Can You Stop Nose Gear Shimmy?

By Dave McFarlane

"A Cessna nose wheel is supposed to shimmy."

"You can’t really stop it."

"All the Pipers do it."

You have heard similar comments many times. My response is always the same question. "Did it shimmy when it was new?" I would like to share with you our experience in solving this problem.

I will bore you with the routine detail of what to look for and how to fix the mechanical issues that allow shimmy to get started in a minute. First, let's talk about the physics of nose gear shimmy. Years ago and after a lot of frustration by us and our customers and a lot of experimenting, we discovered what was causing our shimmy problems. We observed that uncorrectable nose gear shimmy seemed to only happen on hard surface runways and rarely on turf runways. Our customers reported that they could stop the shimmy by either taking weight off the nose gear with the elevator or applying the brakes putting more weight on the nose gear. It didn’t seem logical that just changing the weight on the nose gear could affect shimmy since the airplane is designed to function with different loading on the nose gear and the weight change does not significantly change the nose gear geometry. We guessed that our customer’s shimmy might have been stopped by the fact that the changing nose weight also changed the tire shape. We assumed that when the tire shape changes so does the contact profile of the tire to the runway. We had already done all of the normal things to perfect the nose gear and shimmy damping system rigging and mechanicals. The customer’s tire seemed fine with no unusual wear patterns that could be detected. We still had shimmy! In frustration, an experiment was done by removing some tread rubber from the tire. It did not seem to be a logical solution, but it worked. The shimmy went away!

There are some interesting dynamics going on during the shimmy action (besides trying to vibrate your airplane apart). When the nose tire is shimmying down the runway it is oscillating from pointing left and then pointing right many times per second while the airplane is going straight. The greater the tire angle diverges from straight ahead, the greater the shimmy inertia and energy. Since the oscillations are equal in divergence angle and time duration, the rubber on your tire is being scuffed in a uniform and distinct pattern that repeats its self each revolution of the tire. This wear pattern shape is directly related to the tire shape created by the amount of weight on the nose tire, the tire pressure, and the speed of the aircraft. The frequency of the shimmy is a derivative of these factors. You might have noticed a braking feel to the airplane when severe shimmying is happening. The braking is from the nose tire skidding sideways during the more extreme angle divergent portion of the shimmy cycle. Since shimmy generally takes place for a short time, the early stages of this wear pattern are microscopic and hard to detect visually or by feeling the tire tread by hand. After the first shimmy, the then created wear pattern tends to start the oscillating action when the airplane speed and nose gear weight matches the speed and weight that the airplane was traveling when the shimmy wear pattern was created. You might have noticed that shimmy starts at about the same landing or taxiing speed each time. The results are that the shimmy gets worse every time it happens even if the mechanical issues that let it start shimmying the first time have been corrected and the shimmy dampener is working and trying to do its job. The shimmy dampener simply is not strong enough to prevent shimmy when a nose tire has an established shimmy wear pattern in the tread. The hidden mystery to this problem is that early shimmy wear patterns in the tire are virtually un-detectable.

"WARNING: Cancer and/or Reproductive Harm - www.P65Warnings.ca.gov"
Continued from previous page

1. The first step in preventing the problem is to look for any un-damped nose gear movement. This is motion of the nose tire without the shimmy dampener moving. Looseness in the nose gear system cannot be detected with the nose wheel off the ground unless the pressure is released from the nose strut. When you move the nose wheel right and then left, the shimmy dampener should also move. If there is any un-damped motion, tighten or replace the worn components such as the torque link bushings and spacers, the steering collar, and shimmy dampener attachments.

2. Remove the shimmy dampener attachments. Check the shimmy dampener for proper fluid and proper operation. Check the dampener for seal condition and excessive wear in the piston and dampener bore. The dampener shaft must have considerable resistance to motion when moved quickly but move easily when moved slowly.

3. Nose gear rigging is important to prevent shimmy. If the steering rods or bungees are biased, damaged, or holding improper tension, shimmy can be started. The aircraft service manuals do a good job of describing proper nose gear rigging procedures. Wheel bearings must be in good condition and properly adjusted.

4. Bad bearings or adjustments can allow un-damped tire movement. Tire balance is also critical for preventing shimmy as an out of balance tire puts cyclic centrifugal loads on the tire tread. Out of round tires will do the same thing. One of the objectives of preventing shimmy is to not have any type of cyclic loads going into the tire system.

