



National Transportation Safety Board

Washington, D. C. 20594

Safety Recommendation

Log 2062

Date: September 22, 1988

In reply refer to : A-88-111 and -112

Honorable T. Allan McArtor
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On December 14, 1987, both persons aboard a Piper model PA-28-161, N2138J, were killed when the airplane sustained an engine stoppage and crashed at Draper, Utah.¹ The accident occurred at night after the airplane struck power lines and flipped inverted onto a highway during an attempted emergency landing. The airplane was powered by an Avco Lycoming Textron model 0-320-D3G engine.

The National Transportation Safety Board's investigation of the accident disclosed that the engine stoppage was caused by a failure of the engine crankshaft gear assembly. The gear, which is attached to the counterbored mounting face at the rear of the crankshaft with a bolt, normally drives and transmits power to several engine components including the magnetos and camshaft that control the engine's ignition system and valve train, respectively. In N2138J, the gear attaching bolt had loosened, allowing relative movement between the gear and crankshaft and causing the gear alignment dowel pin to break. The loss of synchronization of valve and ignition timing then resulted in immediate stoppage of the engine. A similar crankshaft gear assembly is installed in all Avco Lycoming direct-drive piston aircraft engines (except 0-320-H, 0-320-E, LO-360-E, TO-360-E, LTO-360-E, and TIO-541 series engines).

The Safety Board believes that the gear attaching bolt loosened because an incorrectly sized heli-coil² had been installed in the gear retaining bolt hole. The heli-coil is believed to have been installed during a field overhaul of the engine in 1985 or in connection with a field repair of the crankshaft gear in 1982.³ The heli-coil had a pitch diameter greater than that on Avco Lycoming engineering drawing No. 3125-24, "Insert," the applicable specification for this part, and a thread length that was only half the value specified thereon. According to Lycoming, it is not permissible for field service personnel to install heli-coils at this critical location. If the gear attaching bolt threads are damaged, the crankshaft must either be replaced or returned to Lycoming for repair where either a heli-coil or a plug (for retapping) will be installed.

¹For more detailed information, see NTSB Accident Brief No. 1981 (attached)

²A screw thread insert for repairing worn or damaged threads.

³The Safety Board suspects that this repair, which required the installation of a new gear alignment dowel pin, was made necessary by a propeller strike.

Since 1982, six other accidents involving engine stoppage have occurred because of failure of this crankshaft gear assembly (see attachment). These occurrences involved Avco Lycoming 0-540 series engines installed in Piper model PA-32-300 airplanes, and 0-320 series engines installed in Piper PA-28 and Cessna 172 series airplanes. The Safety Board's investigation of the accident at Dexter, New York, on October 24, 1982, involving a Piper PA-32-300, N4031W, also disclosed evidence of improper installation of the crankshaft gear. In this case, the gear alignment dowel pin had been installed improperly, which prevented proper seating of the gear. As in the case of N2138J, this improper assembly resulted in loosening of the gear attaching bolt and eventual fracturing of the dowel pin and stoppage of the engine.

A review of incidents involving Avco Lycoming 0-540, 0-360, and 0-320 series engines disclosed the occurrence of eight additional failures of the crankshaft gear assembly since 1982; all occurred in the 0-540 and 0-320 series engines. Moreover, during the period February 1985 to February 1988, another 10 failures of this assembly (including 2 involving the 0-360 series engines) were referenced in general aviation Service Difficulty Reports (SDR).

Because of occurrences of damage or failure of crankshaft gear assemblies similar to those described above, Avco Lycoming, on June 29, 1973, issued service instruction No. 1179D, "Crankshaft and Gear Assembly: Inspection and Repair." The service instruction was subsequently revised and upgraded and on October 31, 1986, was superseded by Avco Lycoming service bulletin No. 475, "Crankshaft Gear Modification and Assembly Procedures." The bulletin, which is to be complied with during overhaul, after a propeller strike, or whenever gear train repair is required, states:

Damage to the crankshaft gear and the counterbored recess in the rear of the crankshaft, as well as badly worn or broken gear alignment dowels are the result of improper assembly techniques or the reuse of worn or damaged parts during reassembly. Since a failure of the gear or the gear attaching parts would result in complete engine stoppage, the proper inspection and reassembly of these parts is very important. The procedures described in the following steps are mandatory.

