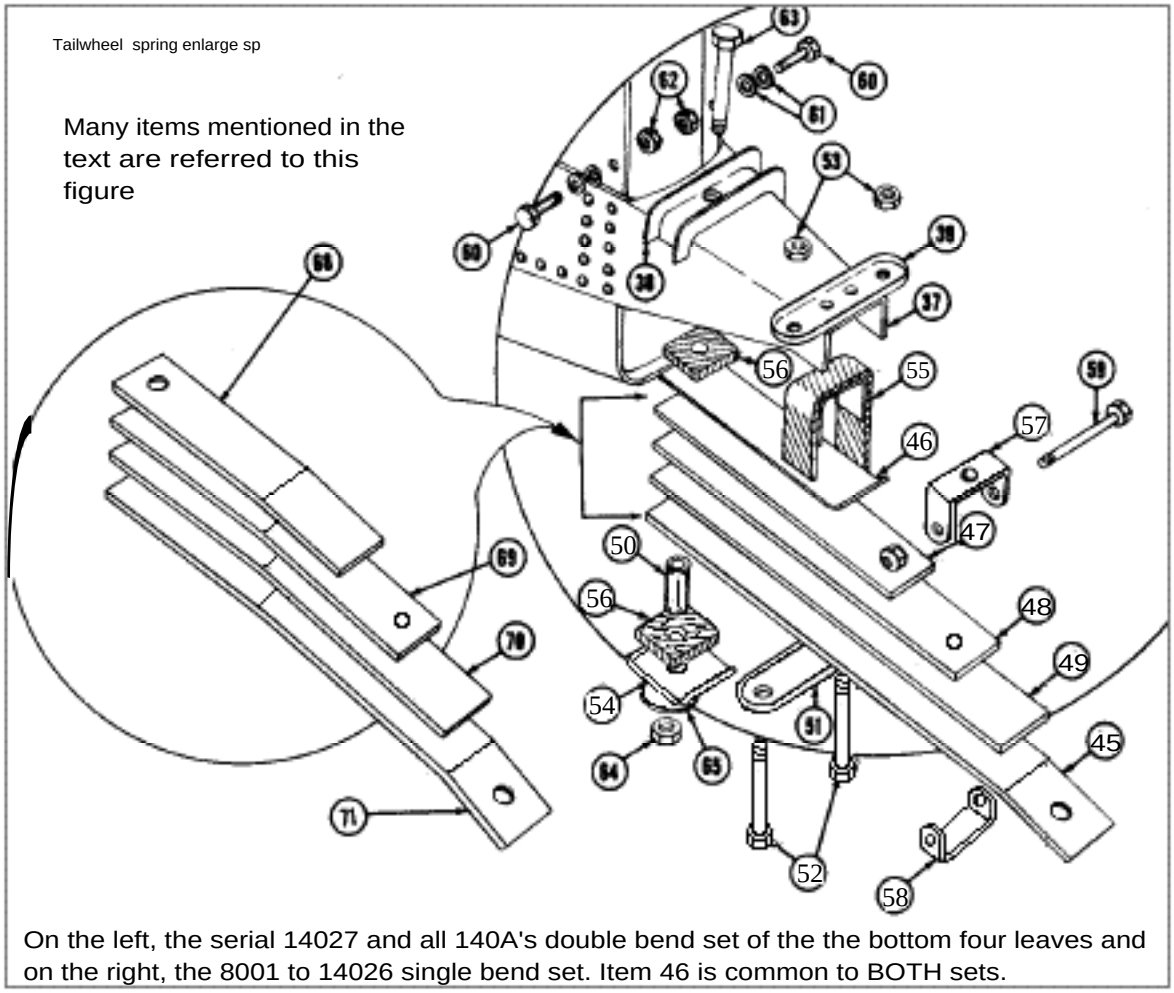
CESSNA 120/140/140A TAILWHEEL
Spring Set Details, Mysteries and Secrets

History and Mysteries and Corrections:

There are a lot of mysteries in our planes and one of them is....what prompted the change from the single bend to the double bend tailwheel spring set? The shift to the double bend alters the angles of the king pin centerline on the tailwheel and that can affect the effort for the wheel to break and its tendency to shimmy and can affect taxiing stability. The single bend set is serially coded for the 8001 to 14026 planes and the double bend set for the subsequent serials and the 140A's. Usually, a serial-coded change is done to accommodate some other serial-coded change but finding the companion change to the tailwheel support assembly of the empennage has proved impossible so far.

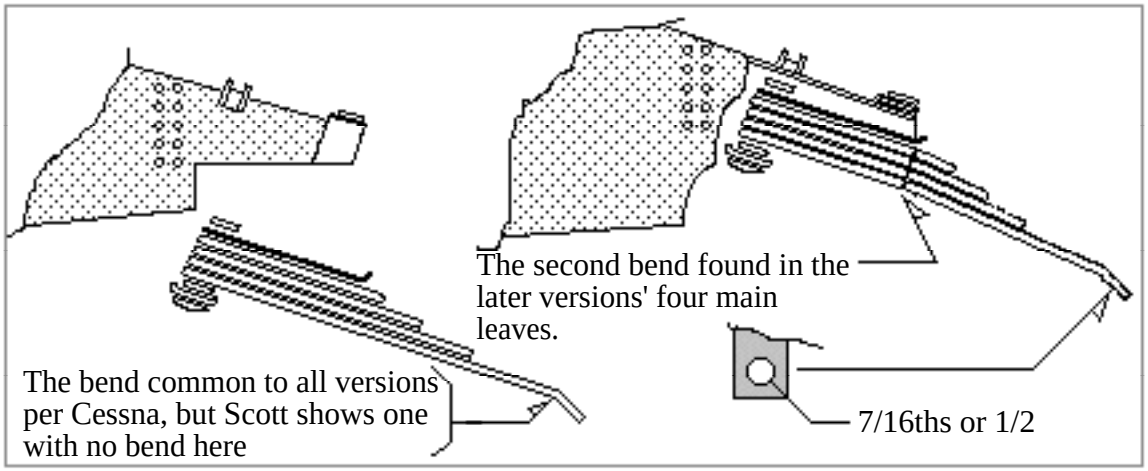


On the left, the serial 14027 and all 140A's double bend set of the the bottom four leaves and on the right, the 8001 to 14026 single bend set. Item 46 is common to BOTH sets.

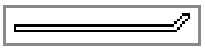
The Scott 3-24B tailwheel (single yoke, hard rubber tire, now the Scott 2000) assembly is called out for all the 120/140/140A's, with the note in the 120/140 catalog that the effectivity for its adoption is 11843 for the 120. It can't be both ways but several other things don't make sense in the Cessna Parts Catalog. The eight inch pneumatic tired, double yoke Scott 3200 model is an option on the 140A's. You could order the plane with the 3-24B Scott or the Maule tailwheel and you could select to not have the tailwheel steerable. Many planes have been changed from the 3-24B Scott to the Scott 3200. That means you might have any of the three models on your tail or other third party tailwheels.

Above is the figure from my Cessna Parts Manual for the 120/140; note that the new stack has two bends but the older setup has only the one bend near the end of the main leaf. In the next figure, I represent the two present choices with the four lower leaves having a bend a few inches back from the main front attach

point and the lower leaf on the later units has a second bend near the rear end of the leaf. The figure by Scott for the 120/140 adaptation of their model 3200 tailwheel to the 120/140 planes only shows the single bend at the end of the main leaf. Confusing? Yes. Some main (the bottom, longest) leaves that we have inspected have been re-bent to better match the need of the Scott 3200 air-tire tailwheel assembly so even the single and double bend combinations are not enough to explain all that can be found on the planes. This leads up to: what you have on the plane may not be what the Cessna book shows, and maybe you should take a look at what you have. Besides, the fabric/rubberoid/Neoprene cushions, items 55 and 56, deserve a look-see every ten years or so anyway.