Check the tire itself for casing shift or other damage as follows:

- Take the weight off the nose tire for a period of time to let the tire take its proper shape.
- Assure that the tire is inflated to the proper pressure for the aircraft.
- Spin the tire by hand and look for any significant lateral divergence (tire wobble) or vertical divergence (out of round). The tire must rotate true, but a little out of round is normal.
- If tire casing shape problems are detected, let the tire stabilize longer without weight. If that does not correct the problem, the only fix is to replace the tire.
- If the tire casing seems to run out true and the tire is determined to be airworthy in all aspects, remove the shimmy wear pattern in the tire tread.

How do you remove rubber on a good tire to get rid of this mysterious and evil tread wear pattern that nobody can see or feel? We use an electric disc grinder that is used in the weld shop for grinding welds and smoothing structural steel. Any large sanding disk power tool with a course grit disc or a belt sander would also work. There will be some rubber flying around the shop so this is a good job to do outside. Get someone else to do it if you have allergic reactions to latex or rubber products. Block the nose gear off the ground and give the tire time to stabilize its shape without weight. Again assure that the tire has the correct inflation pressure. Touch the grinder to the tire at an angle that rotates the tire and removes rubber. With a little practice you will be able to control the tire rotational speed with small grinder angle adjustments. If you allow the tire to rotate too fast, very little rubber will be removed. If you allow the tire to rotate too slow, it is hard to remove the rubber evenly. Taxi speed tire rotation seems to work best. You can actually remove small "out of round" tire conditions by being steady with the grinder and allowing the grinder to work harder on the tire high spots. The grinder must be worked across the tire tread as evenly as you can. Never grind into the sidewall of the tire. You can feel advanced shimmy wear patterns before you start and they will take more work to remove than the patterns you cannot feel. The tire must feel smooth and even when you are done. Only experience will tell you how much rubber to remove. Be sure that the tire has good tread depth when you are finished, and verify that there is not any inadvertent damage to the tire. Clean up the rubber grindings and high speed taxi test the airplane. You will probably be smiling with the results. It is a good idea to re-balance the tire after grinding the tread and before returning the aircraft to service. If the test does fail, repeat the process. Yes, with a little patience, this shimmy beast can be tamed!

4. Use a belt sander to remove the shimmy wear pattern in the tread.

5. Use wheel balancer P/N TOOL128 for 3/4" diameter axles or P/N TOOL129 for 1", 1¼", and 1½" axles to check tire for proper balance (additional sizes available). See page 263 for additional information.
Keeps exhaust and carbon monoxide out of the cabin
Protects the cabin in case of an engine

Doubler for Cessna Aircraft
McFarlane doubler for 150-152 aircraft
is now FAA-PMA approved.
Cheaper to replace than clean corrosion, prime, and paint the original!

- Doublers are alodined, primed, and painted to save installation time.
- Cheaper to replace than clean corrosion, prime, and paint the original!
- Approved at less than 1/2 the Price!

Keep all steering rod boots are manufactured with a black Kevlar®/fiberglass blend fabric. The fatigue resistance of Kevlar is uniquely mated with the fiberglass. This is a super tough, high temperature fabric that will provide many years of outstanding performance.

- Keeps exhaust and carbon monoxide out of the cabin
- Protects the cabin in case of an engine fire

Save Hundreds $$

New! 182E thru 182T Steering Rod Boot
10 times the life at half the price!
P/N MC0713666-1 for 182E thru 182T
McFarlane has improved the design of both the boot and the retaining flange. The Cessna boot is prone to ripping and tears caused by fatigue and premature infrared heat related material break down. McFarlane has utilized a three ply material design incorporating both Kevlar and fiberglass, and a supple high temperature rubber coating. Kevlar and fiberglass work together to prevent wear, fatigue, and heat failures while offering 15 times the fire resistance of the original boot for extended fire protection at 2,000 degrees F.

- McFarlane has improved the design of both the boot and the retaining flange.
- Cessna original boots are prone to ripping and tears caused by fatigue and premature infrared heat related material break down.
- Fire proof stainless steel flange
- Deeper convoluted design for better flexibility and longer life

Maintenance Tip:
Boot failure occurs from radiant heat off the exhaust system and flexing with the steering system. Cessna original boots are manufactured with a fragile fiberglass base material and peroxide cured silicone that becomes stiff and brittle. This system offers poor resistance to flexing fatigue which causes premature boot failure. The 182 boot must be free from holes and leaks to prevent carbon monoxide from entering the cabin. It is normal for the exhaust system to leak exhaust at the component joints. Leaks in the firewall will allow exhaust and carbon monoxide to enter the cabin.