CAUTION

Prior to making any repairs to the crankshaft, insure that the counterbored gear mounting face of the crankshaft is undamaged by fretting or galling. Damage of this nature is unrepairable.

The bulletin outlines procedures for the following: Inspecting the counterbored gear mounting face of the crankshaft; inspecting, plating, stress relieving, and grinding the pilot flange; inspecting and replacing gear alignment dowel pins; modifying the crankshaft gear (to facilitate inspection of the mating of the gear and crankshaft); and reinstalling the crankshaft gear. The bulletin also emphasizes the need to examine the threads in the gear retaining bolt hole of the crankshaft and to ensure that the tappet hole is clean and the threads are undamaged. If necessary, the threads can be cleaned by running a tap through them. However, although Lycoming does not authorize field repairs to crankshafts with damaged threads, e.g., through use of heli-coils, the bulletin contains no specific information as to the action that should be taken under these circumstances.

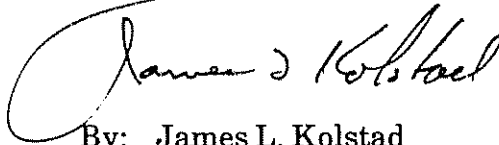
Since proper inspection, repair, and reassembly of these parts is essential to avoid complete engine stoppage, the Safety Board believes that compliance with Avco Lycoming service bulletin No. 475 should be made mandatory. However, the bulletin should also be amended to specify that crankshafts with damaged threads in the gear retaining bolt hole must be replaced with a serviceable unit or be repaired by Lycoming or a facility specifically approved to do that repair.

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

Issue an airworthiness directive applicable to all Avco Lycoming direct-drive piston aircraft engines (except O-320-H, O-360-E, LO-360-E, TO-360-E, LTO-360-E, and TIO-541 series engines) requiring compliance with Avco Lycoming service bulletin No. 475, "Crankshaft Gear Modification and Assembly Procedures," during overhaul, after a propeller strike, or whenever gear train repair is required. (Class II, Priority Action) (A-88-111)

Require that Avco Lycoming amend service bulletin No. 475, "Crankshaft Gear Modification and Assembly Procedures," to specifically indicate that crankshafts with damaged threads in the gear retaining bolt hole must be replaced with a serviceable unit or be repaired by Lycoming or a facility specifically approved to do that repair. (Class II, Priority Action) (A-88-112)

KOLSTAD, Acting Chairman, BURNETT, LAUBER, NALL, and DICKINSON, Members, concurred in these recommendations.



By: James L. Kolstad
Acting Chairman

**ACCIDENTS AND INCIDENTS
INVOLVING BROKEN CRANKSHAFT GEAR ASSEMBLIES
IN AVCO LYCOMING 0-320 AND 0-540 SERIES
AIRCRAFT ENGINES
1982 THROUGH 1987**

Accidents¹

<u>Date</u>	<u>Location</u>	<u>Model</u>	<u>Registration</u>
06/29/82	Glacier Bay, AK	PA-32-300	N2947N
10/24/82	Dexter, NY	PA-32-300	N4031W
05/03/83	Milpitas, CA	PA-28-51	N40755
03/09/85	Friendship, MD	PA-28-140	N1859J
11/08/85	Monroe, LA	C-172P	N52995
12/12/85	Omaha, NE	PA-32-300	N8895E
12/14/87	Draper, UT	PA-28-161	N2138J

Incidents²

<u>Date</u>	<u>Location</u>	<u>Model</u>	<u>Registration</u>
07/03/82	Albuquerque, NM	PA-28-140	N32142
07/22/82	Forty Fort, PA	PA-32-300	N4250R
05/31/83	Columbus, OH	172M	N13739
12/15/83	Yorba Linda, CA	PA-28-161	N82857
10/27/84	Twenty Nine Palms, CA	172M	N8962V
09/30/86	Walnut, MX	PA-32-300	N8905N
03/23/87	Westerly, RI	PA-32-300	N4885T
01/08/88	Carefree, AZ	172P	N5337K

¹NTSB Accident File

²FAA Incident File

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

File No. - 1981 112/14/87 DRAPER,UT A/C Reg. No. N2138J Time (Lcl) - 1858 MST

Basic Information---
Type Operating Certificate-ON-DEMAND AIR TAXI

Type of Operation -POSITIONING
Flight Conducted Under -14 CFR 91
Accident Occurred During -APPROACH

