

Landing Gear Failure

Cessna 310B, N6602B

Accident Number:WPR20LA187

Gear Examination Report

Coeur D'Alene Airport KCOE

August 5,6 2020



Report Written & Prepared By:
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Vulcan Aero LLC

██████████. Athol, ID 83801

Abstract: This report covers the analytical exam of N6602B landing gear system that experienced a failure upon landing on June 18, 2020. This exam was conducted by Zane Brown A&P I/A and assisted by Gavin Klein CPL, M.I.T. (Mechanic in Training) on August 5th and 6th 2020 on location at KCOE.

Probable Cause: It is of my professional opinion that the landing gear failure was caused by poor maintenance practices resulting in a mis-rigged condition of the retraction system and over center forces, causing the collapse of the L/H gear.

Findings:

- Post-accident exemption revealed that the landing gear compartment was extremely dirty and covered in oil and debris.
- L/H MLG door was ripped from plane, damage was indicative of the door being in the open or partially open position upon contact with the ground. Normal state of the door with the gear configured for landing would be closed.
- L/H MLG torque link (scissor link) hardware lacking proper safety devices. (All castellated nuts lacking cotter pins.)
- L/H MLG missing grease zerks, no damage noted to threads on zerk boss, appears to be missing pre-accident.
- L/H MLG torque tube intact with no damage noted.
- R/H MLG torque link (scissor link) center bolt missing nut and appx. 2/3 backed out. No wrench marks noted on bolt and grime on bolt, suggests this condition existed prior to accident.
- Full gear swings were not achievable due damage of NLG, however once NLG system, gear was swung manually and normally with electric motor. L/H MLG did not retract due to broken main drive tube. R/H gear

performed normally. Gear Acuator found to be mis-rigged, *Cessna 310-310D Service Manual* (p/n P-150C) Sec.2-315 states emergency crank should be backed off two turns and DOWN limit switch adjusted to just actuating at this point. Subject aircraft found emergency crank backed off three (3) turns after actuation.

- L/H Door Actuator Arm (Item 19 Fig. 2-51) appears to be recently replaced due to cleanliness of part along with clean swarf located in L/H gear well. No notation of part replacement in Airframe log books from 1990 to present. Asked Latitude Aviation's chief mechanic Dustin Wise about recent arm replacement he stated that it was not replaced that he knew of, but that roll pins (Item 21 Fig. 2-51) were recently found sheared and replaced prior to the accident. However no record of replacement was noted in maintenance logs.
- L/H MLG Lock Link not in over-center "locked" condition. When Intermediate Push-Pull Tube removed from idler link (which is attached to door actuator arm mechanism) Lock Link cammed over-center and "locked". Visually intermediate tube appeared to be 2-3 "turns" out of rig.
- R/H Downlock tension measured at 11.3lbs. (Measured with Nidec Digital Force Gauge FG-3008 S/N 4121906145 calibration last performed 07/18/2020) Service manual requires a routine maintenance tension of 40-60lbs
- L/H Downlock tension measured at 8.3lbs. (Measured with Nidec Digital Force Gauge FG-3008 S/N 4121906145 calibration last performed 07/18/2020) Service manual requires a routine maintenance tension of 40-60lbs
- Multiple instances of recently replaced hardware with no thread protrusion through lock nuts (Not in accordance with *Service Manual, AC43.13-1B* or standard practices) nor found in maintenance log books.
- NLG centering mechanism broken and rusty, may have been pre accident condition give amount of corrosion in break compared to items broken during accident.

- Gear warning system appears to be operating properly, although is it possible L/H down lock switch just out of rig. Green light indicator flickes with R/H gear down and locke NLG switch mechanically bypassed and L/H gear in as found condition (lock link in almost locked position).
- L/H MLG Main Drive Tube found failed at actuator attachment lug. Failure mode appears to be compressive in nature. Tube was retained and sent to Maja Smith for metallurgy testing.