2,000° Flame Test
New original boot failed in 40 seconds. McFarlane boot still ready for more after 15 minutes!

Nose Wheel Steering Rods offered on page 145!

www.mcfarlaneaviation.com
Nose Wheel Steering Rods for Cessna Aircraft
Tired of ‘soft’ worn out steering rods?
Replace them with improved McFarlane steering rods.

- Redesigned long life springs!
- Stainless steel tubes for improved corrosion resistance (MC0543022 Series)
- Hardened internal washer for greater durability
- Optimum performance even after years of service!

**New!** Steering Bungee P/N MC0760622-1 for 182E thru 182T

**New!** Sprocket P/N MC0760630-1 for 182E thru 182T
Anodized to prevent corrosion and wear

**New!** Rod End P/N MCM3M12 for 182E thru 182T
Direct replacement

### Maintenance Tip:
How do I know if my steering rods need to be replaced?

- Nose wheel steering is unusually sluggish.
- One or both sides offer little or no spring resistance to steering input.
- More than 1 1/8” of free travel is present in either steering rod.
- The aircraft pulls to either side during taxiing.
- Inconsistent steering or rudder rigging.

Nose Baggage Compartment Cargo Door
Up Latch for all Cessna 207 Aircraft
No more holding up the door while loading!
P/N AF1213922-1

- Improved strength
- Nickel plated for corrosion resistance

Manufactured by Airforms, Inc.

High Strength Parts for Helio H-295
Courier Aircraft
Parts are manufactured from high strength material and machined from a single billet - stronger than original welded assemblies!

Axle P/N AF250-040-495

- Cad plated for increased durability
- Precision fit - drop in direct replacement
- Accommodates wheel-ski installation

Manufactured by Airforms, Inc.

Axles for Cessna Aircraft
Don’t lose an airplane because of a broken aluminum axle!

Steer axle
P/N AF1441003-1

- Weighs only 2.28 lbs
- Save hundreds of $$

Titanium axle
P/N AF1441003-1T

- Reduces weight by 2 lbs per A/C vs. steel axles
- Will not rust

Manufactured by Airforms, Inc.

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Items on this page: WARNING: Cancer and/or Reproductive Harm - www.P65Warnings.ca.gov
**Nose Gear Torque Link Repair Kits for Cessna Aircraft**

P/Ns TL-KT-1 thru TL-KT-11
- Includes all commonly replaced torque link parts in a convenient kit
- McFarlane manufactured FAA-PMA approved kits.
- Fits most single engine Cessna aircraft.
- Now with specific model eligibility.
- Prevents Nose Wheel shimmy.

Kits include:

**Brass Nose Gear Torque Link Shim Kit for Cessna Aircraft**

- Eliminates undamped torque link motion to prevent shimmy
- Also available individually in torque link repair kits

**Torque Link Spacers for Cessna Aircraft**

P/N MC0543047-1 and MC0543047-2
- Tightly controlled minimal end chamfer maximizes bearing surface between spacer and fork to ensure a secure clamp and prevent fork wear.
- Precision length

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**NAS1149F0316P Ultra-Thin Washers**

These hard to find 3/16” ID, 0.016” thick standard steel washers are sometimes useful for fine tuning the center “knee” joint fit on most Cessna torque links. Available in packs of 5.

Not included in torque link kits.

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Not included in torque link kits.
Torque Link Stop Lugs and Safety Plate for Cessna Aircraft

This often overlooked but important part is affordable at McFarlane! The torque link stop lug is a sacrificial part that hammers against a flat spot on the lower part of the shock strut outer tube when the strut extends after take off. This prevents the strut from overextending and forces the nose wheel and rudder system into proper alignment for flight.

Due to repeated hammering with every takeoff, these stop lugs must be periodically replaced. Excessive wear can allow overextension of the strut. They also often wear unevenly resulting in inconsistent alignment of the nose wheel in flight which then causes extra drag and yaw. The extra yaw can require increased rudder trim which causes even more drag. So yes, replacing a torque link stop lug can reduce drag!

- Safety plate features bend up tabs to secure stop lug bolts
- Super tough 4130 alloy steel
- Kits include stop lug, safety plate and applicable 3/16" bolts.

Maintenance Tip:
Replace the stop lug if it is no longer flush with the strut, mushroomed, worn rounded, bent away from the torque link, or if it has stress cracks. The safety plate should not be reused.

