

Stinson Shock Strut Overhaul

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Struts Leaking? - It might be time for an overhaul.

Shown above are the overhauled landing gear shock struts on my Stinson 108-3 project. What follows is a compilation of photos and information that should help others who are contemplating the job. As usual, all work should be done in accordance with the regulations of

the jurisdiction where the work is done. In the United States, this means that the owner/pilot can do the work if it is done under the supervision of a certified airframe mechanic who makes the appropriate log book entries. Special thanks to Dennis Crenshaw, who provided many of these photos and details. Dennis points out that a summary of the procedure for overhauling the struts can be found on the International Stinson Club "Knowledge Base CD", available from the [ISC](#). The summary also appeared in the October, 2007 issue of the club newsletter, *Stinson Plane News*. Membership in the ISC is highly recommended for all Stinson owners. Shock absorber maintenance is also covered in the *Stinson General Service Manual*.

Easy Access:



Access to the shock struts is gained by removing the shock tower cover. Remove the seats first, then remove the screws along the front and back of the cover.

Need a Lift?



Before work can begin, the aircraft must be supported while the struts are removed. While I did the my strut overhaul on a bare fuselage, and was able to easily lift and support the fuselage structure on saw horses, Dennis did his overhaul during an annual inspection. He used engine hoists to lift the airframe and fabricated temporary struts while completing the strut overhaul. Two hoists provide stability and distribute the load. Others have used various methods to support the fuselage and remove tension on the struts, including using a come-a-

long between the axles using fabricated fittings.



Mike Greenwood of Greenwood Flying Service, based at Hummell Field (W75) in Topping, Virginia, prefers to use an aircraft jack like the red and blue one shown in the photo above. Mike says that this fits nicely at the landing gear to fuselage attach points, once the fairings have been removed. If you have one or two of these jacks on hand, you might want to try this method.





Braces Recommended - Orthodontist not required.

After removing the struts, use temporary braces while the overhaul work is done. Here, flat steel bar stock is used, 1/4" thick, 1 1/2" wide, and 15" long. 3/8" holes are drilled, spaced 13 5/16" center to center. The dimensions are not that critical - but with these dimensions Dennis found the plane sat in the "normal" stance with the braces in place. Trim ends as needed to clear struts. Two braces are used on each side. With thicker bar stock you could use just one brace on each side. Dennis will loan you his braces for the cost of shipping. He will require a refundable deposit. Email [Dennis](#) if you would like to borrow his.



Need Parts?

With the struts off and the plane secure, you're ready for the strut overhaul. But first, you'll need some parts. The following is a list of the parts used along with current (as of 2007) sources of supply. Dennis gives Bill Beerman (Raleigh, N.C.) credit for tracking all this down. He provided the list of parts and lots of good info from his experience overhauling his shocks.

- The seals can be obtained from McMaster-Carr, www.mcmaster.com.
- The large O-ring, MS28775-331, is listed as part # 9464K54, which is AS568A-331, Viton O-ring.
- If you choose to use a quad seal for the large O-ring, part # 90025K474, which is AS568A-331, Double Seal Buna-N O-ring.
- The small quad seal to seal the piston is listed as part #

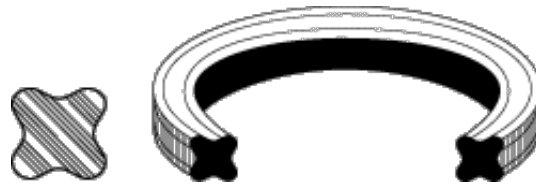
90025K405, which is AS568A-325, Double Seal Buna-N O-ring.