There are two possible spring sets available today, the one on the left called the "single bend" and the one on the right called the "double bend". The 140 planes up to serial 14026 were built with the single bend set, the later with the double bend set, including all of the 140A's, but many planes have other than they should have by serial because of modifications or repairs and no hint in the log books. Some may have 170 sets as recommended by some of our members, without any consideration of the additional stresses this puts on the tail bracket or what the final angle of the kingpin of the gear is. To determine, see the dimensions paragraph for the relative thicknesses.

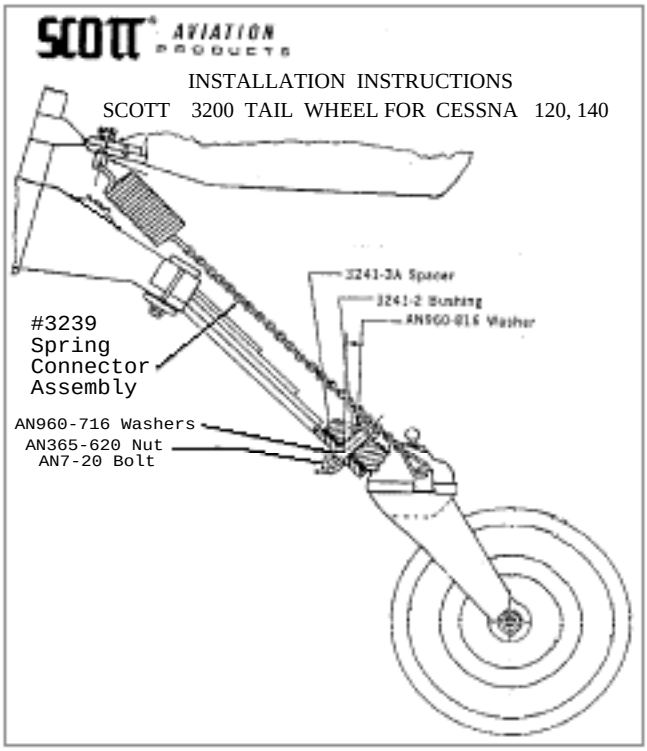
Note that there are "FIVE" leaves called out in the parts manual for both sets.  This side view of the top leaf, item 46, with the turned up nose shows it is much thinner than the other leaves and is not really serving as a spring but its lip serves as a retainer for the part noted as "Assy Strap -- Tailwheel Spring Abrasion" (item 55). Aircraft manufacturers use unique parts callouts, and the one that confuses many is illustrated with this item 46. There are two views to the spring sets in the parts manual, one with five leaves and the other, an inset figure, with only four. However, in the parts list, the four thick, working leaves have different effectivities as denoted by the serial number batches noted in the parts descriptions. The top, fifth leaf is called out for <u>both</u> sets, because it is <u>not</u> serial coded.

Cessna changed the drawing and issued a Service Letter to show the two bolts (item 52) holding the middle clamp to be "upside down", opposite aviation practice, to prevent the steering spring chains from catching on the bolts. It is dismaying to observe the resistance of owners and A&X's to the installation of the bolts "upside down" because their training was to always install bolts head up so that, even if the nut falls off, 'maybe' the bolt will stay in position and do its job. Oddly, the next tenet is that, regardless of a rule, if the print says do it a certain way, do it that way; the designers and builders knew the rule, too, and needed to go against it in certain instances. Insisting on a "rule" can cause grief.

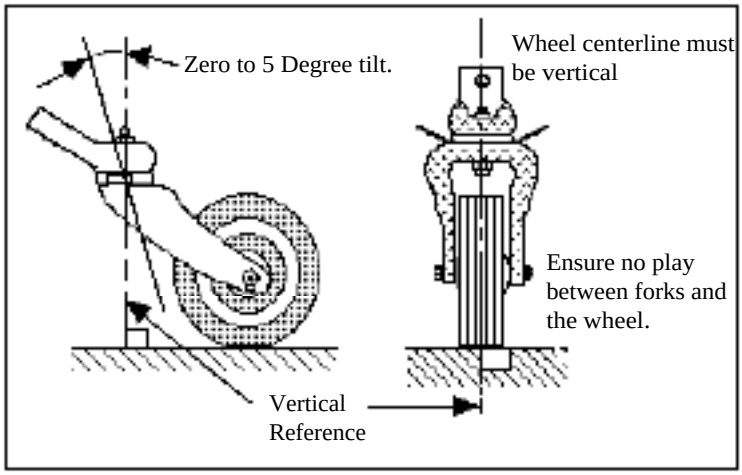
Item 58 has caused confusion; some planes have it, some have one upside down, but most of the planes lack it. It should be added, even if local manufacture. The item 58 "guard" is for the purpose of preventing the chain from catching on the , but they snuck it in without noting when and why. However, in the 140A parts manual, they are specific and note that it is a "guard, tailwheel steering chain" which verifies our deduction about it. (In the 140A manual, the item number is 81.) It is here shown correctly installed. Keep the bolt as short as possible.

The three versions we have seen , with the bends noted.

Of the several planes' tailwheel spring sets we have worked on in the last few months, not one has been anywhere near "correct" and of four, three should have had the single bend set but had the double bend set instead, and the fourth had a set from a 170 (and none of the owners were aware of the shortcomings except none had the easy swiveling of the 3200 they should have had). Emails from others of the site reveal that they find "odd" things as well, and I included one thorough description of a finding at the end of this report.



The early Scott I-168 installation drawing for the Scott 3200 (air tire assy, above) on the 120/140's shows a zero bend spring set. The '46 140 we replaced the whole set with had the main leaf like this picture, no rear bend, but it and the other three leaves have the front bend just like on a double bend set. Confused yet? Note that the Scott figure might be correct for the early planes with the front bend and not rear bend. I have not come across a like figure for the Scott 3-24 hard rubber tire unit (now the Scott 2000) for the earlier planes. Truth? Use what works for the tilt. Note that Scott shows the steering springs at the top and the chains lower? I am going to suggest later that that arrangement be reversed because the big springs for the Scott 3200 unit beat on the bottom sides of the rudder, deforming the metal.



Tilt and Tension:

From Scott Engineering, this 0 to 5 degrees "positive" tilt range is their recommendation for the tilt allowance; some owners have had to have their main leaf annealed, re-bent, and re-hardened to achieve this requirement. A tilt which exceeds this range in either direction is to be avoided to prevent shimmy and instability. An excessive forward tilt also means that "breaking" the wheel from the 45°-0°-45° range is very difficult because not only are you trying to get the wheel to swivel, the excess forward tilt means you are forcing the tail to rise as it rotates further toward the front, so pivoting the plane may not be possible because the wheel won't swivel.

