

Sooooo...your Landing Gear Struts Leak. Let's fix 'em.

(by Steve Mestler and Tim Sutter – January 4, 2011)

NOTE: Before we get started, regardless of position or orientation of the parts being discussed, the "TOP" of the part is the top as it would be in the normal gear down position. For example, "...the top of the knuckle..." is the top as it would look sitting on its landing gear in the hangar. Obviously the "BOTTOM" is the lower side of the part, as it would look sitting on the gear.

**You must have the assistance of a FAA certified mechanic to do this!
A logbook entry is required.**

Also, it cannot be stressed enough to keep your work area and the strut parts clean. Before assembling the struts, clean the inside areas with denatured alcohol or lacquer thinner. Lubricate all o-rings and internal parts liberally with hydraulic fluid as they are assembled. In some cases waterproof grease is used.

If you have noticed a little red hydraulic fluid (5606) under your landing gear struts or around the collar, some or all, of your strut seals (O-Rings) may need replacing. This little article explains the procedure for changing ALL (6 or 7) seals in the strut. You must, however, get the assistance of a qualified FAA certified aircraft mechanic to legally change them and sign off the logbook.

Chances are the leaky seal is on the bottom of the strut. This seal is sometimes difficult to change as some axles have been welded to the strut itself. This was done as an after-Republic modification and if you are lucky, the axles have not been welded to the strut. Don't get me wrong, welding is a good idea because the axles had a way of loosening up after a time and would screw up the ground handling characteristics big time! This was one way to fix it so it wouldn't shift. Another way suggested by Seabee Club member Tim Sutter is to weld a short boss on each side of the strut giving much more support to the axle. This allows for axle removal AND prevents the aforementioned wear and tear. The welded version is not a big problem but makes the lower seal housing a little tricky to remove, as you will see shortly.

First, jack your Seabee up in the normal manner as if to do a retract test which is normally done at each annual. Be sure the airplane is stable and cannot shift, as it will be there for a day or two. If you are really quick and lucky you may be able to do it in a day.

Once "up-in-the-air" depressurize the strut. Do this by depressing the schrader valve located on the top of each strut. Use caution, as there is a lot of pressure in these struts and some hydraulic fluid may come out at the same time. Use a rag to catch the oil. After ALL the pressure is relieved, remove the schrader valve and the Schrader fitting so there is absolutely no danger of "exploding" parts. This also

allows for the replacement of the o-ring or crushable aluminum washer under the Schrader valve fitting. The original Schrader Valve Fitting had a solid aluminum crush washer under it. The o-ring may have been added later.

Next, drain all the hydraulic fluid from the strut by either retracting the gear with a drain pan under each strut or by sucking it out of the strut with a long vinyl (1/4") tube and siphoning it out with a suction gun. Tim Sutter likes to bring the strut to the workbench first and then drains the fluid into a 5-gallon bucket. Whichever way you do it remember, there is approximately 4 pints in each strut so make sure your drain pan is at least that large.

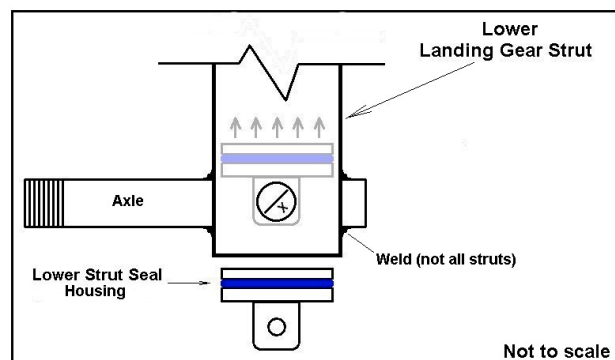
As the struts drain, start removing the cotter pins from the landing gear through-bolt nuts and the scissor link nuts.

Caution: Keep all the scissor bolts and nuts in place until the strut assembly is removed from the airplane.