Aircraft Information---
Make/Model - PIPER PA-28-161
Landing Gear - TRICYCLE-FIXED
Max Gross Wt - 2325
No. of Seats - 4

Environment/Operations Information---

Weather Data
WX Briefing - NO RECORD OF BRIEFING
Method - N/A
Completeness - N/A
Basic Weather - VMC
Wind Dir/Speed- 260/004 KTS
Visibility - 30.0 SM
Lowest Sky/Clouds - 6500 FT SCATTERED
Lowest Ceiling - 25000 FT OVERCAST
Obstructions to Vision- NONE
Precipitation - NONE
Condition of Light - NIGHT(BRIGHT)

Personnel Information---
Pilot-In-Command
Certificate(s)/Ratings(s)
COMMERCIAL,CFI
SE LAND,ME LAND

Asse - 27
Biennial Flight Review
Current - YES
Months Since - 19
Aircraft Type - PA-28

Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT
Flight Time (Hours)
Total 961
Make/Model- 123
Instrument- 85
Multi-Eng - 255

Instrument Ratings(s) - AIRPLANE

Narrative---

DRG A NGT FLT TO REPOSITION THE ACFT TO ITS HOME BASE, THE ENG LOST PWR AS THE FLT WAS CRUISING AT ABOUT 1000' AGL, HE TRANSMITTED A "MAYDAY" CALL & MANEUVERED THE ACFT TO MAKE A FORCED LNDG ON AN INTERSTATE HIWAY, WHILE APCHG TO LND, THE ACFT STRUCK THE TOP (GROUND) WIRE OF A PWR LINE THAT CROSSED THE HIWAY IN THAT AREA. THE ACFT THEN FLIPPED OVER & FELL ON THE NORTHRD LANE OF THE HIWAY. A TEAR DOWN OF THE ENG REVEALED THE ACCESSORY DRIVE GEAR ATTACHING BOLT (PN: STD-847) HAD BACKED OUT, ALLOWING THE DRIVE GEAR TO LOOSEN. THIS RSLTED IN A LOSS OF SYNCHRONIZATION OF VALVE & IGNITION TIMING. AN INCORRECTLY SIZED HELI-COIL, USED TO REPAIR THE GEAR ATTACHING THREADS, WAS FOUND INSTALLED IN THE CRANKSHAFT.

Aircraft Damage
DESTROYED
Fire NONE
Crew 0
Pass 0
Fatal 1
Serious 0
Minor 0
Injuries 0
Monr 0

Eng Make/Model - LYCOMING O-320-D3G
Number Engines - 1
Engine Type - RFCIPROCATING-CARRURETOR
Rated Power - 160 HP
ELT Installed/Activated - YES/NO
Stall Warning System - YES

Itinerary
Last Departure Point
SALT LAKE CITY,UT
Destination
PROVO,UT

Airport Proximity
OFF AIRPORT/STRIP

Airport Data
Runway Ident - N/A
Runway Lth/Mid - N/A
Runway Surface - N/A
Runway Status - N/A

ATC/Airspace
Type of Flight Plan - VFR
Type of Clearance - VFR
Type Apch/Lnds - FORCED LANDING

Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT

Flight Time (Hours)

Total 961
Make/Model- 123
Instrument- 85
Multi-Eng - 255

Instrument Ratings(s) - AIRPLANE

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Brief of Accident (Continued)

File No. - 1981 12/14/87 DRAPER, UT A/C Reg. No. N213RJ Time (Lcl) - 1853 MST

Occurrence #1 LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/HALT
Phase of Operation CRUISE - NORMAL

- Findings(s)
1. MAINTENANCE, INSTALLATION - IMPROPER -
2. ACCESSORY DRIVE ASSY, DRIVE GEAR - LOOSE
3. ACCESSORY DRIVE ASSY, DRIVE GEAR - DISENGAGED

Occurrence #2 FORCED LANDING
Phase of Operation DESCENT - EMERGENCY

Occurrence #3 IN FLIGHT COLLISION WITH OBJECT
Phase of Operation APPROACH - VFR PATTERN - FINAL APPROACH

- Findings(s)
4. OBJECT - WIRE, TRANSMISSION
5. LIGHT CONDITION - NIGHT

Occurrence #4 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation DESCENT - UNCONTROLLED

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

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are findings(s) 1,2,3

Factor(s) relating to this accident is/are findings(s) 4,5