With the lines plugged and the actuators capped they can be taken to the workbench and drained one at a time with no danger of system contamination. See photo below.



Locking Landing Gear



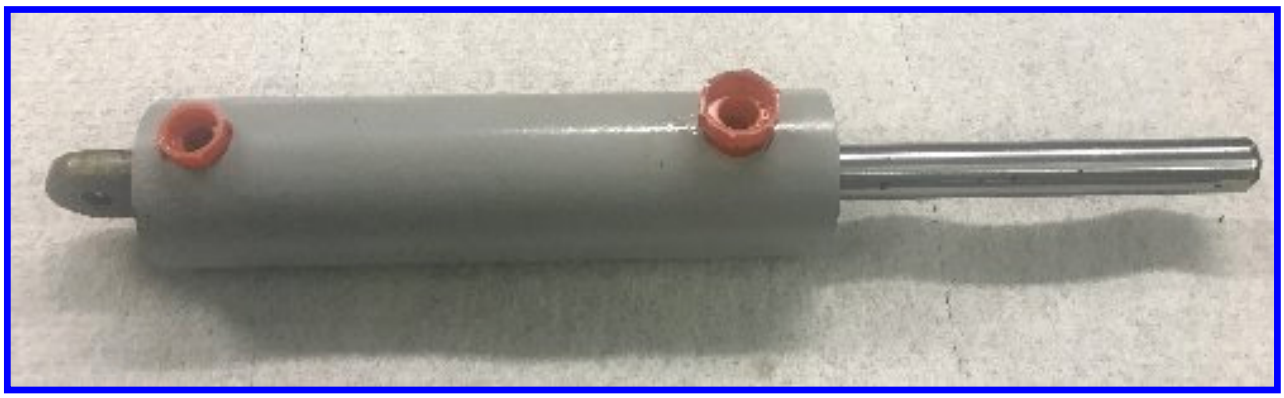
Caplugs, Caps and Plugs



Drawing of actuator fitting placement
Note "T" fittings on each actuator

Actuator maintenance: With the actuators removed, drain the fluid from each one and remove the fittings and circlips on each end of the actuator. Remove end caps and piston. Inspect and clean all parts with mineral spirits and dry completely. Check for scoring in the cylinder and if it's questionable hone the cylinder until smooth and free from contaminants. Clean again with mineral spirits. The cylinders can be painted if desired but don't get paint inside the cylinder.

When the actuator is ready for assembly, make sure you use NEW O-rings and circlips. Circlips have a sharp edge and a semi-round edge. The sharp edge provides a little more bite and is installed facing out.



Flap Actuator

Actuator Aft view
Note circlip

Actuator Forward View

Circlip (Snap ring)

Using a good lubricant like, Parker O-Lube (Vaseline will work), coat the o-rings and cylinder liberally and replace all o-rings in the end caps and piston. There are four in each actuator but there is one that is impossible to replace; it is the piston rod seal. This o-ring is inside the piston against the piston rod and is staked in place. Unless there is a major deformity this o-ring doesn't need to be replaced. Once the piston is in place the end caps can be installed just as the piston was with plenty of lubrication. Install the circlips (snap rings). Fill both ends of the actuator with New, clean hydraulic fluid. Install the AN fittings in the same orientation as they were when they were removed and use a good pipe sealer. Apply the sealer starting on the second thread of the fitting. No sealer should make its way into the cylinder.

When assembly is complete, be sure the flap actuator rod is extended completely and the landing gear actuator rod is retracted completely. This facilitates installation later. Point the fittings as noted on the drawing on page 5. Cap the fittings.

Important Note:
Also, it must be noted to check the bushings on the ends of the actuators. After 75+ years chances are good that there are a few that are worn. Check the mounting hardware for wear. If you can feel anything as you run your fingernail down the grip of the bolt, change it. Inspect the fittings on the actuators for any irregularities. The 37° flare ends should be smooth. There have been leaks from worn fittings.

Parker O-Lube

Thread Sealer for Fittings

PowerPac Removal: If you noticed early on that the PowerPac has to come out, remove it before any draining of the system. Drain the reservoir as noted above. Remove the floor panels covering the PowerPac. Remove the PowerPac handle grip if installed. Remove and plug the four lines (two on each side) on the left and right of the PowerPac. If an electric pump is installed, remove the pressure and suction lines going to the PowerPac and plug and cap the lines. These pressure and suction lines may be a different size than the actuator lines. Remove the 7/16" bolt on the top of the reservoir and pull the reservoir straight up through the control cables. You may need a flat screwdriver to pry up the front edge of the reservoir. Remove the four mounting bolts holding the PowerPac in place. Remove the PowerPac straight up between the control cables. There should be enough flexibility in the cables to remove it. Take it to the workbench.

PowerPac overhaul: There have been PowerPacs with what looked like coffee grounds inside before overhauls (you know that isn't good) and, let's face it, you really don't know what lurks beneath the reservoir. If it's in the reservoir it's in the system!

Due to the complexity and special tool requirements, someone who knows how to do it should overhaul the PowerPac. Contact the Seabee Owners Club for more information.

Conclusion:

It is remarkable that these hydraulic systems have lasted so long and with proper maintenance and fresh NEW fluid every once in a while, they will last a good long time.

Remember:

Fresh NEW fluid (Mil-5606), NEW o-rings, tight fittings, new hoses (if required) and safety all actuator hardware!

O-rings and Circlip part numbers:

Tail Wheel and Flap Actuators

Circlip (Snap Ring) –	McMaster-Carr P/N 99142A500 or HO-125ST PA (2 ea. Per cylinder)
Rod seal –	MS28775-012 (1 ea. Per cylinder)
Cap rod seal –	MS28775-112 (1 ea. Per cylinder)
Piston and Cap seal –	MS28775-214 (3 ea. Per cylinder)

Main Gear Actuator

Circlip (Snap Ring) –	McMaster-Carr P/N 99142A590 (2 ea. Per cylinder)
Rod seal –	MS28775-113 (1 ea. Per cylinder)
Cap rod seal –	MS28775-210 (2 ea. Per cylinder)
Caps –	MS28775-224 (2 ea. Per cylinder)
Piston seal –	MS28775-326 (1 ea. Per cylinder)

Tools Required

Step ladder
Droplight (<4" in diameter)
9/16" and 1/2" open-end wrenches (Angle wrenches work great for PowerPac removal)
7/16", 1/2" and 9/16" socket with 1/4" ratchet handle
3-blade fine hone (if required)
Parts washer (to clean all parts)
Parker O-Lube or equivalent
Straight blade screwdriver
Hose and bucket
Pipe thread sealer (Loctite P/N 567)
A good pair of gloves (for landing gear spring removal and installation)
Hydraulic fluid (Mil-5606) – About one quart required for "Total Replacement" but get a gallon.
Mineral spirits – Parts washer is preferred.

Caplugs or AN caps and plugs:
Plug - *ACS P/N 04-00024, *ACS P/N Cap-04-00033 or AN929-4 (cap), AN806-4 (plug)
(Note: The plugs and caps above may be a different size for the pressure and suction lines on the electric pump)

*ACS = Aircraft Spruce

Company Links

Aircraft Spruce – www.aircraftspruce.com
McMaster-Carr – https://www.mcmaster.com/products/retaining-rings/internal-retaining-rings-6/
Seabee Club – www.republicseabee.com