INSTALLATION INSTRUCTIONS

700-0116 REV -



INSTALLATION OF 700-0112 OVER-CENTER BUSHINGS IN LANCAIR LEGACY / IV / IVP

LOG OF REVISIONS

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TABLE OF CONTENTS

LIMITS TO LIABILITY AND DISCLAIMER 2

INTRODUCTION 3

PARTS AND TOOLS REQUIRED 4

PROCEDURE 5

ACKNOWLEDGEMENT

The design for these stainless steel bushing replacements and instructions were originally developed by Robert Pastusek after extensive research of Lancair gear collapse failure modes. Bob and LOBO deserve all the credit for discovering and finding a solution to this issue.

LIMITS TO LIABILITY AND DISCLAIMER

This manual and 700-0112 bushings are provided to assist owners and mechanics complete their own repairs to their aircraft. O'Day Design LLC makes no claim to the airworthiness of these products.

By using these instructions, and/or the 700-0112 bushings, the installer, owner, operator, and their representatives understand and assume all risks involved with completing the work and subsequently operating the aircraft. To the extent permitted by law, they agree to indemnify, defend, and hold harmless O'Day Design LLC from any and all claims, actions, liabilities, suites, injuries, demands, obligations, losses, settlements, judgments, damages, fines, penalties, costs, and expenses, including attorney's fees and other expenses, (collectively a "Claim") arising out of, or relating to, the installation or use of these instructions or the 700-0112 bushings.

O'Day Design LLC encourages feedback from owners and installers on the content of these instructions so that they may be improved for other future installations.

INTRODUCTION

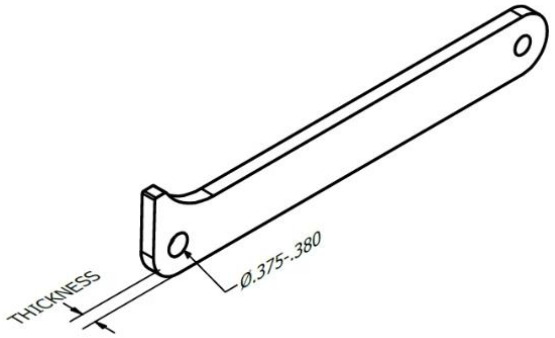
This manual contains instructions for installing 700-0112 stainless bushings on Lancair Legacy and IV models replacing bronze bushings 4722. They are intended, and the manual is written, for nose gear installations, however main gear installations on the Legacy are similar, using different hardware.

BACKGROUND: The Lancair IV-series aircraft incorporated different retractable landing gear assemblies from previous models. The three-piece nose gear scissor links used on the IV-series contained ¼" (AN4) drilled bolts that acted as pivots between the single-piece upper link and the two lower links. Due to builder difficulty in installing/adjusting this critical pivot joint, Lancair modified the lower links with introduction of the Legacy kit (which used the same parts) to include a bronze bushing that acted as the pivot and replaced the drilled and cotter-pinned bolt with a torqued AN4 tension bolt. Lancair provided the new parts with all Legacy kits after about 2006, and as an upgrade under Service Bulletin SB077-0518 for Lancair IV models.

The first issue that came up was that some IV owners installed the new lower links and bushings using the instructions contained in the original IV build manual. Specifically, they **used a drilled bolt and castle nut/cotter pin** to loosely join the upper and lower links. This allowed the bronze bushings to rotate on the bolts rather than on the lower link as designed. **These incorrect installations** allowed the bushing and bolt to wear rapidly, resulting in at least **six documented nose gear collapses**. The second issue, that took a bit longer to identify, was that even when installed correctly, **the bronze bushing material was too soft to absorb the nose gear touchdown impact** (especially in the IV models) and allowed the bushing to swage itself to the lower links. This caused the torqued bolt to loosen and become the pivot. Tightening the bolt typically locked the scissors linkage, either preventing gear retraction or loosening the bolt with each gear cycle so it again became the pivot point. As wear on the bolt/bushing increased, the over-center point for nose gear retraction moved from the designed bolt pivot point to the point of contact between the ears of the lower links and the upper links. This defeated the "over-center" function of the scissor links assembly and allowed the gear to retract upon touchdown under some conditions—specifically, with failure of the primary hydraulic system and/or a weak emergency extension gas spring; or a hard touchdown on the nose gear.

The 700-0112 bushings are **made of stainless steel** which is significantly stronger than that of the bronze bushings. This allows them to better handle the loads applied by the nose strut. This joint is also secured with an un-drilled AN4 bolt and a **friction locking nut** with sufficient torque to **prevent rotation of the bolt** within the bushing.

The 7721 over-center linkages have been found to be made from a wide range of material thicknesses. To provide a better fit two bushings are available, 700-0112L (long) and 700-0112S (short). These correspond to the thickness of the 7721 over-center links which should be measured to determine which bushing is appropriate:



Over-Center Link Thickness	Use Bushing
.245-.256	700-0112S
.257-.274	700-0112L

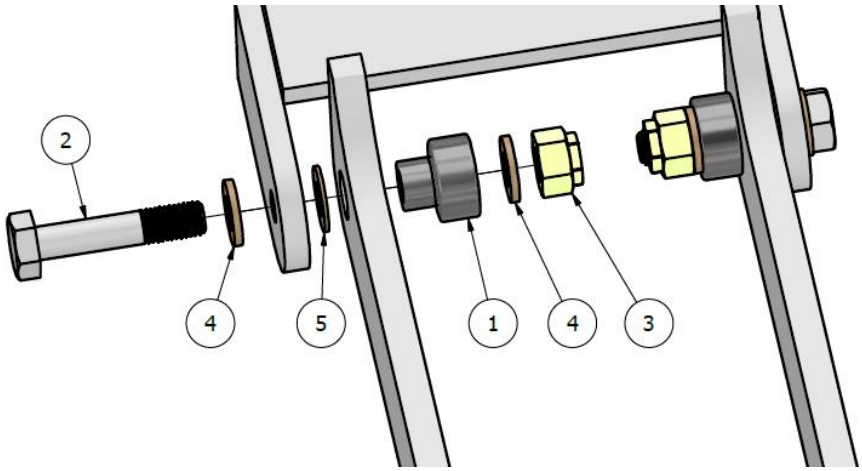
PARTS AND TOOLS REQUIRED

PARTS:

- **700-0112S OR 700-0112L Bushings**
    - Obtained from www.odaydesign.com/product/700-0112
    - Determine Long (L) or Short (S) based on table in introduction section

- **Installation Hardware Included With Bushings**

ITEM	PART NUMBER	DESCRIPTION	QTY USED
1	700-0112S	BUSHING, SHORT	2
1	700-0112L	BUSHING, LONG	ALT
2	AN4-12A	BOLT, UNDRILLED	2
3	AN363-428	NUT, METAL LOCKING	2
4	AN960-416	WASHER, THICK	4
5	AN960-416L	WASHER, THIN	2



TOOLS:

- **Wrenches**
- **Socket Set**
- **Torque Wrench**
- **Bathroom Scale**

PROCEDURE

1. Securely block the aircraft and raise the nose wheel off the ground. Bleed off any pressure in the hydraulic system.

2. Remove the lower engine cowling and disconnect the nose gear door linkage.

3. Remove the long AN5 bolt securing the two lower scissor links to the nose strut. Ask an assistant to push up on the lower scissor link to relieve pressure of the gas spring while removing this bolt.

4. Test the gas spring. (This step is optional)
    a. Remove the gas spring from the upper scissor link.
    b. Test the gas spring for a minimum measured compression force of 90#. Bathroom scales work well.
    c. Re-install the gas spring or a replacement (available through O'Day Design) taking care to safety the attachment bolts (IV) or install the retaining clip (Legacy)

5. Remove the two lower scissor links from the upper scissor link assembly, discard the hardware and original bronze bushing. You may need to use a drift punch to remove the bushing, being careful not to damage the steel scissor links.

6. Test the spherical pillow block bearings attaching the top of the nose strut to the motor mount for free pivoting and strut side-to-side movement. Any detectable movement (more than 0.01") requires further diagnosis and correction.

7. Clean the scissor links and remove any paint where the bushings/washers make contact with either the upper or lower scissor links. It is especially important that the thin AN4 washer provided with the stainless bushings have metal-to-metal contact with both the upper and lower links when assembled…no paint between these mating parts. Inspect both linkage holes to ensure they are not worn. If worn, they require replacement.

8. Inspect the upper linkage. Besides wear in the holes, the most common issue with this weldment is failure of the hydraulic actuator bracket at the top of the weldment. The bracket and its welds should be inspected closely for cracking.

9. Referring to the parts list for orientation, test fit the bushings in the lower linkages. Verify that the new stainless-steel bushings protrude through the hole in each lower scissor link by at least 0.001" and rotate smoothly inside the linkage.

10. If the bushings do not protrude slightly through the scissor link when fully inserted, do not proceed with this installation, as the joint will not pivot freely when tightened. (You may need a different bushing length or a different linkage).

11. Re-install the lower scissor links to the upper link, using the new AN4-12A bolts and AN363-428 locking nuts as shown in the above parts list. Note that the bolts need to be installed from the outside in, with the nut on the inside of the assembly. This provides clearance between the pivot bolt and gas spring on Legacy aircraft when the gear is retracted. Torque these bolts to 80-90 inch-pounds, using a torque wrench!!

12. Verify that the lower links will pivot on the upper link through the range of motion required during gear retraction, and that the pivot bolts do not contact other gear components. THIS IS A CRITICAL STEP. Do not proceed until this condition is satisfied!

13. Lubricate the pivot points and reinstall the hydraulic actuator and gas spring.

14. Clean, lubricate and re-install the lower scissor links to the nose strut. As with removal, ask an assistant to help push the lower scissor link into position against the gas spring. Note that some nose struts have a bushing inside the tube that's welded to the strut. The lower scissor links are bolted and torqued to this bushing. Other struts used a pivot bolt through the tube that's drilled and secured with a castle nut and cotter pin. Be sure to note which type you have and reinstall accordingly! Recheck the security and safety of all fasteners!

15. Check the over-center relationship of the upper and lower scissor links by aligning a flexible straightedge between the center of the upper scissor link attachment bolt at the motor mount and the center of the bottom lower scissor link mounting holes, with the scissor links fully extended against their respective stops. The center pivot bolt/bushing should be slightly "over-center." The acceptable over-center distance is 1/8"- 3/8". THIS IS A CRITICAL STEP. Do not proceed until this condition is satisfied!



16. Conduct a gear retraction test to verify nose gear operation without binding and full nose gear door closure. Check specifically the clearance between the new SS pivot assembly and the nose strut when retracted. THIS IS A CRITICAL STEP. Do not proceed until this condition is satisfied!

17. Re-install the lower cowl and nose gear door linkage.

18. Make a logbook entry of this modification. Weight and balance are not affected.

19. Add the requirement to lubricate these bushings and verify the security of the pivot bolts after ten landings and at each subsequent condition inspection. Any looseness of more than 1/8 turn of the pivot bolt nuts is cause for disassembly and inspection IAW. Tightening the pivot bolts without checking that the links swing freely after tightening can prevent nose gear retraction or extension.