Before you remove the brake lines from the brake assembly at the wheel end take some pictures of the routing of the brake lines on BOTH sides with your digital camera! After all is said and done and it comes time to replace the brake lines in the correct position you will be glad you did. My memory isn't what it used to be and pictures are a real life saver (I keep a camera in the hangar all the time). I used an appropriately sized AN-4 cap and plug to prevent the brake fluid from oozing out all over the place. This also saves hydraulic fluid and shortens the brake bleeding time. If it's time to change your brake fluid this is a good time to do it. Let the brake fluid drain into a pan and when the struts and wheels are reassembled you can fill the brakes with new fluid from the wheel end up to the brake cylinder. I use a trigger type oilcan with a clear hose attached that is dedicated to hydraulic fluid only.

There are, most likely, clamps holding the brake line in place at the scissor link pivoting locations that need to be removed. Keep the three scissor link pivot bolts in place for now.

Remove the brake assembly and wheel in the normal manner. I find this relatively easy when the gear is in the retracted (up) position. Also while you have it in this position remove the lower axle bolt. Use a brass drift or wooden dowel to remove it. If it has been a while since this bolt has been removed it may take a little "persuasion" to get it out. **DON'T FORCE IT!** These are expensive bolts. If your axles have NOT been welded, you can remove the axle at this time. Again it may take a little effort to remove it. This will allow the lower seal housing (see illustration) to be removed from the bottom of the strut assembly tube after the oleo is removed from the strut.



If, on the other hand, your axles are welded to the strut you must remove the lower seal by tapping (slowly and carefully!) from the BOTTOM of the strut and removing it from the TOP of the strut tube after disassembly. (see illustration above)

Now lower the gear to the "down" position and remove the two large thru-bolts holding the strut assembly to the cross-tube that runs the width of the airplane. Remove the strut by holding it by the lower strut and the knuckle and rotating around the cross-tube it as you pull. It should come off easily as you did remove them for the last annual inspection, right? If difficulty is encountered during removal, you may have to resort to drastic measures; heat, penetrating oil, propane, MEK and/or lacquer thinner. What ever you do though, DO NOT BANG ON THE KNUCKLE! Tap on the cross tube and be patient. Let the penetrating oils and the heat work. It takes time sometimes.

Take the strut assembly to a large, clean workbench or strong table. Keep in mind there may be some residual fluid in the strut so I recommend not doing this on the kitchen or dining room table. It can get messy. While the struts are off, check inside the cross-tube for corrosion. A small wire brush connected to a pole works good inside the cross-tube if the corrosion isn't too bad. If there is major corrosion the cross-tubes need to be removed and thoroughly cleaned and de-corrosioned.

As I mentioned before, keep the work area clean and organized. I use small trays for the small parts and keep everything to the right of the workbench for the right strut and everything to the left for the left strut. This way I don't lose anything and all the parts are with their respective strut.

Remove the three previously un-cotter-pinned nuts and bolts from the scissor link. Put the scissor links aside for now. Remove the safety wire from the two small bolts on the side of the strut holding the bronze collar in place. Once they are removed the collar and all the supported hardware can come out of the strut fairly easily.

Once the scissor links and collar bolts are removed there is nothing holding the strut assembly together so put the strut on the floor vertically and with one foot on the axle (if it's still there) and holding on to the upper strut a few cautious vertical pulls on the knuckle should remove the "guts". You now have the knuckle, oleo, thru-rod and the associated parts dangling from your hand. Put the lower strut/axle tube section aside for a moment.

Put the knuckle assembly on the previously used workbench and remove the cotter pin that is locking the top castle nut on the 3/8" thru-bolt and remove the nut. This is located close to the schrader valve. This allows you to remove the various large spacers and washers from the bottom of the knuckle assembly along with the thru-rod. This rod should have another washer, castle nut and cotter pin on the bottom end. Leave these alone unless they need replacing. No need to make more work for yourself.

