

Log 2327



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 28, 1993

In reply refer to: A-93-74 and -75

Mr. Joseph M. Del Balzo
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

On April 2, 1991, the pilot of a Cessna Model 172RG, N9592B, made an intentional wheels-up landing at DuPage Airport, West Chicago, Illinois, after repeated attempts to lower the landing gear resulted in extension of only the left main and nose gears. The airplane, which had accumulated a total time of 4,567 hours in service, sustained only minor damage, and neither of the two persons aboard was injured. A metallurgical examination disclosed that the splined aluminum shaft on the right main landing gear pivot assembly (P.N. 2441100-1) had failed in torsional overload. Cracks were observed at the roots of many of the spline teeth and were observed to have propagated a significant distance into the shaft. The left main landing gear pivot assembly was found cracked in the same location. Fracture of the splined shaft separated the pivot assembly and gear strut from the hydraulic actuator, making mechanical extension of the landing gear impossible.

Since 1988, there have been a significant number of incidents involving fractured spline-shafts on Cessna Model 172RG main landing gear pivot assemblies. In one case, the pilot was able to force the failed landing gear to the down and locked position by maneuvering and subjecting the airplane to higher than normal load factors. Most of the incidents, however, involved wheels-up landings, which were performed to avoid loss of directional control and to minimize the potential for personal injury and structural damage.

Between January 1, 1986, and February 26, 1993, 20 Service Difficulty Reports (SDR) were submitted to the Federal Aviation Administration (FAA) regarding main landing gear pivot assemblies on Cessna Model 172RG airplanes. These reports reflect two failure modes related to cracking or fracture of the pivot assembly shaft in two distinct areas of the spline. First, the loss of main landing gear system braking and/or brake fluid because of cracks in the pivot assembly shaft under the bushing adjacent to the spline,

and second, mechanical separation of the pivot assembly and gear strut from the main landing gear hydraulic actuator because of fracture of the spline shaft within the actuator sector gear. The latter failure mode, which precipitated the aforementioned incidents, was the subject of 12 of the reports, and occurred in airplanes with total time in service ranging from 1,942 hours to 4,567 hours. The former failure mode, the subject of eight reports, was normally discovered as a result of routine maintenance efforts to locate the source of brake fluid leakage and was cited in only one incident, wherein the pilot lost directional control of the airplane while taxiing.

Several SDR's have also been submitted to the FAA regarding spongy brake operation or loss of brake fluid in R182 airplanes due to cracked main landing gear pivot assemblies. None of the cracks, however, was related to an accident or an incident, and there have been no reports of failure of the main landing gear on those airplanes to extend because of fracture of the pivot assembly's splined shaft.

On April 20, 1990, the Cessna Aircraft Company issued Service Bulletin (SB) SEB90-1, "Main landing Gear Pivot Inspection," applicable to Model 172RG, R182, and FR182 airplanes. The SB recommends that the main landing gear pivot assemblies on these airplanes be inspected for evidence of cracks in the area of the splines during the next 100 hours of operation or annual inspection, whichever occurs first. If cracks are detected, new pivot assemblies (Part Nos. 2441100-9 for the 172RG and 2241102-13 for the R182 and FR182) must be installed. The bulletin also indicates that the inspection must be repeated anytime an airplane has experienced a landing gear overload condition or if the brakes have a "spongy" operation that cannot be attributed to brake component wear or improper servicing.

The new main landing gear pivot assemblies referred to in SB SEB90-1 are intended to assist in providing improved fatigue life. The diameter of the pivot shaft under the bushing adjacent to the spline is increased to prevent cracks and loss of brake fluid. However, the diameter/design of the pivot spline shaft within the hydraulic actuator's sector gear remains unchanged and several fractures of new pivot assemblies have already been reported. Cessna believes that fracture of 172RG main landing gear pivot assemblies in this area results from pilot-induced gear overload conditions such as hard landings and/or excessive sideloads. However, the continuing statistical propensity for pivot assembly fracture failures in 172RG airplanes does not appear to substantiate this belief. Moreover, the relatively large number of landing gear pivot failures in 172RG airplanes contrasts sharply with the lack of similar pivot assembly failures in R182 and FR182 airplanes. As a result, the Safety Board believes that neither pivot assembly Part No. 2441100-1 nor Part No. 2441100-9 is adequate for long-term normal service and that the design of the

new pivot assembly's splined shaft should be changed to improve its structural integrity and durability.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an airworthiness directive applicable to Cessna Model 172RG airplanes with main landing gear pivot assemblies which have been in service for 2,000 hours or more or are known by the operator to have been subjected to excessive sideloads or other hard landing conditions. Unless previously accomplished, the AD should require an inspection of the pivot assembly shafts in the area of the splines for evidence of cracks in accordance with Cessna Service Bulletin SEB90-1. If cracks are detected, new pivot assemblies (P.N. 2441100-9) should be installed before further flight. The inspection should be repeated at appropriate intervals thereafter to ensure the continued structural integrity of the pivot assemblies. (Class II, Priority Action) (A-93-74)

Require the Cessna Aircraft Company to change the design of the splined pivot shaft in the Model 172RG main landing gear pivot assembly, Part No. 2441100-9, in order to improve its structural integrity and durability and preclude the requirement for routine repetitive inspection, as outlined in Safety Recommendation A-93-74. (Class II, Priority Action) (A-93-75)

Chairman VOGT, Vice Chairman COUGHLIN, and Members LAUBER, HART, and HAMMERSCHMIDT concurred in these recommendations.