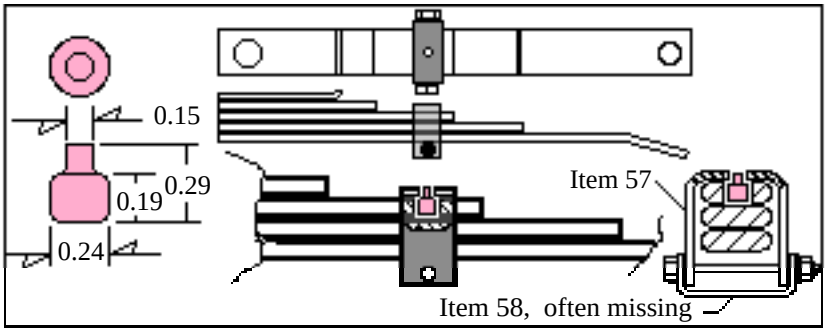
One of the most critical alignments is for the king post of the tailwheel to be as Scott indicates. Changes that affect it never seem to include consideration that the changes can alter this angle. Consider: 1) extenders or not, 2) swung forward main gear struts on the newer planes which emulate the extenders, 3) changing to the Scott 3200 air tire tailwheel, 4) changing the main spring, or set, from single bend to double bend or vice versa, and 5) changing from 600-6 main tires to the bigger, taller, "bush" type tires. None of the documentation discloses whether the addition or removal of the main wheel extenders or the newer swept-forward main gear can change this angle so measure what you have. Note that the change of the main gear fore or aft with the modifications is not just a matter of the angle of the second bend of the main spring, but of the much greater weight on the tailwheel caused by the cg shift; when the tailwheel load changes, so does the "rest" angle of the tailwheel. One of the Cessna140.com site inputs was from an owner who had made a tailwheel spring change without considering the effect on the angle and was begging for assistance as to why he could not make the wheel "break"....you can't if the angle is wrong, and tail wheels not considered when you make one of the changes might suddenly go from a non-shimmying type to a terrifying shimmying type!

Scott, in its I-168 bulletin for the 3200, cautions that there is not to be any tension in the coil springs (3239 set of the springs, chains, and connectors) and chains but they fail to note: "when the tailwheel is on the ground!". There is a tremendous movement of the wheel vertically as the main spring is unloaded with the tailwheel off the ground; zero chain/spring tension when on the ground means quite a bit of tension when the plane is in the air so more than zero tension when on the ground makes the in-air tension that much greater. If the tension is not symmetrical when flying, the stronger side will turn the tailwheel into an unwanted second rudder. The hard-tired Scott 3-24B (now the model 2000 which uses the 2134 spring set per the I-115 bulletin) is to have 25 to 30 pounds of tension in the spring/chain by cutting off enough chain links to stretch the springs one inch.

Caveat:

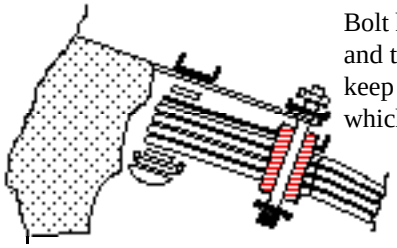
As always in these articles, this alert: make sure you discuss the features and intentions with your A&E and A&I before you buy parts or make any changes without their supervision.

Bits and Pieces:

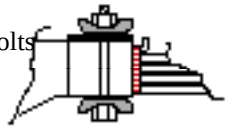


The anti-slide retainer above with the dimensions listed is another of those oddities; it is not called out in the parts catalogs for the 120/140's or the 140A's nor is it shown in them. These details are missing from the Cessna figures and the two holes in the 140A rendition are sized opposite of reality with the big hole in the saddle clamp and the little hole in the spring. The reason the dimensions (steel is the material) are here is that you might have to make one if yours is missing. It is very difficult to order a part that is not shown on and not noted in the Cessna parts manual! Items 57 and 58 make the three captive leaves share the load and this small part prevents the clamp from sliding off. Its dimensions are such that there is a little slop between this stop device and the hole in which it sits and the hole in the item 57 bracket.

Lately, one owner related that his mechanic insisted the stop device (which was like this one, correct) was broken and made the owner change it to a screw and nut, with the screw head made to fit in the hole in the third from the bottom leaf. On another set we took apart for study, the stop had been replaced with an aluminum rivet, lightly peened in the item 57 bracket hole (and severely bent from stress and shear where its shank fit in the hole in the leaf) and in another, item 57 was welded to the middle leaf. Thanks to member Ray Hunter, who bought new items 57 and 58 from Univair, we know the dimensions of the two parts (see a later section) AND, the mystery of the little anti-slide piece is solved. It is not quite stamped out of and comes with the new leaf; Ray suggests that, after a few landings, the item would float in the hole to appear as we have seen them.

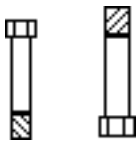


Bolt heads are to be down per a Cessna Service Letter and the Parts Manual figures; this positioning is to keep the chain from catching on the threads of the bolts which extend beyond the nuts.



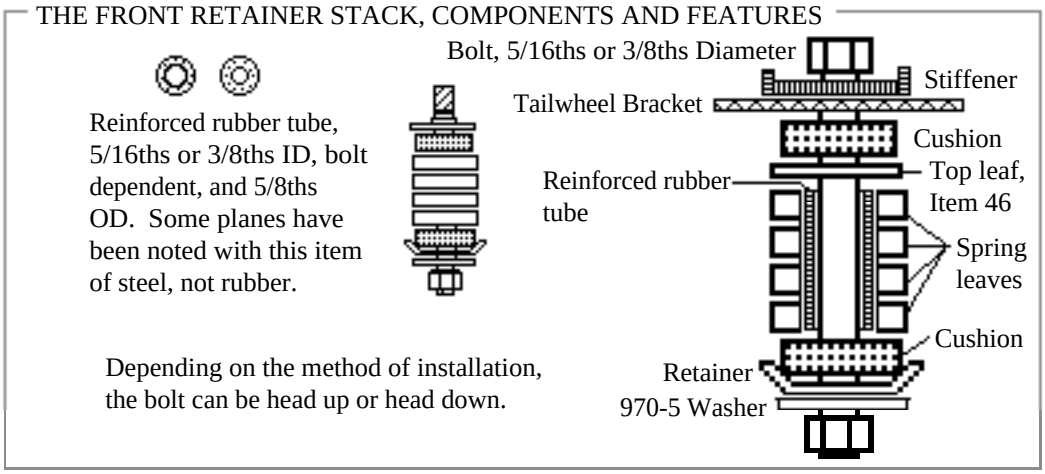
Note, too, the proper installation of the top, fifth leaf which serves with its lip to keep the Abrasion part in position.

Front to rear movement of the spring set is prevented by the main front bolt (5/16ths on some, changed to 3/8ths diameter on others), and the side to side movement of the spring set is reduced by the rear bracket which nests in the tail assembly as shown in these sketches. Note that the lip of the topmost "spring" leaf is doing its job with the lip up by preventing rearward movement of the abrasion assembly. The 120/140 plane parts lists call for the 5/16ths bolt, but the 140A uses the 3/8ths bolt. Some 5/16ths bolts have broken but no broken 3/8ths size have been reported.

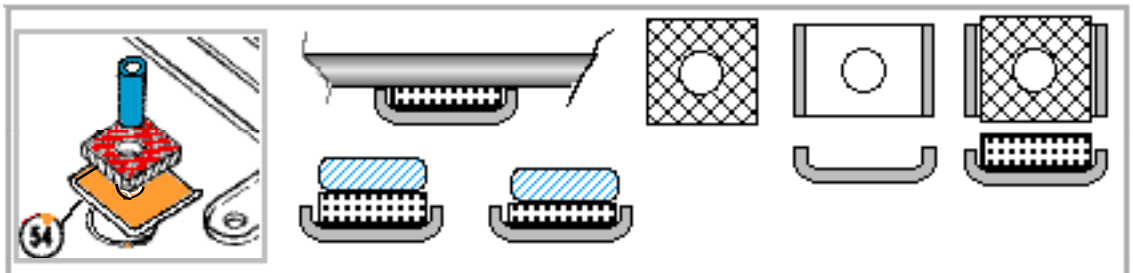


Bolt, 5/16ths or 3/8ths and different lengths. Initially, the bolts were heads up but many have been inverted to avoid having to remove the rudder assy when replacing the tailwheel springs. If nut up, the length must be carefully controlled so as to maintain clearance from the rudder!!!