KEEP THE PARTS IN THE RIGHT ORDER! Starting from the bottom of the thru-rod you should have this stack of parts:

- A 1/4" thick steel washer with a large hole in it (in addition to the thru-bolt hole)
- A bronze spacer with the inner-flanged end toward the bottom
- A large steel spacer tube
- Upper bronze collar

These must be replaced in the correct order to keep the strut geometry and integrity intact. By the way the other hole in the steel washer acts as a restrictor that slows the extension and retraction of the strut. This prevents it from slamming up and down on those less-than-stellar landings and when the gear extends after takeoff. This is the shock absorber. Very clever.

Remove the oleo from the knuckle. It should come off fairly easily with a long wooden dowel or 2 x 2 wooden stick placed inside the tube and tapped lightly on the inside of the knuckle. Do this over soft padding so as not to damage the knuckle when it lets loose. Don't let it fall to the floor, as these are very expensive to replace! (Tim Sutter says \$1000 a piece!)

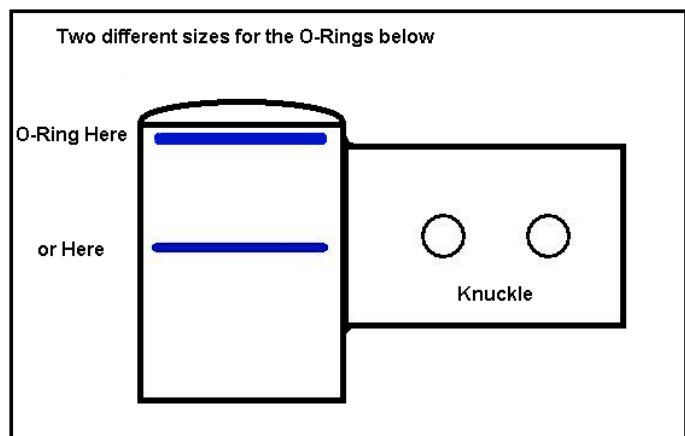
You now have the strut completely disassembled and ready for cleaning, inspection and o-ring replacement.

Clean and inspect all the parts. Check for cracks in the knuckle and strut tube. The scissor link and hardware should be checked for cracks and wear. Replace any bolt or bushing that shows signs of undue wear. If you can run your fingernail down the length of the bolts without noticing a wear ridge, they are most likely okay.

Check inside the knuckle for cracks and corrosion. Repair or replace as necessary.

An o-ring is located at the top inside of the knuckle or in a groove halfway down the inside of the knuckle. These are two different size o-rings and some knuckles do not have the o-ring halfway down the knuckle leg and depend solely on the top o-ring for sealing capabilities (see illustration). I have one of each and they each work flawlessly so don't worry.

Before doing the next step, "dry fit" the oleo into the knuckle and put some masking tape around the oleo as a reference point as to where the oleo should bottom-out in the knuckle when the upper o-ring is in place.



Grab the bronze collar and clean and/or paint it as necessary. Two o-rings are used on this collar. One outside on the LOWER groove (MS28775-232) and one on the inside (MS28775-334). Install the bronze collar with the o-ring installed inside the collar with plenty of waterproof grease around the inside. Push the collar on from the TOP of the oleo strut and push it down about half way. The taper at the top of the oleo allows for a much easier installation of the collar.

NOTE: The upper groove on the outside of the bronze collar is a channel used for holding the two small retaining bolts, you removed earlier. Be sure they are not too long (no more than about 1/4" deep) as this will deform the collar and prevent freedom of movement. The o-ring goes in the lower groove.

After the knuckle is cleaned and/or painted replace the top o-ring (MS28775-230) inside the knuckle and liberally lubricate the inside of the knuckle wall and the mid-groove o-ring (MS28775-231) with waterproof grease. Do not put grease inside the o-ring groove (for the mid-knuckle o-ring) as this will prevent the chrome oleo from getting past it.