By: Carl W. Vogt
Chairman

Brief of Incident

File No. - 5021

4/02/91 WEST CHICAGO, IL

Time (Lcl) - 1600 CDT

A/C Reg. No. N9592B

Basic Information---

Type Operating Certificate-NONE (GENERAL AVIATION)

Type of Operation - INSTRUCTIONAL
Flight Conducted Under - 14 CFR 91
Incident Occurred During - LANDING

Aircraft Damage
MINOR
Fire
NONE

Crew Pass
Fatal 0
Serious 0
Minor 0
Injuries
None 2
None 0

Aircraft Information---

Make/Model - CESSNA 172RG
Landing Gear - TRICYCLE-RETRACTABLE
Max Gross Wt - 2650
No. of Seats - 4

Eng Make/Model - LYCOMING O-360-FLA6
Number Engines - 1
Engine Type - RECIPROCATING-CARBURETOR
Rated Power - 180 HP

ELT Installed/Activated - YES/NO
Stall Warning System - YES

Environment/Operations Information---

Weather Data
Wx Briefing - NO RECORD OF BRIEFING
Method - N/A
Completeness - N/A
Basic Weather - VMC
Wind Dir/Speed - 140/010 KTS
Visibility - 15.0 SM
Lowest Sky/Clouds - 2500 FT SCATTERED
Lowest Ceiling - NONE
Obstructions to Vision - NONE
Precipitation - NONE
Condition of Light - DAYLIGHT

Itinerary
Last Departure Point
SAME AS ACC/INC
Destination
LOCAL

Airport Proximity
ON AIRPORT

Airport Data
DUPAGE

Runway Ident - 15
Runway Lth/Wid - 3400/ 100
Runway Surface - ASPHALT
Runway Status - DRY

ATC/Airspace
Type of Flight Plan - NONE
Type of Clearance - NONE
Type Apch/Lndg - FULL STOP

Personnel Information---

Pilot-In-Command
Certificate(s)/Rating(s)
COMMERCIAL, CFI
SE LAND, SE SEA

Age - 25
Biennial Flight Review
Current - YES
Months Since - 11
Aircraft Type - C-310

Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT
Flight Time (Hours)
Total - 1531
Make/Model - 280
Instrument - 139
Multi-Eng - 355
Last 24 Hrs - 2
Last 30 Days - 15
Last 90 Days - 25
Rotorcraft - 0

Instrument Rating(s) - AIRPLANE

Narrative---

AFTER REPEATED ATTEMPTS TO LOWER THE LANDING GEAR, ONLY THE LEFT MAIN AND NOSE GEAR WOULD EXTEND. THE PILOTS ELECTED TO MAKE A WHEELS-UP LANDING. DURING THE LANDING, THE LOWER FUSELAGE AND PROPELLER TIPS RECEIVED MINOR DAMAGE. AN INVESTIGATION REVEALED THE RIGHT MAIN LANDING GEAR PIVOT ASSEMBLY (PN 2441100-1) HAD FAILED. A METALLURGICAL EXAMINATION DISCLOSED THE SPLINED SHAFT ON THE PIVOT ASSEMBLY HAD FRACTURED IN TORSIONAL OVERLOAD. AS A RESULT, MECHANICAL EXTENSION OF THE RIGHT MAIN LANDING GEAR WAS NOT POSSIBLE.

Brief of Incident (Continued)

File No. - 5021

4/02/91

WEST CHICAGO, IL

A/C Reg. No. N9592B

Time (Lcl) - 1600 CDT

Occurrence #1 AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation MANEUVERING

Finding(s)

1. LANDING GEAR, NORMAL RETRACTION/EXTENSION ASSEMBLY - FRACTURED
2. GEAR EXTENSION - NOT POSSIBLE -
3. AIRCRAFT/EQUIPMENT, INADEQUATE DESIGN - PRODUCTION/DESIGN PERSONNEL

Occurrence #2 GEAR NOT EXTENDED
Phase of Operation LANDING

Finding(s)

4. WHEELS UP LANDING - INTENTIONAL - PILOT IN COMMAND(CFI)

-----Probable Cause-----

The National Transportation Safety Board determines that the Probable Cause(s) of this incident was:
FAILURE OF THE SPLINED SHAFT ON THE RIGHT MAIN LANDING GEAR PIVOT ASSEMBLY. A FACTOR RELATED TO THE INCIDENT WAS
INADEQUATE DESIGN OF THE LANDING GEAR PIVOT ASSEMBLY.