Other Notable Observations:

- Hobbs meters removed from Aircraft, not able to record current maintenance time.
- While Vulcan Aero LLC was onsite, a Mooney M20 underwork inside Latitude Aviation's hangar suffered a maintenance induced nose gear collapse and subsequent damage from jacks placed at main jack points.
- When asked to see 310 B Service manual Latitude Aviation mechanics spent time shuffling thru various boxes until a binder marked 310 D matching all other service documents for Latitude's newly acquired replacement 310 was found and given to Vulcan Aero. I suspect that they did not have a proper manual prior to that time.
- Last recorded maintenance action was 06-03-2020 (MLG wheel inspection, tire and brake replacement, etc.)
- Last 100Hr / Annual was signed off 03-17-2020 by Larry Brown
[REDACTED]
- On 04-09-2020 a maintenance entry stating aircraft is safe for ferry flight from KGEG to KCOE, however no special flight permit found in record package, nor any notation of reason for ferry flight.

I certify all statements made on this report to the best of my knowledge are true and correct.

Zane Brown A&P [REDACTED]



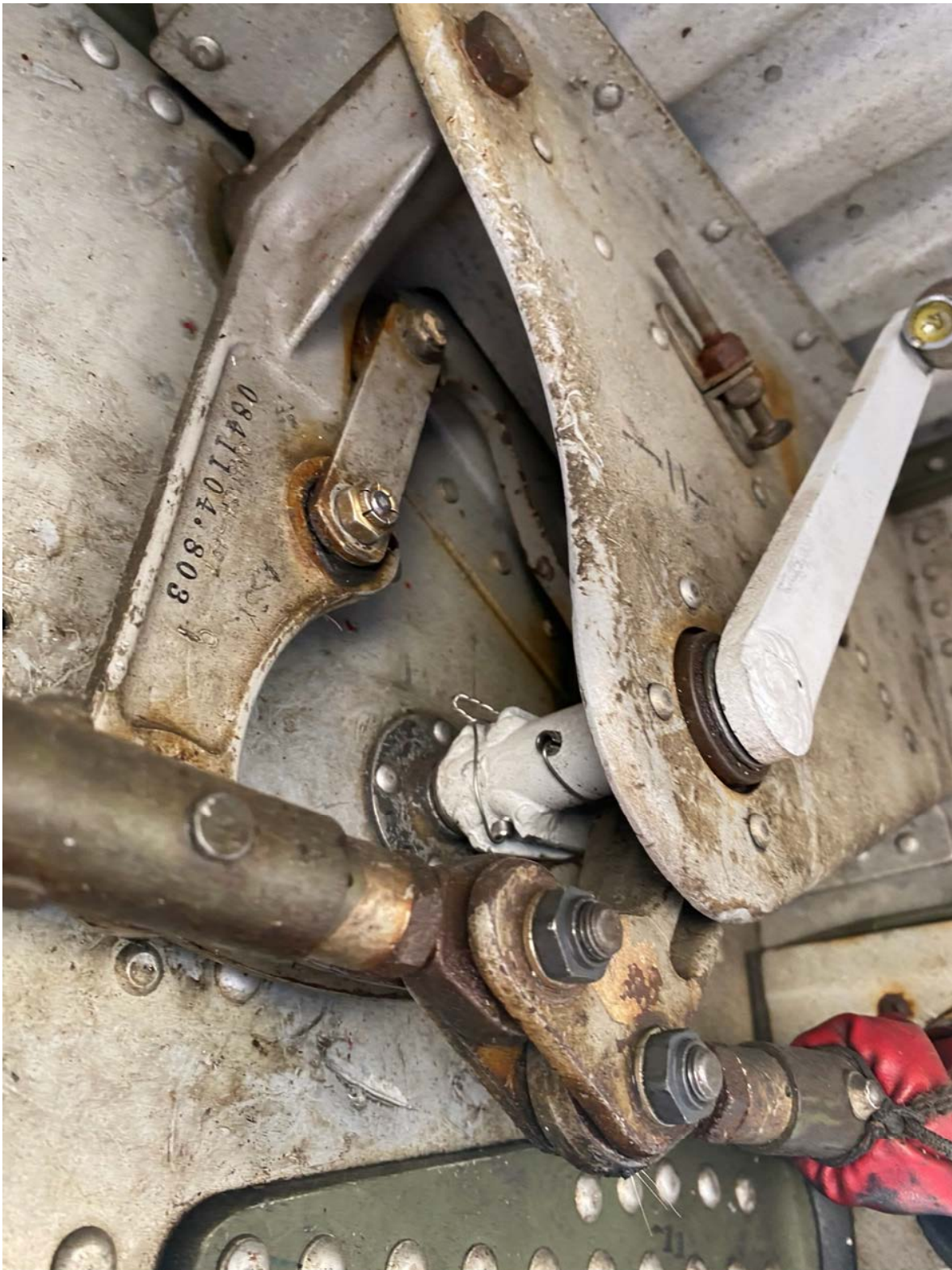
General Condition of Oil and Dirt throughout gear wells