More Important Than You Think
Overextension of the nose strut due to a worn out stop lug can lead to a cascade of problems. McFarlane A&P mechanics have seen struts over extend to the point where the metering pin comes out of the orifice. This results in loss of dampening action and the pin hammering the orifice every landing and distorting and enlarging it. Over time, the excess nose strut travel and lack of dampening can result in fatigue cracks in the torque link arms. McFarlane recommends thoroughly inspecting all nose strut components when replacing a severely worn stop lug.

Cessna Upper Torque Link Assembly
McFarlane has developed a stronger upper torque link for Cessna 210 Aircraft

- Direct replacement for the original Cessna parts
- Stronger aluminum alloy and heavier flanges.
- More resistant to the bending
- Bent links allow the strut to overextend

Save Thousands $${}$

www.mcfarlaneaviation.com

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## Nose Gear Torque Link Repair Kits for Piper Aircraft

Prevents shimmy by removing looseness in the torque links.

- Replaces all common wear torque link components in a convenient kit
- Fits most Piper aircraft
- Contains all FAA approved parts and standard hardware
- Save time and money! No more research and ordering of individual parts.

### Aircraft Serial Number Main Wheel Kit Nose Wheel Kit

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Eligibility continued on next page
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### Removable Torque Link Bushing (Nose Gear Scissors)

By Dave McFarlane

Removing the flanged bushings from the torque link forging can be difficult as there is not a good surface to press against or grab onto. An easy way to remove them is to thread them with a tap, screw a bolt in the thread you made, and then drive or press against the bolt. The thread does not have to be a full depth thread for the bolt to hold securely in the bushing. The bushing material is somewhat hard, but not so hard that a standard hardware store tap will not do the job. Use cutting oil on the tap to prevent tap damage. Normally the bushing will then come out easily. For stubborn bushings, soak the link assembly in boiling water before pressing the bushing. The heat will expand the aluminum forging more than the steel bushing. This helps loosen the press fit while limiting the temperature to prevent from overheating and harming the heat treat of the aluminum forging. A controlled oven can be substituted for boiling water as a heat source, but do not exceed 350°F. Do not use flame or other non-controlled heat sources. An alternate method is to put dry ice in the bushing before driving or pressing on the bolt you threaded into the bushing. Do not over-press or hammer as the aluminum can gall to the bushing and leave a damaged bushing bore. If the bushing does not come out with light to moderate force take the time to use some heat or cold to help.

### Cessna Brake Line Fairing Extrusion

Reduce Drag!

P/N PS80058

- Paintable
- Easily attaches with super glue
- Replaces P/N S1511-1

White rubber extrusion that attaches to the trailing edge of flat Cessna landing gears and serves as a fairing for the brake line. This extrusion was original equipment on later model aircraft with flat gears. Many mechanics use this as an improvement for the earlier aircraft.

### Wheel Pant Mounting Plates for Cessna Aircraft

P/Ns MCO441225-1, MCO441225-2, MC0541220-1 and MC0541220-2

- Machined from high strength aluminum alloy
- Anodized for corrosion resistance
- Nut plates are riveted in place - ready to install!

**Wheel Pant Mounting Plates**

- 172, 172-70001 thru 172-70050 sold in 5 ft. lengths
- FAA-PMA Approved
- Sold in 5 ft. lengths

**Maintenance Tip:**

Wheel pant mounting plates commonly crack around the axle. If any cracks are present, they should be replaced. The cracks are caused by wheel pant vibration. Assure that the wheel pant axle bolts are tight. Proper wheel balance will lessen wheel pant vibration. See page 263 for a simple but effective wheel balance.
**Landing Gear and Nose Wheel Steering Parts**

**McFarlane’s FAA-PMA Australian Nose Strut Seal Kit Solves the Problem!**

Don’t waste your time with substandard seals, nothing compares!!

- Double edge (“X” style) seal that will not twist and leak!
- Solves the continuous leak and re-service problems with the Cessna nose strut.
- Go years without servicing!

**P/N MCSK172-1F**

- FAA-PMA direct replacement for Cessna P/N SK172-1F.
- Also includes AN901-5A gasket.
- Improved lock rings are made of 304 stainless steel for better corrosion resistance.
- Components also available separately.

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>MCSK172-1F Contains</th>
<th>Qty</th>
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**Note:** P/N NSS-KT-2 doesn’t contain the improved square (“X” style) O-ring. Adding this improved part is pending FAA-PMA approval.