The Front Attachment Stack:



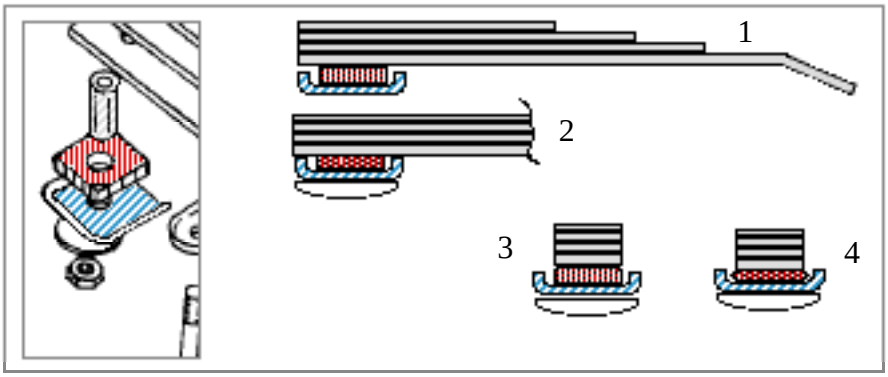
If the parts are correctly stacked, there is a significant takeup of the bolt so make sure, if you use the head down bolt, that the final position of the bolt end does not interfere with the rudder movement.



Neoprene cushions 1/4 inch thick and 1-1/2 on a side are used on the top and bottom of the assembly, with a center hole to fit the bolt size used. In the Cessna parts manuals, the bottom cushion retainer, the U-shaped item in the parts manual figure as item 54, is rotated 90 degrees from the way it should be installed. If installed as shown in the manual, the "lips" of item 54 would strike the bottom main leaf, negating any cushioning from the rubber. The correct orientation of item 54 to the bottom leaf shows how the lips would straddle the bottom leaf, allowing the Neoprene to cushion as intended.

tailwheel U shaped item

Although shown and explained above, this next figure of the front bolt parts stackup at the bottom accentuates the Cessna drafting errors. The red-striped part is the Neoprene cushion and the blue-striped item is the steel U-shaped retainer. On the left, as Cessna shows it. Note figure 1; if installed as the Cessna figure indicates, the orientation from the side would be as shown here, 90 degrees from the position it should have. In 2, the Neoprene would be compressed only until the two arms of the U-shaped retainer strike the main leaf and then would stop, thereby preventing any cushioning from the Neoprene. Figure 3 shows the correct installation and figure 4 shows that with this positioning, the Neoprene can cushion as it should.

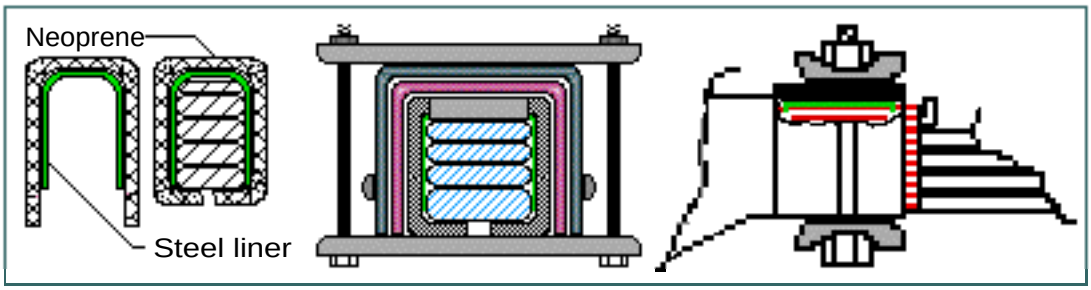


The "Abrasion" part Details:

The side to side movement of the spring set is both restrained by and its forces cushioned by this item 55 assembly, made up of an upside down "U" metal part which is glued to 3/16ths thick Neoprene material. The assembly in the manual is incorrectly rendered and has confused in the past, so the next figure is really how it looks. The red upside down U is 0.04 thick steel, with dimensions to be a close fit to the spring stack, and the Neoprene "tails" are bent under during the final assembly and do not usually meet at the center, just as shown here.

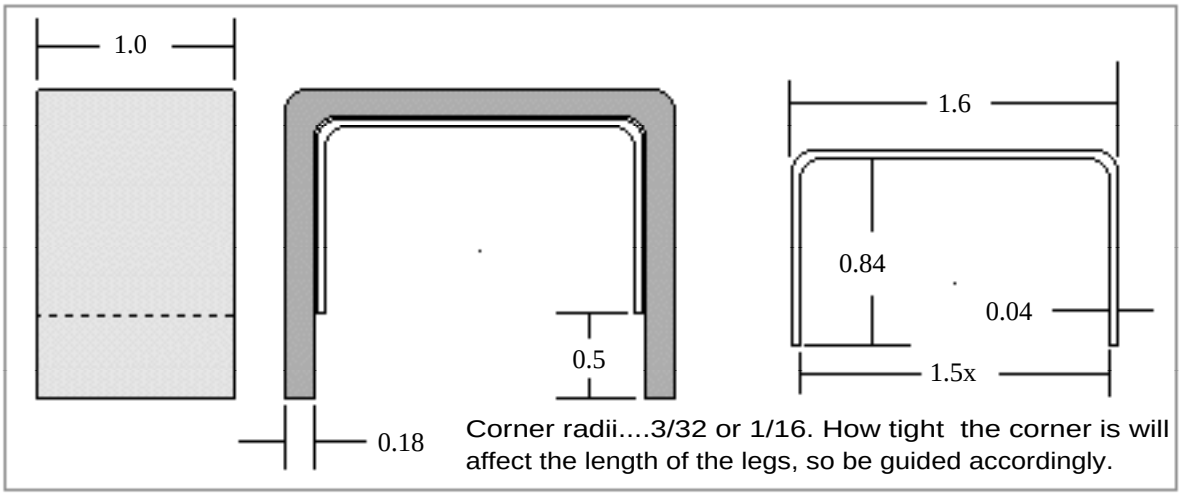
The lip on the top leaf of the spring set is abutted by the metal upside down U (shown on the next page) to prevent this "abrasion" assembly from moving to the rear, allowing the leaves to swing side to side. Univair is the only catalog that carries a mention of the "Assy Strip --- Tailwheel Spring Abrasion" part but they show no figure for it, so details of the actual part are only on Cessna prints. The dimensions listed in this report were taken from the PMA-ed part from Univair (a later sketch shows how it was mis-made) and you will find that sketch and dimensions at the end of this article. Note the special comment about some tail assemblies being different, and so check that yours is as shown in those figures before trying to use a part of the wrong size.

Inside the "Assy Strip --- Tailwheel Spring Abrasion" is a layer of metal which serves to help retain the cushion during assembly and to serve as a pressure spreader when the leaves swing to a side.



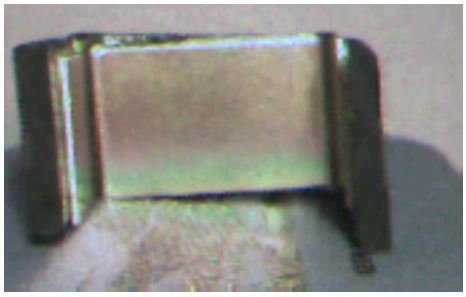
The legs of the steel liner should extend to just below the horizontal centerline of the bottom leaf. The Neoprene on the Univair part is 3/16ths thick and extends about half an inch beyond the legs of the steel liner but does not close the gap when the Neoprene is bent under at the bottom.