Replace the oleo inside the knuckle and be sure it is seated all the way. Once installed a light tapping on the far end of the oleo with a block of wood or a plastic/rubber hammer may be necessary to seat it completely (check the tape you applied earlier for proper position). Take care and be sure the o-ring at the top of the knuckle is seated correctly by looking down the oleo tube to see if there is any sign of the o-ring poking its little head inside the oleo edge. If there is, you have to do it over again. Sorry.

WARNING: Do not try to reuse a deformed o-ring! Throw it away.

Put the knuckle assembly aside for a moment and put the lower strut tube on the workbench and remove the lower seal as follows:

- If your axle is removed, use a long (30") wooden broomstick as a drift and tap the seal out the bottom of the strut.
- If your axle is welded, use the same broom stick handle and lightly tap it so that the seal housing comes out the top of the strut. BE CAREFUL! You will have to tap on one side of the seal then the other to get the seal out without damaging it. GO SLOW!

Inspect, clean and/or paint the lower strut section. Repair any corrosion inside the tube. Simple honing may restore the strut to acceptable condition if minor corrosion is noticed. For major corrosion around the o-ring contact area a replacement strut may be in your future. \$\$\$ Cha-ching! \$\$\$

If your axle is removed as discussed earlier, this honing job is easy. If your axle is welded to the strut, you may have to resort to using a very long hone or crocus cloth and remove the corrosion by hand.

Inspect the lower seal housing and replace the o-ring (MS28775-232) using liberal amounts of hydraulic fluid or waterproof grease around the seal housing and o-ring. Coat the inside of the strut tube with grease as well (Remove the grease after the seal housing is installed).

Carefully replace the lower o-ring seal housing with the aforementioned broom stick making sure it returns to the original position squarely.

NOTE: Some lower o-ring housings are contoured to fit around the axle at the correct angle so make sure the angle cutout in the housing matches the angle of the axle as you install it. See illustration below.

A depression is located on the top of the seal housing and makes the centering of the wooden broomstick easy if you are replacing the seal from the top of the strut. Be sure to clean out the strut once the bottom seal is in place. If you are replacing the seal from the bottom of the strut, a simple wooden block held against the seal and lightly struck with a hammer should do the trick. Be sure there are no sharp edges around the inside of the axle bolt holes on the bottom of the strut tube as this will surely tear the o-ring as it goes by the hole. As the o-ring housing is pushed by the axle holes a Popsicle stick makes a good pusher-downer for the o-ring. In all cases of replacement, **MAKE SURE THE O-RING IS SEATED IN THE STRUT TUBE SQUARELY!** If allowed to pinch against the side of the strut it will leak and a new o-ring may be needed.

Realign the axle bolthole in the lower o-ring housing with a wooden or brass drift and reinstall the axle, bolt, nut, washer and cotter pin. This bolt need not be tightened too much as it is simply a "shear" bolt. It should not be loose however.

Reassemble the upper strut knuckle assembly:

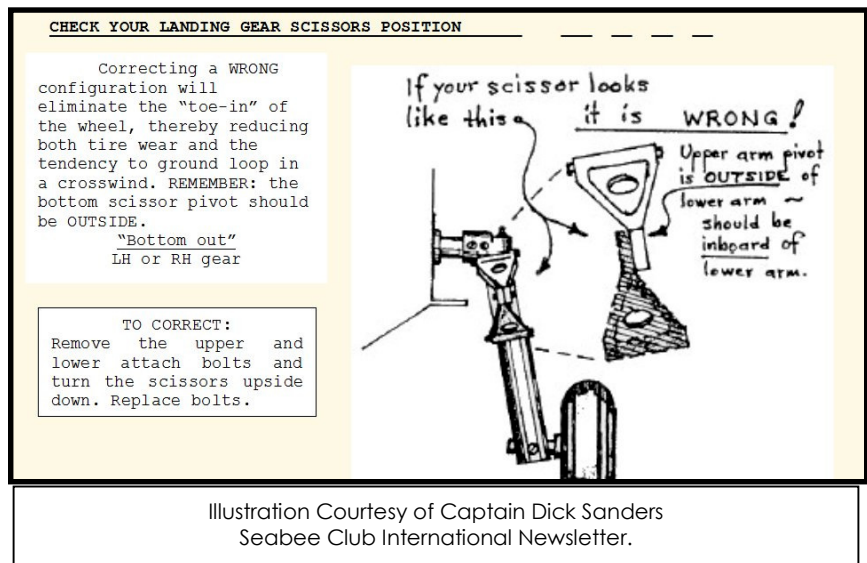
- Lubricate the oleo with 5606 hydraulic fluid or waterproof grease and install the bronze collar from the top of the oleo making sure the inner o-ring doesn't deform against the oleo. Move it about halfway down the chrome oleo.
- With the castle nut, small washer and cotter pin installed on the bottom of the thru-rod, slide the 1/4" thick steel washer down the rod, then put the steel spacer tube over the oleo then put the bronze spacer with the flange down onto the bottom of the oleo.
- Slowly slide the thru-rod through the top of the knuckle. The steel tube and bronze bushing go OVER the oleo. You will notice the bronze bushing has a flange that prevents the oleo from passing through it. This bushing slides over the bottom of the oleo.
- Using a wrench on the bottom castle nut to prevent the upper nut from turning, install an o-ring (MS28775-12), steel washer, castle nut and cotter pin on the top of the knuckle. Make sure the thick (1/4") washer is centered on the thru-rod. The steel washer is slightly smaller than the bronze spacer, which allows it to ride, unencumbered inside the strut tube. If it isn't centered it will rub on the inside of the strut tube where it will "make metal". Torque the top nut to 3/8" specs (95-110 inch-pounds) and then just a little more so the cotter pin can be installed.

NOTE: After strut installation and servicing if you notice leaking around the top nut, try tightening the nut. If the thru-rod turns with the nut a small slot cut into the thru-rod with a Dremel® tool will allow a screwdriver to hold the rod as you tighten the nut.

Install the upper strut assembly into the lower strut tube using plenty of waterproof grease around the collar and use care not to pinch the outer o-ring on the bronze collar when installing it into the lower strut tube. Collar orientation is not critical but if you can get the collar placed in the same position when it came off the strut, this will insure the integrity of the retaining bolts. Be sure the inside tube is clean and use ProSeal or equivalent around the bronze bushing to seal the outer tube to prevent future corrosion. If necessary, tap the collar down (lightly) into the lower strut completely using a wood block or a plastic hammer around the circumference of the collar. Look through the two bolt-holes on the side of the lower strut tube to insure the bolt holes line up with the top groove of the bronze collar.

Install the collar retaining bolts and safety-wire them to each other going around the back of the strut. Be sure the bolts are not too long (just slightly over 1/4"). Long bolts will deform the bronze collar and cause rubbing against the oleo causing binding and premature wear.

Replace the scissors with their respective bolts using plenty of grease when assembling. **REMEMBER, DOWN AND OUT!** The lower scissor link is mounted so that the small pivot lug is toward the outside (see illustration to the right). Don't ask me why.



WARNING: If you have to change the scissors with the strut already serviced, jack the airplane up, remove ALL the air in the strut and then reverse the scissor links. Otherwise severe damage or personal injury could occur. The scissor links are all identical. Switching positions will do no harm. The only exception is that the hinge bolts on some airplanes used are either 5/16" or 3/8".

Do not install the castle nuts on the scissor link permanently at this time as the brake line clamps must be installed first.

Coat the outside of the cross-tube with a liberal amount of grease and spray the inside of the tube with your favorite corrosion proofing substance then replace the strut onto the cross tube and install the large through-bolts, washers and castle nuts with new cotter pins. Don't tighten the bolts too much! Tighten just enough to get the cotter pins installed and that's it. The knuckle is a casting and as such does not "give" with tension at all and may crack if undue stress is applied (see \$1000 price tag above). You may want to wait to finish the cotter pin installation until you leak-check the strut after final servicing (see instructions below). You can also leak check the strut on the workbench before installation. This would prevent you having to take the strut off again if a leak were detected.