**Maintenance Tip:**
Wipe the chrome strut down with Stoddard solvent (mineral spirits) periodically to soften and remove any dried oil film, dirt, dust and bugs.

---

**Why Does My Cessna Nose Strut Keep Leaking Down?**

By Dave McFarlane

Cessna Nose strut “leak down” has plagued Cessna owners for the last 65 years. Why is it that a month after you reseal the nose strut you find the strut down again or just low and showing signs of a little MIL-5606 on the pretty chrome? It always happens on Sunday when no one is around to help you service it. You service it up the next week only to have it do it again next month. After several strut reseals most people just resign to servicing it often and consider it part of owning a Cessna. Piper and Beech struts do not leak down or need to be resealed often and they are high pressure!

With a strong belief that everything that goes wrong on an airplane has a reason that can be explained by physics, we did some research. It was observed that the low time leaking O-ring that was removed always showed signs of being slightly twisted and otherwise like new. Further experiments and close evaluations proved that the O-ring would twist from friction caused by an oxidized hydraulic fluid film on the chrome strut. You probably have noticed how MIL-5606 hydraulic fluid tends to dry and get sticky after it is exposed to air. Add a little runway dust to the back side of the strut and it really gets sticky. The low operating pressures of the Cessna strut does not put a lot of holding pressure to stabilize the sealing O-ring. It was observed that the sticky film on the chrome strut can grab and adhere to the O-ring during a normal strut action cycle. If the sticky film is not evenly dispersed on the strut, the O-ring is rolled a little on the flimsy side only. This uneven film is not evenly

---

**New Style Seal**

**Old Style Seal**

O-ring allowing a slow unpredictable leak.

It seemed logical that if you lowered the friction on the O-ring surface you could eliminate the problem. A hunt was on for a low friction O-ring that would resist being rolled and would have good durability. After many experiments with Teflon® coated and other specialty O-rings only partial success was achieved. They either were not as durable or the sealing characteristics were not as good as the standard rubber O-ring.

A break finally came at Airventure Oshkosh when Tony Brand of Horsham Aviation Services located in Horsham, Victoria, Australia came by and explained how they solved the problem. They had observed the same twisting of the strut O-ring and went on to explain how they replaced the round O-ring with a square (“X” style) O-ring that can not rotate. The standard backup rings were simply reversed to match the square sides of the new style O-ring. The “X” O-rings have the same material as the standard ones. Brilliant! Why didn’t we think of that!? We rushed home and changed the old O-ring seals in five of the airplanes on the field. One of them was our 152 trainer that takes a lot of abuse. We were going to find out if those innovative Aussies knew what they were talking about. Sure enough, that was almost five years ago and we have never had to service the nose strut (not even with air) on any of the aircraft with the square O-rings! My hat goes off to the boys from Down Under for saving the industry thousands of man hours every year and making the Cessna fleet more reliable! Thank you!

Our FAA-PMA seal kit, P/N MCSK172-1F now includes the square (“X” style) O-ring and instructions for reversing the back up rings.
**Original Cessna Shimmy Dampener Parts**
Save $— Repair your fluid dampener
Don’t buy a disposable rubber dampener. Save money with replacement PMA parts. McFarlane now has affordable repair parts for the original fluid dampener. Save over $400.

- More cost effective than a throwaway unit
- Proven design with up to 5x the dampening power of Lord®

**Improved Shimmy Dampener Shaft**
Save more than 50% — Lasts longer!
- Perfected chrome finish for improved o-ring life and seal
- Durable one piece design — heat treated 4130 steel

**Head Bearings and Piston**
Precision Machined, Direct Replacements

- Simplify your repair process
- Assembled kits make overhaul more efficient
- One part number gives you everything you need

*Maintenance Tip: Measure the diameter of the head bearing to determine the correct piston assembly or repair kit.*

**Piston Assemblies** includes pre-assembled shaft, head bearing, piston, head bearing o-rings, and roll pin.

<table>
<thead>
<tr>
<th>Aircraft</th>
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<th>Part Number/Description</th>
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<td>Head Bearing (13/16&quot; diameter)</td>
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**Seal Kit** P/N SDKT-1
Includes all necessary o-rings and backup rings

**Repair Kit** P/N SDKT-2 (15/16" diameter)
Includes piston assembly, snap ring(s) and housing o-ring.

**Hardware Kit** P/N SDKT-4
Includes all nuts, bolts, washers, cotter keys, and bushings to attach the shimmy damper to the nose strut.