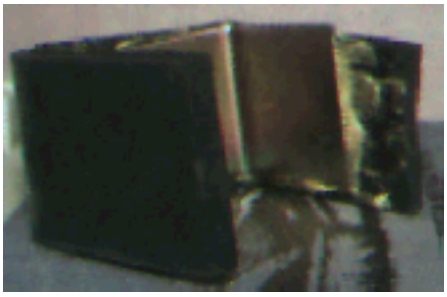
The Neoprene of the Univair part was secured to the steel liner with contact cement. If you want a good one, make your own and do use the cement but let it dry to the touch before mating; if you don't attach the rubber to the metal part, the rubber will squiggle (technical term) away.



The measurements noted in the diagram are from the part I purchased from Univair, assertedly made from Cessna prints. I left this full size so a printed copy could be used as a guide. The "x" in the 1.5x dimension is a bit more than 1.55....make the dimension to fit easily over your 1.5 inch wide leaves and the paint they have on them. Measure the thickness of your stack and vary the dims such as the 0.84 accordingly so that the end of the steel comes just below the centerline of the bottom leaf.

This next figure is the part as-received from Univair...it took 11 days to get here after being told that it was in stock and then this clobbered job. The Neoprene was attached to the metal U with contact cement, but they failed to let the contact cement dry per instructions so it slipped as shown when the big rubber band was put on it to hold it in place. Their QC apparently never compared part to print.





On some planes, there was a doubler added to the tail bracket assembly and it could affect whether the abrasion part fits or you will have to make a new one.

Dave Sbur sent a note and picture of a part he found at the auto parts store. One inch wide, plenty long and 3/16ths thick Neoprene.

Notes:

The forward bolt was originally installed with its head up, as per aircraft practice. To remove it means taking off the rudder; some have found it expedient to cut the bolt head off and re-assemble bolt head down in order to avoid rudder removal. After removal, many change the bolt size to 3/8ths and alter the mating parts accordingly; the hole sizes in the cushions, bottom cushion retainer, washer and the rubber tube all must change. Several recent failures of the front bolt were described and the authors end their tales with the

recommendation that the bolt be changed to the 3/8ths size for the added strength. If installing the bolt head down, the correct length of bolt must be carefully chosen and proven; it has to be long enough to go through the nut and show the threads, but not so long as to interfere with the rudder. On one plane, we found the bolt improperly chosen such that the nut, incredibly hard to loosen, had been tightened so much that the nut was actually trying to create threads on the non-threaded shank of the bolt, and therefore the bolt was not compacting (loading) the stack of leaves and cushions as intended. With the rudder in place, you can hold the top hex of the bolt/nut with an open end wrench at an angle, but you cannot turn it because the U-shaped doubler prevents wrench rotation.

To add to the confusion of missing callouts, incorrect figures, odd serial matches, and the variety actually found on the planes, some catalog sources do not illustrate the sets for the 120/140, sell only the double bend set or double bend main spring and no other parts of the set. Others sell both sets (these sets are made up of the four bottom leaves), ignoring the top, fifth leaf. Of the catalogs at my disposal, Univair and Aircraft Spruce show all five leaves in both sets they sell. Aircraft Spruce, now buying product from Univair, has the springs in two places in the catalog, shown correctly one place and incompletely in the other. Both show the top leaf upside down from the way Cessna indicates. Spruce lists one part number, 06-14800, in two places for the full set but in the Cessna section, you get the correct five leaves and in the Spruce listing on page 231 of the '05 catalog, only four.

According to the figures in catalogs and the Cessna parts manuals, the single bend spring set was to be used on serials 8001 to 14026, and the double bend set from 14027 and subs, including all the 140A's. Maybe that is part of the truth, but maybe the Scott figure for the installation is also correct, showing the four main leaves with the front bend and no rear bend. With all this information, if you have excessive forward tilt or any backward tilt, start looking at what you "should have" and what you need to have as a set to get the correct tilt. Not stated elsewhere is the fact that you cannot mix parts of the two available new sets.

Many planes started with the Scott 3-24B single yoke, 6 inch diameter hard rubber tire assembly. The Scott 3200 double yoke air tire tailwheel was an optional choice at the time of purchase of the 140A, and many have changed to that model since on the 120/140/140A's.

The second bend in the main spring starts life at 15 degrees. When a new main leaf causes the tilt to be wrong, do not try to overpower the second bend in a press because it will fracture if not first annealed and then later re-hardened...to??? Yes, the fracturing has been proven.

The things to look for:

Which main spring you have...the straight (early), single bend, or double bend type. If the main spring leaf is double bend, so should the other three leaves the front bend. All spring sets should have five leaves, though the top one is not a "spring" but a retainer of the abrasion part.

1. The U-shaped item at the bottom of the stack of the front is rotated 90 degrees from where it should be. It should be such as to cup the rubber cushion and NOT have the turned up ends contact the springs as it would if installed as shown. A sketch of it if you have to make it is on page 13.
2. The bolts on the one saddle clamp are shown upside down according to aviation practice (the head is normally "up" so that there is a chance the bolt will stay in if the nut is lost). In this case, the drawing in the parts manual is correct, so the bolt heads should be down per the Service Letter that came along after it was found that the chain could catch on the bolts' threaded ends if installed with the heads up. Your A&X might fight that orientation, so have the Service Letter handy.
3. There is a hole shown in the one leaf, into which a "locking pin" of the clamp arrangement should go...the pin is not shown or called out. Make as per the drawing here, and install.
4. No torque is called out and it is beyond us as to how much should be used....it is always a temptation to be "tight" but consider that you are compressing two pieces of Neoprene in the front stack and the more you tighten the bolt, the less cushioning you get from the Neoprene pads. Perhaps better would be to tighten the bolt until some threads show through the nut and quit. Nobody has the correct answer.
5. To get the tailwheel spring set off to take a look at it for wear or replace it to be sure its okay, you have the choice of taking off the rudder to remove the spring assy, or you can remove the nut, push the bolt up and hold with vise grips, and cut the top off with a hacksaw. See the note about the subsequent "upside down" installation of the new bolt.

6. Match the steering springs with the tailwheel per the Scott Installation Instructions; the Scott 3-24 set requires one size and the Scott 3200 requires the more robust set. It used to be that the catalogs would list the two types and state which was for which, but most do not now. (2005...Spruce again offers the correct spring set for the 3200, but not on the spring set pages...it appears on pp229 as the last extra item for the 3200.)

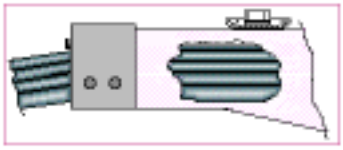
The issues of the Aircraft Spruce catalog include shortcomings about the tailwheel spring sets. In Spruce, the springs are called out in two places. Same part number but only four leaves one place and five the other. Use and believe only the entries in the Cessna section of the catalog. The Cessna section appears to be exactly the same as the Univair pages and the sets we have purchased from Spruce have had a Univair label underneath the Spruce labels.

Results:

When using a new, borrowed middle set of double bend springs with the double bend main leaf on my plane with the Scott 3200, the angle was 8 to 9 degrees negative (top of the main tailwheel attach bolt back farther than the bottom). That tilt made turning difficult....you had to work very hard to get it to break and when it did, the plane wanted to keep going in circles and did not!!! like going straight. When using my old (incorrect double bend set with the " very tired" last bend), the tilt is 9 to 10 degrees forward. I, too, will have to change the whole set back to the single bend. The old set has been on the plane for more than 25 years, a fault that might have been responsible for the bad action of the Maule which preceded the Scott and shimmied and shimmied.

Replacing the "wrong" double bend set of springs on a '46 plane with the new complete single bend set yielded an angle of 4 degrees forward, and works the best of all. It is correct for the first time since the present owner has had the plane, more than 20 years. Of four planes, all had incorrect sets.

Which set you have has proved very difficult to determine without taking the spring set out. The difference of the distance between the inside top of the bracket to the top of the first leaf often cannot be seen because of things like a worn abrasion part or the top leaf upside down.