Replace the brake assemblies, wheels and brake hose clamps using the photos you took earlier and be sure to use new cotter pins on the scissor link castle nuts. Reattach the brake line(s) and bleed brakes with the aforementioned trigger type hydraulic oilcan to refill the system. In most cases this requires a helper to check the fluid level in the master cylinders unless you have really long arms.

CAUTION: Keep your oilcan filled with hydraulic fluid. Allowing the oilcan to "suck air" will introduce air into the brake lines requiring continued pumping until the air is eliminated.

Make sure the brake line is installed in the scissor link clamps correctly. These are normally installed on the inside of the strut with plenty of slack for gear movement when retraction and strut extension takes place.

Before you let your Seabee down on its wheels, service the struts per the owner's manual if you haven't do so already to prevent the struts from hitting the wing lift struts and retract the gear a couple of times to check for proper clearances and freedom of movement. The brake lines should not kink or rub on any airframe component nor should they slip inside the hose clamps. The clamps should not put undue strain on any part of the brake hose.

Okay, now lower the airplane onto its wheels CAREFULLY and if you haven't done so fill the struts with 5606 hydraulic fluid until they are full. If you are doing this at the workbench, fill the strut with hydraulic fluid when retracted (compressed) to the top of threads of the Schrader valve opening. Reinstall the Schrader valve loosely and "cycle" the oleo up and down a few times then recheck the fluid level. Repeat until the strut is full.

Place an o-ring (MS28775-14) on the bottom of the schrader valve housing and using install an aluminum washer and tighten the assembly into the top of the knuckle. The original Schrader valve housing had just an aluminum crush washer under it without the o-ring. I have used both and they work equally well. Recharge the struts with approximately 150-psi of air (or Nitrogen) if sitting on its gear or 58-psi

if the gear is off the ground. I use Nitrogen to prevent moisture in the strut – it's cheap – about \$12 to fill a small “B” bottle at the welding shop. It lasts quite a while. Strut extension should be about 6-1/2” when on the gear and the airplane is empty or 5-1/2” with full fuel tanks. Use soapy water to check for leaks and tighten fittings and thru-bolts if necessary. Install the remaining cotter pins on the castle nuts if required. Don't forget to check the lower strut seal under the axle. (This is where my leak was.) When all is complete, grease all the strut fittings. I use red grease fitting caps to cover each grease fitting. These keep the water and dirt out of the fittings really well.

NOTE: For specific details on strut servicing, see Republic Service News #3 available at:

<http://republicseabee.com/Service%20News/Seabee%20SN-03.pdf>

or Seabee Owner's Manual page 40-41 for proper strut servicing procedure.

Don't forget to have your mechanic check or do your work and make a logbook entry and sign it off. You are now good-to-go for another 10 years at least! One final note: keep your chrome oleo struts clean! Dirt is the enemy. I have a bottle of hydraulic fluid I keep in the airplane that I use for emergencies AND for cleaning the oleos. The struts will work much better and last longer if they are clean. Good luck and good flying to you!