Missing Cotter pins



Backed out bolt on r/h Gear



L/H Gear showing new hardware and new parts(door actuating arm)



L/H Gear showing mechanism binding in as found condition



L/H Gear no bolt protrusion



L/H Gear recent gouge in bulkhead behind idler arm undetermined cause



Gear actuator in mid position



R/H Gear new "short" hardware on gear door



Subject Aircraft on jacks



L/H Gear close up of replaced roll pins



NLG Centering Mechanism



NLG Centering Mechanism



Data Plate



Actuator splines intact



L/H Gear Main Drive Tube removed from A/C



L/H Gear close up of broken drive tube



L/H Gear close up of broken drive tube



R/H Gear Torque Link center bolt

DOIFA324R, LH may DOIFA324R SN DOIFA
• Installed new wiring harness PN 10-423674-1
• Changed oil. Cleaned & Inspected screen. Good. Se
w/ 12 Qts Aeroshell 100 mineral oil.
I certify that this engine has been inspected I.A.
100 hr inspection and was found in airworth

2020

INSPECTION & MAINTENANCE RECORD

DATE	TOTAL TIME	INSPECTION OR MAINTENANCE PERFORMED AGENCY & CERTIFICATE NO.
03-05-20	1,738.8	Welded carb. support bracket Lh. ear to orig
Tach -	228.3	position, Ref. AC 43.13-1B CHG 1.4-86(c).
		Resafetxed oil temp prob to correct position
		Replaced Lower alternator bracket w/new
		(PN:10-9003), & replaced MAP line from airplene
		to fire wall. Inspected & serviced engine I.A.
		a 100hr check list & deem it to be in an airw
		condition. A&P#

69/ #6 69/ 280 100

3.13-1B P4-57

Philips x/c

Date: 03/17/2020 Hours: 228.4 Tail: N6602B

Make: Continental Model: O-470-M S/N: 53833-6-M-R

Name: Larry Brown Cert: AP

Co: Inceptus Inc DBA Latitude Aviation Signed:

100 HR Annual inspection completed this date I.A.W FAR 43 appendix (d) and Cessna 310B checklist. Left Engine Compression as follows. 1-58 2-66 3-72 4-72 5-64 6-76. Drained oil and serviced with 12QTS Phillips 20W50. Cleaned and inspected oil screen. Washed down engine Post run showed no leaks at this time. I certify that this ENGINE has been inspected I.A.W. a 100 HR/ANNUAL inspection and was found to be in AIRWORTHY condition on this date. END.