Spring Set Dimensions:

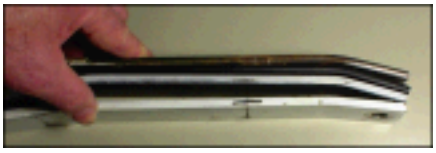
For the 170 set, its dimensions are 5/16" for the bottom leaf, 1/4" for the next up and 3/16" for the other two. There had been discussions about the possible use of the 170 springs for the 120/140's and finding a set shows it can be and was done. I confirmed dimensions by measuring two other 170's. Not recommended for use, but some do. (170 dims...0.320 for main, 0.250 for next up with the other two 0.186 thickness. Top number five leaf is 1/8th.)

Thanks to member Garry Fancy, who sent along the thicknesses of his four springs while asking the thickness of the top leaf, it was noted that the dimensions For the 120/140's the thicknesses are 0.25 for the bottom leaf, 0.187 for the next three above, and 0.12 for the top leaf/retainer.

Digital Pictures of the actual main spring leaves:

The world has changed again and now we can take actual pictures of the features of the springs. In this first set, showing the front ends of the main leaves, the top one is from a green 140, history unknown, of the '46 variety. The next, the black one, is a brand new one intended for a 120 with a single bend set. The bottom one is brand new, part of a double bend set, and the one above it is the fatigued double bend main leaf.

Next, the other end of the main springs. The top is from the green 140, the black one is the new single bend main spring, and the next down is the new one for the double bend set and the bottom one is from the fatigued double bend set. Replacing the old white with the new white yielded an angle of 4 degrees, right on and a good combination again.



Comparing like with like. The top two are the units removed from the green 140, history unknown, and the brand new single bend for the 120; the bottom two are the fatigued and the new double bend mains.

Last, the view showing what a vast difference there is end to end, especially for the new double bend unit and the well-used double bend unit, both white. The amount of fatigue bending of both ends of the used unit confirms that usage will change the shape drastically, leading to tailwheel swiveling and "break" problems.

For the double bend new main spring, the front bend is between 12 and 13 degrees and the aft bend a precise 15 degrees. When the weight of the tail is on the tailwheel, those angles change.

Seeing is believing and the amount of fatigue-induced change in the two bends is evident here when showing the new set and the removed main leaf which was once the same shape as the new main leaf.

Next, a tailwheel spring set from an early '46 140, within the first 1200 manufactured. Note two things;

1. there is a "front bend", about 5 inches behind the front end of the leaves, and
2. there is no rear bend.

This array conforms to the Scott I-168 installation for the model 3200 tailwheel for the 140 with respect to there being no rear bend, though one cannot be sure if there is a front bend in their figure. Poor handling.

Steering Spring Sets for the 3200 and 2000 (3-24B) Tailwheels

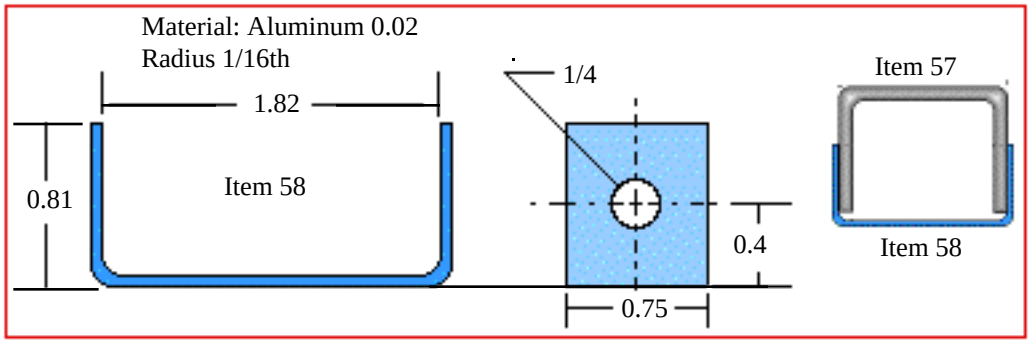
The proper tension-type steering springs for the Scott 2000 wheels (were the Scott 3-24B set) are the Scott 2134 part number, and those are part of the 2151 "universal" (that word gets us in more trouble because it is so often misused, as here) kit from Scott. The 2151 kit contains the 2134 springs, the 2133 links and chain. Here is what the original Scott I-115 bulletin from Scott says about the hard rubber tired six inch 3-24B/2000 set: cut off enough chain links from each connector chain to stretch the spring (the correct one!!!) about an inch and that will produce a tension of approximately 25 to 30 pounds. Make sure the length/tension is the same on both sides. Spruce, in 2005, lists the 2151 kit, but they do so on the Maule page, not on the Scott page, and do not note that they are for the Scott 2000. This smaller spring set should NOT be used with the Scott 3200 system.

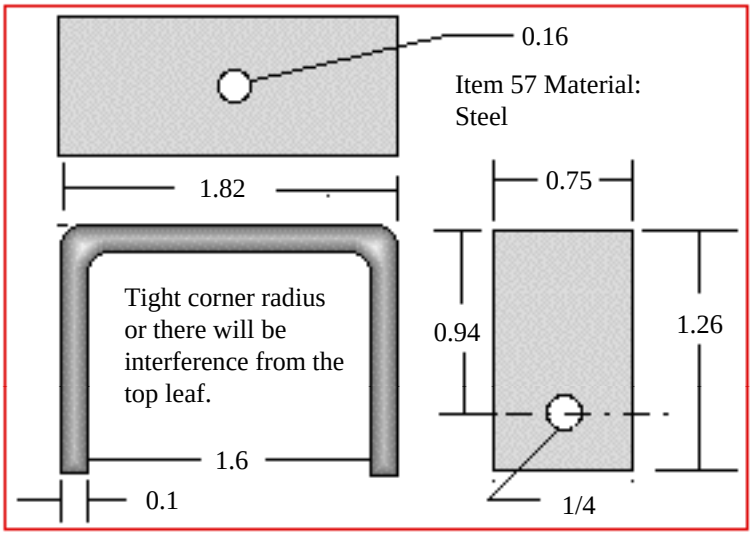
Every issue of the catalogs seems different so use caution. Spruce left out the correct springs for the Scott 3200 tailwheel for a couple years but now list the 3239 kit (includes chain and ends) in 2005 in the Cessna section on the Scott 3200 page. The chain and links are no longer listed separately. Wag-Aero shows two sets, the one obviously the Maule compression type and the other???? with no identifier as to maker or part number or size or strength. When queried, their response was that "either can be used with any of the tailwheels". Good luck if you do.

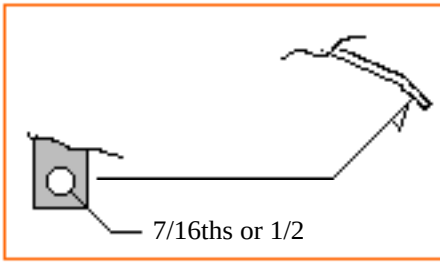
Do NOT use the springs for the Maule. They are asymmetrical in strength and will give weird results, including a second rudder trim tab effect. They are often misrepresented as to their attributes and capabilities. What no one states is that compression springs are the same as tension springs but the compression springs become "solids" when compressed to the point that each spring loop hits the next loop. This means that after a relatively short compression movement, the now "solid" non-springs are putting direct, not spring, tension on the rudder horn and on the chain and tethers and the rudder cable. Restated: the tension type springs lengthen as they transfer tension to the tailwheel; compression type springs apply tension to the tailwheel until the compression springs become "solid" and stress the rudder horn and the tailwheel.