Part Numbers

MS28775-12 or AN6227B-7

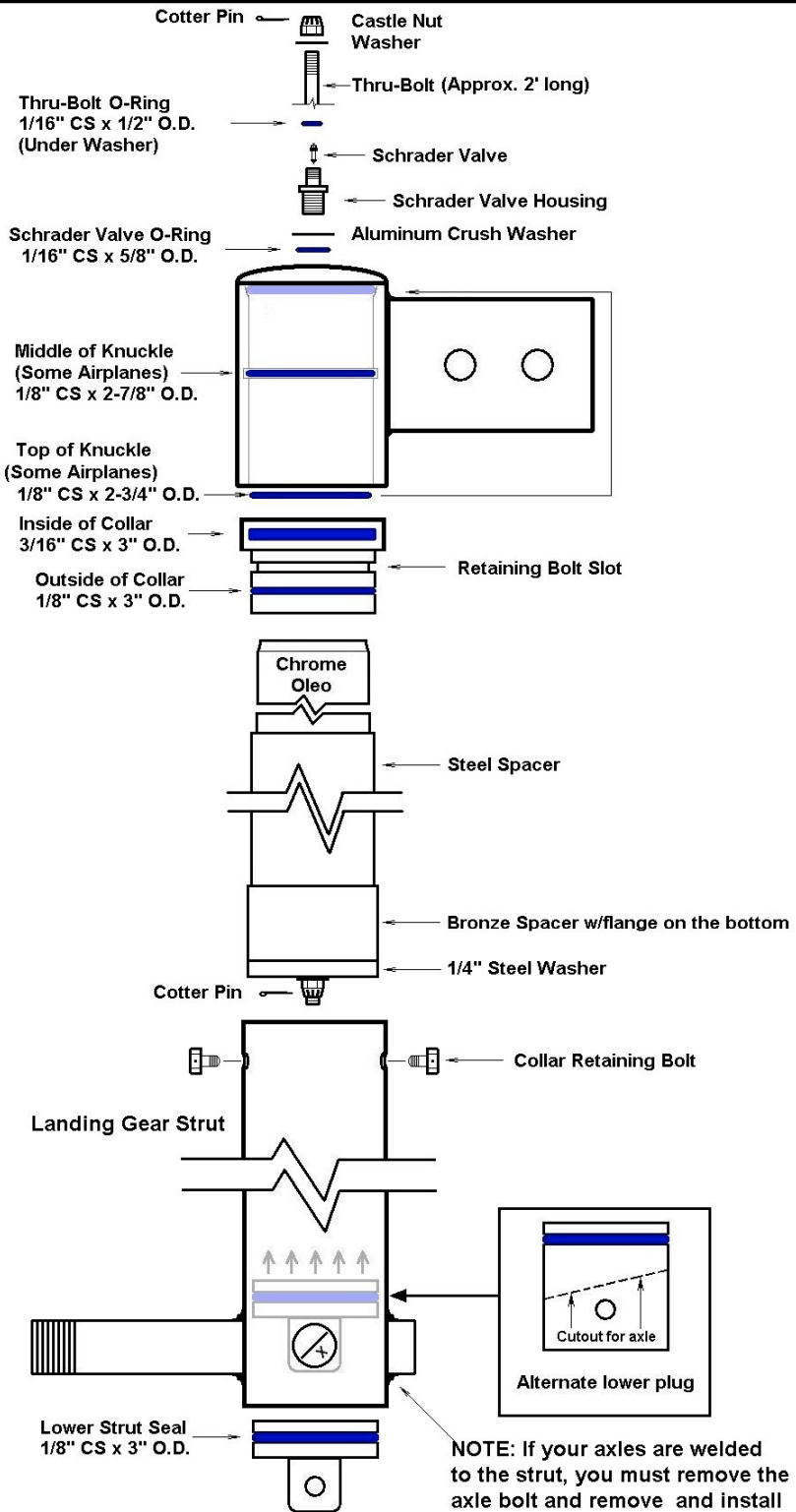
MS28775-14

MS28775-231 or AN6230B-9

MS28775-230 or AN6230B-8

MS28775-334 or AN6227-37

MS28775-232 or AN6230B-10



MS28775-232 or AN6230B-10

Landing Gear Strut O-Ring Detail
(O-Rings hi-lighted in BLUE for clarity)

NOT TO SCALE

NOTE: If your axles are welded to the strut, you must remove the axle bolt and remove and install the lower seal from the TOP of the strut! Use an old broomstick or a wooden dowel as a punch from the bottom of the strut.