Larry Brown 1- AP

DATE 2017	RECORDING TACH TIME	TODAYS FLIGHT	TOTAL TIME IN SERVICE	DESCRIPTION OF INSPECTIONS, TESTS, REPAIRS AND ALTERATIONS ENTRIES MUST BE ENDORSED WITH NAME, RATING AND CERTIFICATE NUMBER MECHANIC OR REPAIR FACILITY. (SEE BACK PAGES, FOR OTHER SPECIFIC ENTRIES)
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10-08	184.0			Changed engine oil (20W-50, 10qt's) A & P# [REDACTED]
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12-06	208.9			Changed oil. Cleaned screen. Serviced w/ 12 Qts Phillips X/C 20W50. A & P# [REDACTED]
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Date: 03/17/2020 Hours: 228.4

Tail: N6602B

Make: Continental

Model: O-470-M

S/N: 51119-6-M

Name: Larry Brown

Cert: AP# [REDACTED]

Co: Inceptus Inc DBA Latitude Aviation

Signed: [REDACTED]

100 HR Annual inspection completed this date I.A.W FAR 43 appendix (d) and Cessna 310B checklist. Right Engine Compression as follows. 1-53 2-66 3-68 4-72 5-66 6-74.

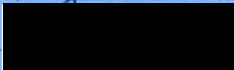
Drained oil and serviced with 12QTS Phillips 20W50. Cleaned and inspected oil screen. Washed down engine. Post run showed no leaks at this time. I certify that this ENGINE has been inspected I.A.W. a 100 HR/ANNUAL inspection and was found to be in AIRWORTHY condition on this date. END.

Larry Brown

1- AP# [REDACTED]

08-17-20	252.8			Changed oil & cleaned oil screen w/ 20W-50. Dustin Wise A & P# [REDACTED]
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05-09-20	Tach	274.9		Changed oil. Cleaned & inspected screen. Serviced w/ 10 Qts Aeroshell W100. A & P# [REDACTED]
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ING	TODAYS FLIGHT	TOTAL TIME IN SERVICE	Description of Inspections, Tests, Repairs and Alterations Entries must be endorsed with Name, Rating and Certificate Number of Technician or Repair Facility. (See back pages for other specific entries.)
			Performed 100 hr inspection using Latitude Aviation 100 hr inspection form. The following work was performed: • Installed new main gear torque link kits PN TL-KT-8 on both main gear. • Installed all new brake linings. • Installed new 6.00-6 nose wheel tire & tube. • Installed new torque tube assembly PN 0813300-46 and 2 bearing assemblies PN 0813000-73 on nose gear. • Re-rigged nose gear due to nose gear uplock hook not engaging. Ops check good. • Installed new flexible brake line on right main gear. Serviced with MIL-5606. Ops check good. • Serviced all wheel bearings. • ELT tested IAW 91.207 CFR and found working. I certify that this aircraft has been inspected IAW a 100 hr inspection and was found in airworthy condition.  AP 

ENGINE LOG

DATE	RECORDING TACH TIME	TODAYS FLIGHT	TOTAL TIME IN SERVICE	Description of Inspections, Tests, Repairs and Alterations Entries must be endorsed with Name, Rating and Certificate Number of Technician or Repair Facility. (See back pages for other specific entries.)
5-19	73.70			Complied with AD 69-12-03 and AD 72-14-08 R1 by visual inspection. [redacted] AP [redacted]
5-19	73.70			Installed oil temp probe PN MS2803 that is good. [redacted] AP [redacted]
7-19	112.20			Tightened tach generator electrical connections to fix faulty tach readings. [redacted] AP [redacted]
-19	112.70			Installed new Rtt landing light bulb PN 4559 and new Heading indicator PN Cassra S3330-1, SN T58594L. [redacted] AP [redacted]
10-19	133.80			Complied with AD 72-14-08 R1 by visual inspection. [redacted] AP [redacted]
11-19				Replaced oil temp wire forward of rear of engine (last 3'). Re-soldered pins in connector to oil temp bulb. Reassembled and tested OK. [redacted] AP [redacted]
	138.70			Removed rubber mounting indicator gauge. [redacted] AP [redacted]

DATE	RECORDING TACH TIME	TODAYS FLIGHT	TOTAL TIME IN SERVICE
2019			
12-6	208.9		

Description of Inspections, Tests, Repairs and Alterations
 Entries must be endorsed with Name, Rating and Certificate Number of Technician or Repair Facility. (See back pages for other specific entries)