Catalogs also list the "compression" type springs with the inference that they will make shimmying less likely. Maybe they do for the Maule, but Scott tailwheels should not be used with them, both because they are weaker than the recommended size for the 3200 and because the two springs of the compression spring sets have different spring force ratios. In the air, the stronger of the two gives you an off-center tailwheel, creating "a secondary trim tab" which will make you think the plane is mis-rigged. The Model 2000 tailwheels should have the tension noted in its installation notes and the Model 3200 is to have no tension on the steering springs/chain, just take up the slack.

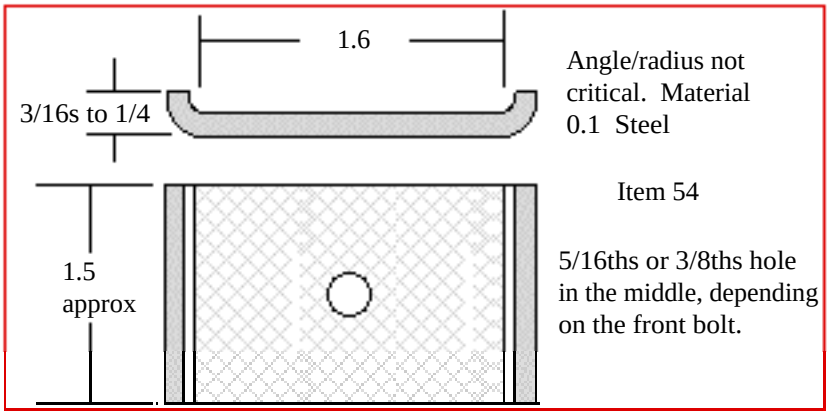
Use the Scott part numbers when you order, not the hype and go elsewhere if the seller does not explicitly state the Scott part numbers.

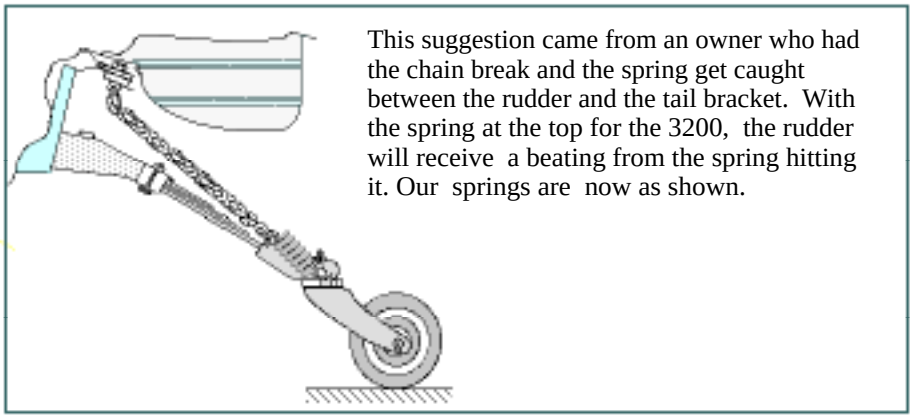




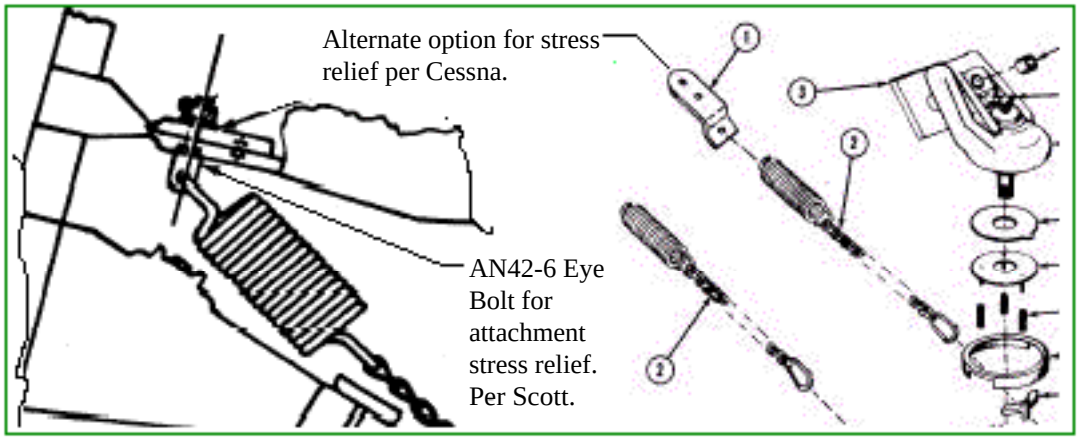


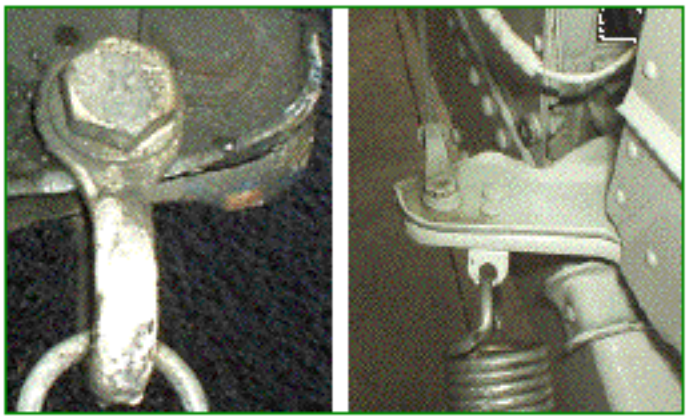
In one of the early figures, I note that the rear hole can be either 7/16ths or 1/2 in diameter. The leaves all come with 5/8ths diameter holes in the front and for the main leaf, 7/16ths at the rear. Some change the kingpin to 1/2 for greater strengh, so the main leaf has to be drilled out to fit. A cobalt bit, run very! slowly, with lots of cooling liquid will make the rear hole without softening the steel. If you change, remove and save the bushing that comes with the 3200 tailwheel.





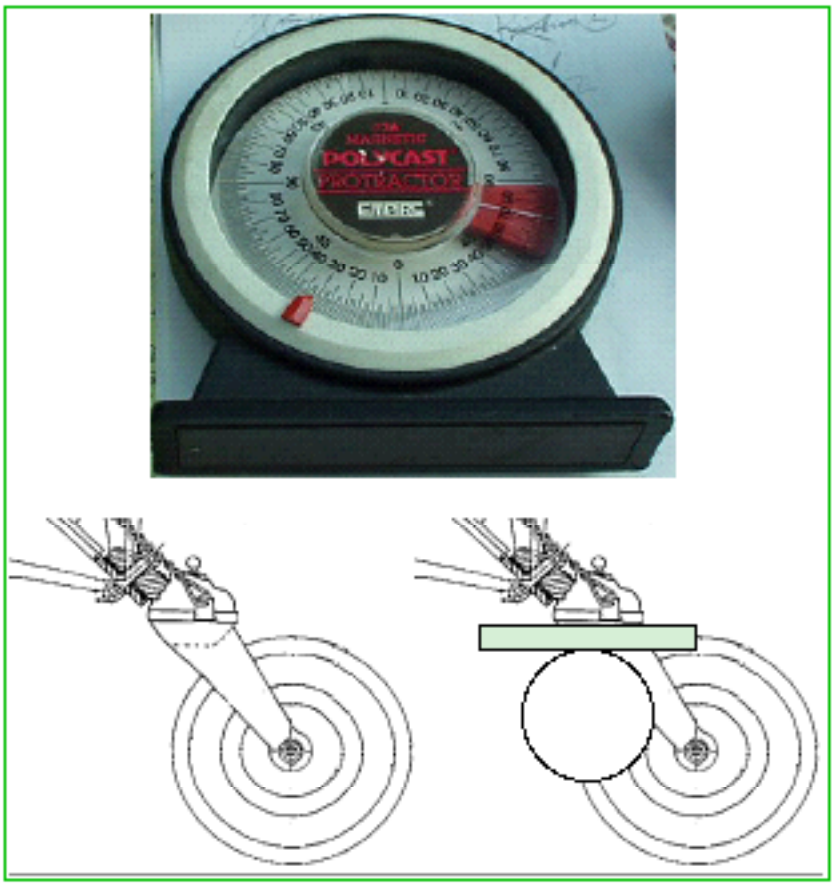
This suggestion came from an owner who had the chain break and the spring get caught between the rudder and the tail bracket. With the spring at the top for the 3200, the rudder will receive a beating from the spring hitting it. Our springs are now as shown.