- If you need shims, part # 91117A231, Jumbo Zinc-Plated Steel Thick Flat Washer, 2 1/2" OD, .113" - .137" thick or Part # 91117A234, shims .234" - .267" thick.
- The piston rings are available from Hastings Manufacturing Company, www.hastingsmfg.com , telephone [800-776-1088](tel:800-776-1088). You need to call them to order because their website is not tailored for online ordering. For the later model shock struts used on the 108-3 (and possibly some 108-2 models) three rings per piston are needed, part # 04905; diameter 2.6250, width 0.0240, wall 0.1000. Early struts did not use piston rings.
- Hydraulic fluid. The Service Manual, circa 1948, specifies "petroleum base hydraulic fluid, Specification No. AN-VV-0-366b." MIL-H-5606, now MIL-PRF-5606, replaced O-366 so it is the only known approved hydraulic fluid. Some have reported using an alternate hydraulic fluid, but since it not approved for the Stinson strut, I have deleted that specific reference in this revision of the webpage.

O-Rings or Quad-Rings?

Quad-Ring® Seals, also know as X-rings or quad seals, are four-lipped seals with a specially developed sealing profile that actually provides twice the number of sealing surfaces as an O-ring. The four-lobed design not only provides lower friction than an O-ring, but also, due to its square cross section, it resists spiral twist. Quad-Ring® Seals are vulcanized as a continuous ring. Quad-Ring® Seals are supplied to the American Standard AS-568A and are said by the manufacturer to be

completely interchangeable with O-rings in these sizes. Quad-Rings® Seals are available in all standard O-Ring sizes from 1/32" to 26", as well as custom seals for unique applications. Be certain to discuss with your A&P or IA the use of Quad-Rings in place of traditional O-Rings.



Advantages of Quad-Rings:

- There are two sealing surfaces to give a positive seal with less friction. Due to an improved pressure profile over the Quad-Ring® Seal cross-section, a high sealing effect is achieved.
- The recessed mold parting line provides no flash or parting line on the surface of the seal and ensures "zero leakage." What's more, a lubricant reservoir formed between the sealing lips improves performance at start-up.
- The quad cross-section resists spiral twisting and extrusion. Due to its special profile, the seal does not tend to twist in the groove during reciprocating movement.
- Twice the sealing surface means less radial squeeze is needed to create an effective seal resulting in less friction, less wear and longer service life.





Disassembly:

With the struts off, unscrew the bleeder screw and filler plug and drain as much fluid as possible from the cylinders. Then remove the top plug by cutting the safety wire and extracting the pins that hold the top plug in the cylinder. Early struts had four pins; later struts, as on my 108-3, used six pins. It may be necessary to soak the plugs with penetrating oil. It took a bit of work to get the pins out on my struts, but after the penetrating oil and a bit a twisting, they did come out. Be careful and try not to damage the pins. Pull on the strut/piston assembly to work the piston assembly and aluminum collar out of the cylinder. It would be a smart move to take a piece of safety wire and thread the pins and the bleeder screw together and put them in a safe place. Those little parts are easily misplaced.





Need Chrome?

Remove the three small rings from the end of the piston. Clean and inspect the piston. Make sure the groove for the rings are clean and that the small hole in the bottom of the piston is unobstructed. Examine your strut pistons (shafts) for pitting or corrosion. It may be necessary to have your shafts re-chromed. Dennis took his pistons to a local shop in Richmond Virginia and had them hard chromed to a mirror finish. Note that you need to go to an industrial, not a decorative, chrome shop. Before taking the pistons in, Dennis measured the diameter at between 1.491 - 1.494 inches. He was concerned that they not be chromed oversized and then not fit through the aluminum collars in the top of the cylinders. Dennis

thought maybe he would have to have them turned down and then chromed back to the original diameter. His concern was well founded. Despite assurances from the shop owner that the shafts would be re-chromed to the original diameter, the finished shafts were 1.496", which of course wouldn't fit through the collars. This was easily remedied with a brake hone and the collars were opened up just a bit so that the shafts slid through nicely. The brake hone (available at NAPA) was also used to hone out the cylinders. A medium grit cylinder hone would be better suited for the shock cylinders though as the stones in the brake hone were a little too fine (and small) for the steel cylinders. Dennis didn't see the need to hone the cylinder walls too aggressively as he was just interested in smoothing out the surface. The piston, after all, has a bleed hole in the bottom of it, so its not like you're trying to get a perfect seal between the piston and the cylinder. Since hydraulic fluid has an affinity for moisture, I suggest you flush the cylinder and other parts and spray with a moisture inhibiting oil such as LPS3. When I did my struts, I took my pistons to a shop in York Pennsylvania. There was sufficient pitting that it was necessary to turn the shafts down and re-chrome to bring the struts back up to specs. I took my aluminum collars to the shop and they measured to insure the fit was correct, so I did not need to hone the collar for a good fit as Dennis did. I have heard that the original drawing specifies that the shaft diameter is 1.492", plus or minus 0.0005". One Stinson owner reports that the original shafts (at least my early ones) were not chromed, they were just 1.5" tubing ground to spec. A&P Bruce Junes suggests sending the piston shafts to:

United Plating
Attn: Jackie

4118 N Mingo RD

Tulsa OK 74116

[918-835-4683](tel:918-835-4683)

Bruce reports that United Plating "inspected my pistons in spring 2009, e-mailed me an estimate to grind/plate/grind/polish to original specs. Had them do the work, took 2-3 weeks. They returned them to me with FAA paperwork form 8130 and they were beautiful. Installed in my plane, no leaks, work great."



The Spring Thing:

Examine the springs for integrity then check the length of the springs. Springs should be 6.5" to 6.75" long. If they are slightly different, you can shim with 2.5" OD washers in the cylinder. Place the cylinder, open side up, in a vice or some other type of stand and place the spring in the cylinder. Place the piston on the spring and gently insert the aluminum collar into the cylinder, aligning the pin holes. The collar should be flush with the top of the cylinder. Measure the distance between the top of the collar to the bottom of the bolt hole in the shaft. This distance should be 3", plus or minus 1/8". If your distance is less, shim with the washers as necessary. If your springs are

compressed too much, you can purchase new springs from Univair. Dennis dropped in one thin zinc plated washer (part # 91117A231, 2 1/2" **OD**, **.113" - .137" thick**) in the bottom of each cylinder prior to reassembly. If your gear is substantially splayed (distance between the brake discs should be 72-75" and distance from a level surface to the prop tip should be about 21") or you fly at or near gross weight frequently, then you might want to use the thicker diameter washers (Part # 91117A234, shims .234" - .267" thick). On my Stinson, I actually used *fewer* washers than were originally installed to achieve the correct height. Some owners who like more prop clearance have been generous with the washers. Be aware that this changes the landing gear geometry - narrower tread and increased camber - which may have a negative effect on ground handling characteristics.





Back Together:

Once the height is correct, remove the plug and the piston, fit the large O-ring (or optional quad seal as Dennis used) on the outside groove of the collar and the small quad-seal on the inside groove. Use a little silicone grease. Install the piston rings on the piston (if you have the late style struts). Insert the washers as needed, then insert the piston and spring. Fill the cylinder with hydraulic fluid to a height of 1/2" past the top of the spring. Slide the collar back over the shaft. Turn the collar so the six pin holes align. Put a bit of anti-seize compound on the pins and reinstall, then safety wire the pins in place. Install the filler plug and bleeder screw.



Got Bolts?

With the shock struts reassembled, you are ready to reinstall them in the airframe. One very good reason to do this shock strut overhaul job is to replace the attachment bolts, top and bottom. The top bolts are AN6-14's and the bottoms are AN6-21's. Dennis was surprised to see the wear on the top attachment bolts! Notice the wear on the bolt in the photo. If one of these bolts broke it would ruin your whole day! Be sure to grease the new bolts prior to installation, and tighten to just snug so that the bolts can still be turned with a wrench. Don't forget the cotter pins on the castle nuts.

Always have the shock absorber strut installed in the airplane and have the airplane on the wheels when topping off the struts with fluid. Remove the filler plug first and then remove the bleeder screw. Add hydraulic fluid slowly through the filler plug in the piston until fluid flows out of the bleeder hole.

Don't forget to have the work signed off by the proper authorities and

be sure to follow all procedures as outlined in the Stinson 108 Series General Service Manual.

[Back to the Hangar 9 Aeroworks Main Page](#)