Date: 03/17/2020 Hours: 228.4
 Make: Cessna Model: 310B
 Name: Larry Brown Cert: AP [REDACTED]
 Co: Inceptus Inc DBA Latitude Aviation Signed: [REDACTED]

100 HR Annual inspection completed this date I.A.W. FAR 43 appendix (d) and Cessna 310B checklist. Lubed all bell cranks and pulleys, inspected and greased all wheel bearings. Removed and replaced Main fuel tank hardware. Removed passenger step and replaced with serviceable unit. Repaired R/H landing light. Removed and inspected emergency exit. Replaced left brake disc. Replaced all brake linings. Inspected ELT I.A.W. FAR. 91.207. Battery due March, 2021. I certify that this AIRCRAFT has been inspected I.A.W. a 100 HR/ANNUAL inspection and was found to be in AIRWORTHY condition on this date. END

Larry Brown AP [REDACTED]

4-9-2020

I certify that this aircraft is safe for a
 ferry flight from K6EB to KCE. See FSDO
 permit.
 End.

100HR

ENGINE LOG

Tests, Repairs and Alterations
 e, Rating and Certificate Number of
 ack pages for other specific entries.)

gear selector links.

Tail: N6602B

S/N: 35702

checklist. Lubed all bell
 fuel tank hardware.
 moved and inspected
 AR. 91.207. Battery due
 ection and was found to

is safe for a

KCOE. See FSDO
 permit.
 End.

DATE	RECORDING TACH TIME	TODAYS FLIGHT	TOTAL TIME IN SERVICE	Description of Inspections, Tests, Repairs and Alterations Entries must be endorsed with Name, Rating and Certificate Number of Technician or Repair Facility. (See back pages for other specific entries.)
19				
5-11-20	274.9			Complied with AD 72-14-08 R1 by visual inspection. No leaks found. Lubed landing gear. [redacted] AP [redacted]
5-16-20	279.70			Complied with AD 69-12-03 by visual inspection. No chaffing found. [redacted] AP [redacted]
6-03-20	279.90			Disassembled, cleaned, + inspected both main wheels. Installed new Tubes + tires + brake plate brake linings on both wheels. Bled RH brake. Replaced old wire for #2 engine CHT from firewall forward with new wire. [redacted] AP [redacted]





L/H Gear Lock Link as found condition (unlocked)