**Seal Kits** P/N SDKT-5 and SDKT-6
Includes all necessary o-rings and backup rings.

**Shimmy Dampener Replacement Parts for Cessna Aircraft**
McFarlane Shimmy Dampener Assembly

Replace the Lord throw away dampener with our fully repairable Shimmy Dampener Assembly!
P/N MCO442512-1 for Cessna 150, 152, 172, 175 and 182 Aircraft

Up to 5x the dampening power of Lord®!!

Direct replacement for part numbers 0442512-1 and 0542119-1
It’s everything the original should have been and more than the rubber units ever could be!!

- Oversize shaft for rigid strength
- Wear resistant hard anodized housing
- Better shimmy dampening
- Totally repairable
- Self lubricating
- Costs less than the throw away rubber dampener

Temperature compensated hydraulics
- Thermally compensated hydraulic action for low maintenance
- Even the first minor movements are dampened
- Consistent dampening action
- No oil leaks

Seal Kit P/N SDKT-7
- Designed specifically to re-seal McFarlane shimmy dampeners
- Contains all required O-rings and back up rings

Shimmy Dampener Assembly P/N MCO442512-1

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WARNING: Cancer and/or Reproductive Harm - www.P65Warnings.ca.gov

Why is a hydraulic shimmy dampener better than a rubber dampener?
By Dave McFarlane

General Discussion: The McFarlane shimmy dampener is designed to drastically outperform the Lord® brand rubber dampener and the original Cessna hydraulic dampeners. All the dampening forces of the McFarlane dampener were found similar to the original vintage Cessna hydraulic dampeners. Improvements have been made to the McFarlane dampener to extend the life, give greater consistency of dampening forces, and reduce the required servicing frequency as compared to the Cessna dampener. Tests were performed and carefully measured on a new McFarlane dampener, a new Cessna hydraulic dampener, and a new Lord rubber dampener. The Cessna hydraulic dampener was found to have similar dampening characteristics as the new McFarlane hydraulic dampener so for simplicity only the McFarlane hydraulic dampener results are shown in the data charts.

Items on this page: ▲ WARNING: Cancer and/or Reproductive Harm - www.P65Warnings.ca.gov

What Does Temperature Compensated Mean?
By Dave McFarlane

When hydraulic oil changes temperature, the volume of the oil also changes. This volume change from a temperature reduction will create a vacuum in the oil chamber of the original Cessna uncompensated shimmy dampener. This vacuum will cause the oil to vaporize giving the oil a foamy expanded mixture that is compressible. The shimmy dampener action is then drastically degraded. An increase in temperature will increase the oil volume causing a drastic pressurization of the dampener oil chamber. This pressure will force small quantities of oil past the dampener shaft seals. The decrease in oil will then aggravate any temperature reduction with increased chamber vacuum and related oil vaporization. This process explains why continuous servicing of the original shimmy dampener is required.

The temperature compensation system works by having a small chamber of oil that is spring pressurized through a very small passage into the main dampening restrictive orifice of the shimmy dampener. The spring loaded oil chamber can adjust for oil volume changes as temperature changes. A similar system is built into your car shock absorbers. The temperature compensated hydraulic system requires very little service over extended periods of time and assures stable shimmy dampening action.

Continued on next page
Why is a hydraulic shimmy dampener better than a rubber dampener?

Continued from previous page

What Would the Ideal Dampener Do? The best possible dampener would move easily with no resistance to motion at slow speeds for quick and easy control of the nose wheel while steering the aircraft and the dampener would have tremendous resistance to motion when moved at high speeds during shimmy. The aircraft steering system uses spring pressure to turn the nose wheel. If the dampener is hard to move while steering, the steering input of the pilot is absorbed by the steering springs and no steering occurs. The result is that the nose wheel does not respond or responds slowly and more erratically to pilot input. The less force required to move the dampener at slow speeds the better steering control the pilot has. Nose wheel shimmy creates high speed movement of the dampener. Shimmy is prevented or stopped by high dampener resistance to motion. The higher the force required to move the dampener at shimmy speeds the better the dampener will stop shimmy. It is desirable to have the dampener forces increase as the speed of the shimmy cycle increases. The ideal dampener would also have heavy dampening forces for a large portion of the shimmy travel cycle. Good shimmy dampening characteristics would be a combination of strong dampening forces and a long motion cycle for the dampening forces.