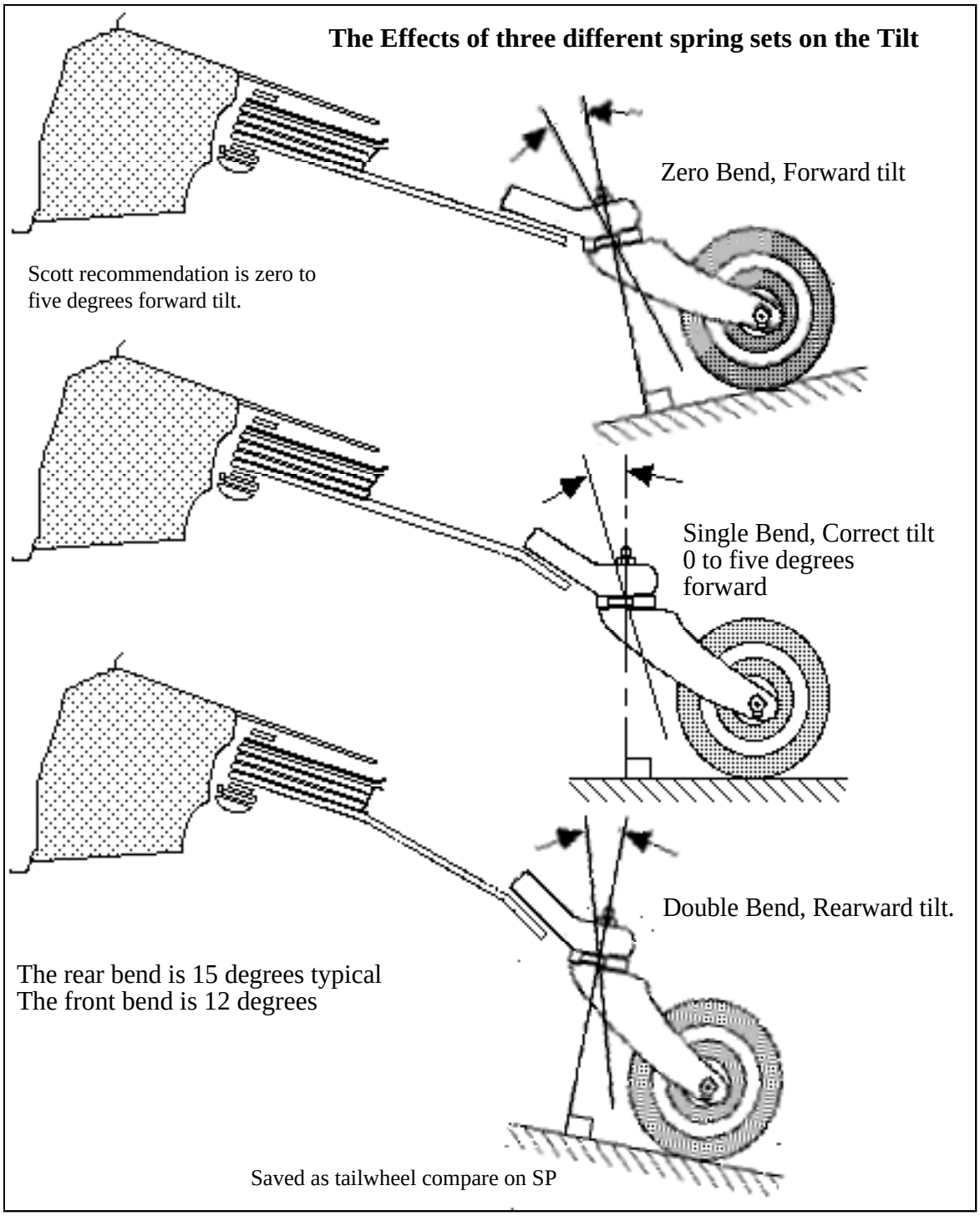




Three alternatives to prevent the steering spring force from cutting a slot in the rudder horn. The one on the left is one cure if you have the older planes with the secondary spring attachment hole. The later planes, as on the '47 to the right, has the Cessna preferred attachment and there is no larger secondary hole. As one owner found, several times, if the rivet holes are not in a line with the tension of the springs, one rivet serves as a pivot and the other as a guillotine.

June ‘05. This next figure added to illustrate the best/fastest way I know to check the angle of tilt of the assembly. Holding the tool alongside the tailwheel as shown such that the flat part is parallel with the flat of the mating surfaces allows one to read the angle directly. The main leaf of the spring takes a terrific beating and sags when it fatigues. Getting the angle right minimizes the tendency to shimmy and makes for very!! easy swiveling of the tailwheel and better tracking. Be aware that changing to the extenders or taking the extenders off can alter the angle.





I created this series of figures to illustrate the effect of using the different spring sets. I have had all three on mine, and definitely prefer the middle, the correct tilt. The bottom figure shows one with a significant rearward tilt and it will easily start to turn with rudder pedal pressure, break easily and then want to stay in the going around in circles mode. It requires lots! of power to get it back straight. The top figure with the excessive forward tilt is very resistant to reasonable steering force.

Use whatever combination gives you the ideal tilt.

Treat your tailwheels kindly, in 2005...Wow new prices. 3200 is $900 and for the model 2000, it is $ 1400!!

An email from: Brian Truitt Courtenay, B.C. Canada
I bought my 140 3 weeks ago and have been poking away at little fixups ever since. That was the plan, a project to keep me out of trouble. Actually it's a pretty nice plane, flies really well & have not found anything really ugly. Until today ! I have read some of the tailspring horror stories on the C140 site so today it was time to have a good look at the back end of the plane.

Several things. Top rubber cushion was missing. Bottom cushion was 99% flattened. The bushing was steel and long enough that there was metal to metal contact on the bottom retainer and undersurface of the tailspring bracket. Washer was no where to be seen and the bolts, well that's another story. Far too long, half of it was threaded, heavy wear on the bolt and a handful of washers to make up for the length. The fifth leaf was upside down the bent portion gradually working its way into the top of the fourth leaf. Item 58 was missing but someone had hammered the bottom part of item 57, the hole area, so that it would hold leaf five. Now wouldn't it have been a lot easier to make item 58 and fasten it with a bolt ? The abrasion strip had virtually rotted away.

End result was a very sloppy tailspring with a somewhat limited life span if not tended to. I have obtained reinforced rubber hose for the bushing, 1/8 inch neoprene to make spacers, doubled, located a Belleville washer & new bolts. All bits & pieces have been thoroughly cleaned, primed & ready for painting.

With any luck she'll be flying by the weekend with a much better tailspring assembly. Can't wait as we really enjoy running about in it. I've been flying for close to 30 years, owned & "wrenched" several planes, too bad I didn't discover the C140 a couple decades ago.

Thanks again for the information.

If you find other anomalies or create hints which make steps easier, let me know for inclusion in future versions.

Neal Filed as: Tailwheel October ‘05

Neal F. Wright
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