L/H Gear newer Cherry rivets



Latitude's Copy of Service Manual

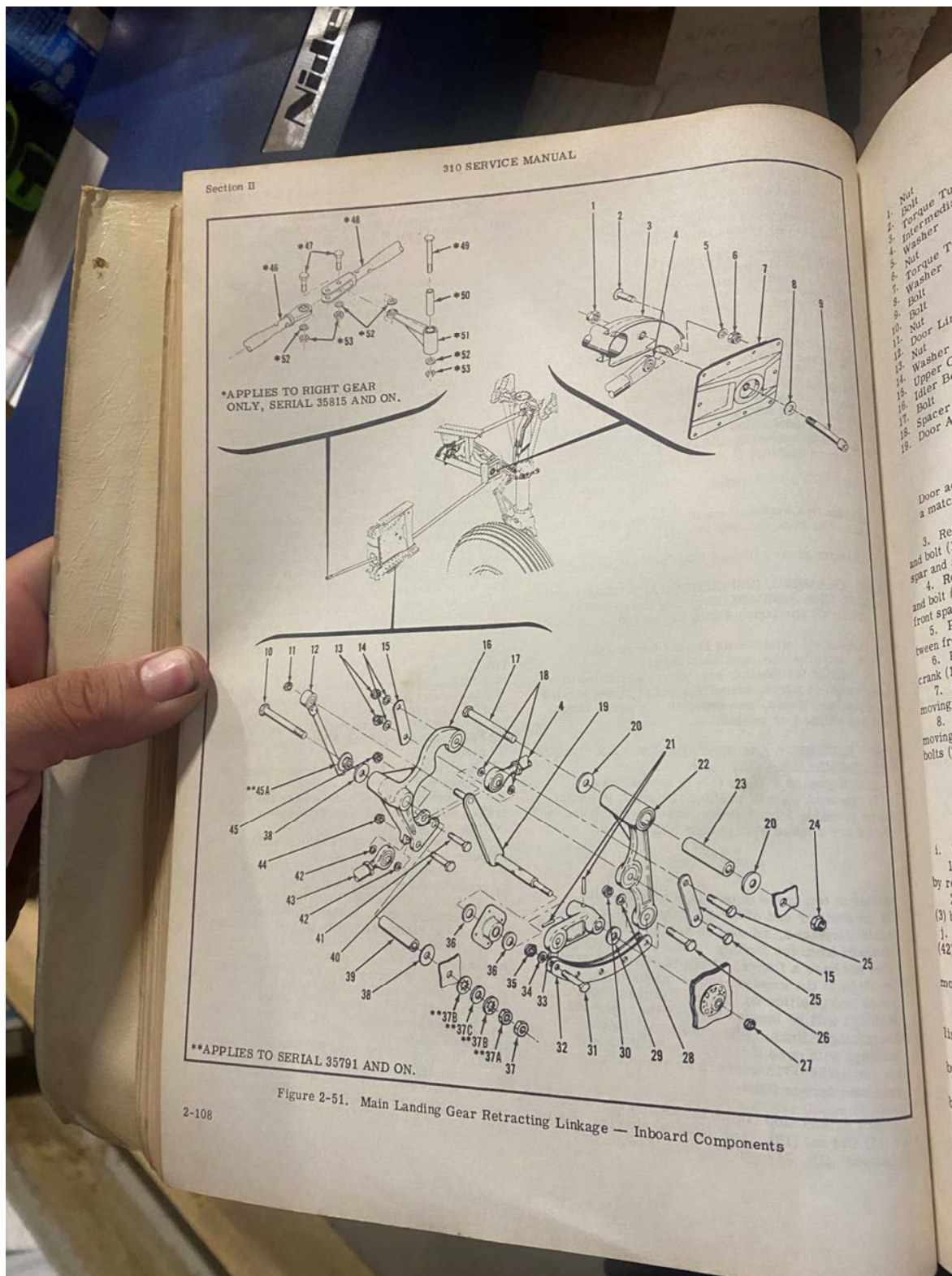
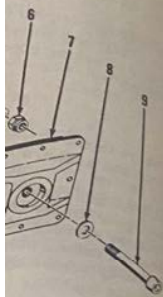


Figure 2-51

Figure 2-51. Main Landing Gear Retracting Linkage - Inboard Components Callouts



- 6. Nut
- 7. Washer
- 8. Torque Tube
- 9. Intermediate Push-pull Tube
- 10. Washer
- 11. Torque Tube Support
- 12. Bolt
- 13. Door Link Tube
- 14. Nut
- 15. Washer
- 16. Upper Connecting Link
- 17. Idler Bellcrank
- 18. Bolt
- 19. Spacer
- 20. Door Actuator Arm
- 21. Thrust Bearing Washer
- 22. Roll Pin
- 23. Bellcrank Rocker Arm
- 24. Spacer
- 25. Nut
- 26. Bolt
- 27. Washer
- 28. Thrust Bearing Washer
- 29. Nut
- 30. Bolt
- 31. Rocker Arm Lower Link
- 32. Bellcrank
- 33. Washer
- 34. Nut
- 35. Washer
- 36. Nut
- 37A. Nut

- 37B. Lock Washer
- 37C. Washer
- 38. Thrust Bearing Washer
- 39. Spacer
- 40. Bolt
- 41. Bolt
- 42. Spacer
- 43. Main Drive Tube
- 44. Nut
- 45. Nut
- 45A. Bearing
- 46. Inner Drive Tube
- 47. Bolt
- 48. Outer Drive Tube
- 49. Bolt
- 50. Bushing
- 51. Idler
- 52. Washer
- 53. Nut

NOTE

Door actuator arm (19) and bellcrank (33) are a matched set.