How Does a Hydraulic Resistance Dampener Work? In general, the hydraulic shimmy dampener design depends on oil flow through a controlled orifice (several small holes in the piston or clearance between the piston and cylinder wall or both). Since the orifice or clearance is a fixed size there is more resistance to the oil flow the faster the damper is moved. The oil path is designed to be large enough that when the oil is moving slowly while steering it can flow easily through the allowed space from one side of the piston to the other. When the oil is moving fast, the oil path is too small to let higher volume of oil through quickly. The faster the shimmy dampener moves the more resistance there is to oil flow. As the dampener action becomes faster, the dampening forces increase. Since dampening forces are related to the speed of the oil flowing through the orifice, there is high dampening forces for all of its travel cycle except when it is changing directions. Restricted flow hydraulics makes the perfect shimmy dampener system.

How Does a Lord® Rubber Dampener Work? The Lord® rubber dampener depends on the friction of the rubber piston against the cylinder wall. Rubber by nature requires a lot more force to start it to move (static friction) than the force required when it is in motion (dynamic friction). By characteristic of rubber sliding on metal, there is little difference in the friction forces when a rubber piston is moved slowly in the cylinder or if it move fast in the cylinder. The friction can actually decrease with the speed of the rubber piston. The Lord® rubber piston is designed where the rubber expands during the change of direction adding more friction that gives it its dampening action. The problem is that as the rubber piston moves back and forth there is increased friction only at the direction change position which is a very small part of the motion cycle. The friction forces during the rest of the shimmy motion cycle is close to the low slow motion (steering) friction forces. The change of direction is only a short part of the travel cycle. With the Lord® damper, there is a diminishing gain of the dampening action as the speed increases. See Figures 1 and 2.

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How Does the Service Life Compare? The service life of the different dampeners was tested by cycle testing a new vintage Cessna hydraulic dampener, a new McFarlane dampener and a new Lord® damper. The Cessna hydraulic dampener failed at approximately 17,000 cycles with the O rings leaking and with significant wear in the head bearing. The McFarlane damper went over 300,000 cycles without a failure. The Cessna hydraulic dampener wears out the head bearing area and that allows the piston to shift out of position resulting in scratches and grooves in the cylinder wall and piston. The Cessna hydraulic dampener is repairable but generally comes up a little short of new performance after rebuild due to the cylinder wall scratches and groves that remain. The new McFarlane damper is designed with an o-ring seal between the piston and cylinder. The o-ring and a heavier head bearing along with hard anodizing prevents significant wear in the head bearing. The McFarlane damper did not fail during the 300,000 cycle test.

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What Do the Charts Tell Us?

You can see from the test data charts, Figure 3, that the rubber damper is going to make the airplane steer harder and be less responsive to pilot inputs. The Figure 1 charts show that at 20 in/sec of motion (a very slow shimmy), the McFarlane damper has twice the dampening power of the Lord® rubber damper and at 30 in/sec the McFarlane damper has 5 times the dampening power. In conclusion, the McFarlane damper allows more responsive steering and a much stronger dampening action to stop shimmy.
Main and Nose Strut Seal and Repair Kits for Piper Aircraft

Precise eligibility for PA-22 thru PA-46 aircraft

McFarlane developed main and nose strut seal and repair kits that are now model and serial number specific giving you only the parts required, saving you time and money. All components are industry standard meeting the applicable MIL-SPEC or original Piper parts.

- Save money!
- Each kit contains exactly the parts required for the job
- Other kits are missing important parts

PSS seal kits contain rubber and plastic parts.
PSR repair kits contain the required PSS seal kit and commonly needed metal parts.

<table>
<thead>
<tr>
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<th>Serial Number</th>
<th>Main Strut Seal Kit Qty per Aircraft</th>
<th>Main Strut Repair Kit Qty per Aircraft</th>
<th>Nose Strut Seal Kit Qty per Aircraft</th>
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<td>PA-31T2</td>
<td>31T-8166001 thru 31T-8166001</td>
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<td>PSS-KT-11</td>
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<td>PSR-KT-7</td>
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</table>

Eligibility continued on the next page

1 Use only when bearing has O-ring groove on ID
2 Use only when bearing has T-seal and backup ring

Items on this page: WARNING: Cancer and/or Reproductive Harm - www.P65Warnings.ca.gov