3. Remove nut (37), thrust bearing washers (38), and bolt (10) attaching idler bellcrank (16) to front spar and support web.
4. Remove nut (24), thrust bearing washers (20), and bolt (17) attaching bellcrank rocker arm (22) to front spar and support web.
5. Pull bellcranks and attached linkage from between front spar and support web.
6. Remove spacers (23 and 39) from idler bellcrank (16) and bellcrank rocker arm (22).
7. Remove upper connecting links (15) by removing nuts (13), washers (14), and bolts (25).
8. Remove rocker arm lower link (32) by removing nuts (30 and 35), washers (28 and 34), and bolts (26 and 31).

NOTE

See figure 2-52 for the following steps.

1. Remove outboard push-pull tube (1) as follows:
 1. Disconnect push-pull tube from bellcrank (35) by removing nut (31), washer (32), and bolts (34).
 2. Disconnect push-pull tube from torque tube (3) by removing nut (5) and bolt (4).
2. Remove bellcrank (35) and side brace lock link (42) as follows:
 1. Disconnect DOWN indicator switch (37) by removing nuts (39) and screws (40).
 2. Remove downlock spring.
 3. Disconnect side brace lock link from lower side link (57) by removing nut (55), washer (60) and bolt (45).
 4. Disconnect bellcrank (35) from upper truss by removing nut (29), spacer (30), and bolt (33).
 5. Remove the side brace lock link (42) from bellcrank (35) by removing setscrew (41) and pin (36).
3. Remove uplock assembly as follows:
 1. Disconnect uplock push-pull tube (10) from uplock assembly by removing nut (22), washer (23), and

2. Remove nut (21), washer (20), spacer (26), and bolt (25) attaching uplock assembly to side link (18).
1. Remove side links (18 and 57) as follows:
 1. Disconnect lower side link (57) from upper truss by removing nut (49), door link rod (50), nut (51), washers (52), spacers (53), and bolt (54).
 2. Disconnect upper side link (18) from support (45) by removing nut (27), washer (28), and bolt (17).
 3. Separate side links by removing nut (59), washer (58), and bolt (56).
- m. Remove torque tube (3) as follows:
 1. Disconnect uplock push-pull tube (10) from torque tube by removing nut (6), washer (7), and bolt (8).
 2. Remove nut (9), washer (11), and bolt (2) attaching torque tube to rib mounting bracket.
 3. (See figure 2-51.) Remove nut (1), washer (8), and bolt (9) attaching torque tube to torque tube support (7).

2-293. CLEANING, INSPECTION, AND REPAIR OF MAIN LANDING GEAR RETRACTING LINKAGE.

- a. Clean linkage components with cloth saturated with suitable cleaning solvent. Do not clean sealed bearings or needle bearings which do not have provisions for lubrication.
- b. Inspect linkage components for cracks, nicks, dents, scratches, and excessive wear.
- c. Check all bearings for smoothness of operation.
- d. Repair of main landing gear retracting linkage is limited to replacement of parts, smoothing out of minor nicks, dents, and scratches, and repainting of areas where paint has chipped or peeled.

2-294. INSTALLATION OF MAIN LANDING GEAR RETRACTING LINKAGE. (See figure 2-52.)

- a. Install torque tube (3) as follows:
 1. (See figure 2-51.) Attach torque tube (3) to torque tube support (7) with bolt (9), washer (8), and nut (1).
 2. (See figure 2-52.) Attach torque tube (3) to rib mounting bracket (12) with bolt (2), washer (11), and nut (9).
 3. Connect uplock push-pull tube (10) to torque tube (3) with bolt (8), washer (7), and nut (6).

Figure 2-51