183
www.mcfarlaneaviation.com

Original Piper parts.
# Landing Gear and Nose Wheel Steering Parts

## Main and Nose Strut Seal Kit for Beechcraft Aircraft

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Main P/N</th>
<th>Nose P/N</th>
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<tbody>
<tr>
<td>PA-39</td>
<td>MS20253-2-2050</td>
<td>JMBZMS</td>
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<td>PA-42-1000</td>
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<td>PA-44-180</td>
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<td>PA-44-310P</td>
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<td>PA-46-350F (w/o G1000)</td>
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<td>MS20253-2-2050</td>
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</table>

### Main Gear Door Hinge Pin for Cessna Citation 550 and 560 Aircraft

P/N MS20253-2-2050
- Corrosion resistant
- Two required per aircraft
- Direct replacement

### Nose Torque Link Assemblies

- Improved to reduce wear and prevent cracks
- Approved for all 208 and 208B aircraft
- Hard aluminum surface to reduce wear
- Precision fit - drop in direct replacement
- Designed to prevent cracking in threaded grease fitting holes
- Ready for installation
- Durable powder coating finish

### Nose Gear Spring Fork Needle Bearing for Caravan Aircraft

P/N MS24462-5
- Fits all Cessna 208 models
- 2 required per aircraft
- Save 30%

### Nose Gear Shock Strut Bearing Cups and Cones for Caravan Aircraft

Bearing Cup
P/N L217813
Bearing Cone
P/N L217849
- Fits all Cessna 208 models
- 2 required per aircraft

---

**WARNING:** Cancer and/or Reproductive Harm - www.P65Warnings.ca.gov
Landing Gear and Nose Wheel Steering Parts

Tail Wheel Fork Bearing for Cessna Aircraft
Bearing Cup
P/N 08231
Bearing Cone
P/N 08118
Direct replacement for Cessna
P/N 0742400-12

Main Gear Scraper Ring
P/N MS28776M2-18
Fits Piper Models
PA-28-140,150,151,160,161,
PA-28-180,181,235,236,201T,
PA-32, PA-32-260,300,301,301T

Main Gear Quad Ring
P/N CA484-769
Fits Piper Models
PA-28-140,150,151,160,161,
PA-28-180,181,235,236,201T,
PA-32, PA-32-260,300,301,301T

Nose Gear Quad Ring
P/N CA484-770
Fits Piper Models
PA-28-140,150,151,160,161,
PA-28-180,181,235,236,201T,
PA-32-260,300,301,301T

Manufactured by PMA Products, Inc.

Cessna Caravan Torque Link Repair STC
Minimal downtime repair to keep 208/208B nose gears shimmy-free
This STC will dramatically reduce nose gear swaps

- Save over $15K and be flying the same-day
- Reduce downtime by repairing in the field
- Convenient tool kit allows for on-airplane repair
- EASA approved

Eligible model series:
Fits all Cessna 208/208B with "double lug" torque links. Includes all S/N's after 2080133/208B0098 or earlier S/N's equipped with SK208-51.

<table>
<thead>
<tr>
<th>Model</th>
<th>Qty per Aircraft</th>
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<tr>
<td>F150K, F150K</td>
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<td>180, 180A, B, C, D, E</td>
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<td>180F</td>
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<td>180G, H, J, K</td>
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<td>A185F</td>
<td>2 - A/R</td>
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<tr>
<td>A190, 195A, B</td>
<td>A/R</td>
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</table>

Manufactured by F. Atlee Dodge

Landing Gear Box Shims
P/N AD0441023-2 .100” tapered shim
P/N AD0441023-160 .160” tapered shim
P/N AD0741022-1 .040” shim
P/N AD0741022-2 .050” shim

- For Cessna aircraft using leaf spring landing gear
- 4130N steel, plated
- FAA-PMA

Save $$

| P/N AD0441023-2       | .100” tapered Shim |
| P/N AD0441023-160     | .160” tapered Shim |
| P/N AD0741022-1       | .040” Shim         |
| P/N AD0741022-2       | .050” Shim         |

Tool kits contain:
Specialty reamers for each joint

Main Gear Scraper Ring
P/N MS28776M2-18
Fits Piper Models
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PA-28-180,181,235,236,201T,
PA-32, PA-32-260,300,301,301T

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PA-28-180,181,235,236,201T,
PA-32-260,300,301,301T

Manufactured by PMA Products, Inc.

Tap handle
Short and long piloted reamers and tap handle

Tap handle
Short piloted reamer
Long piloted reamer

Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
Figure 6
Figure 7
Figure 8

Landing Gear Box Shims
P/N AD0441023-2 .100” tapered Shim
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