

Adopted: 11/16/90



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: November 19, 1990

In reply refer to: A-90-164 through -166

Honorable James S. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Since February 3, 1990, turbocharged Piper Models PA-32RT-300T (Turbo Lance II) and PA-32R-301T (Turbo Saratoga SP) have been involved in four accidents (two fatal) as a result of in-flight engine fires that resulted in engine stoppage and/or dense, heavy smoke filling the cabin. The airplanes are powered by Textron Lycoming Model TIO-540-SIAD engines. Previous accidents involving similar in-flight engine fires in these airplanes were the subject of National Transportation Safety Board Safety Recommendations A-88-147 through -152 issued to the Federal Aviation Administration (FAA) on October 19, 1988. Excerpts from the recommendations illustrate the continuing nature and causal circumstances of these accidents:

On October 13, 1987, a turbocharged Piper Lance Model PA-32RT-300T airplane, N39922, crashed in Lincoln, Nebraska, killing two of the three occupants aboard. The airplane had just departed the Lincoln Municipal Airport and was climbing to cruise altitude when smoke began filling the cabin. Shortly thereafter, the engine stopped and the pilot attempted an emergency landing. However, the airplane struck the roof of a house, a chainlink fence, and a large woodpile and then immediately burst into flames. The fire killed the pilot and front seat passenger and caused second- and third-degree burns to the rear seat passenger who was able to escape.

The Safety Board's investigation of the accident disclosed that an engine fire had occurred as a result of a failure/separation of the engine's left intermediate exhaust pipe (elbow). This 90 degree elbow, Lycoming part No. LW-15811, had separated from the exhaust crossover tube leading to the turbocharger and allowed intense, hot exhaust gases flowing from the elbow to spew directly into the engine compartment. The aft end of the elbow is normally attached to the crossover tube through a slip joint. The forward, flanged end of the elbow remained attached to the No. 6 cylinder exhaust pipe through a V-band coupling and gasket, Lycoming part Nos.

LW-12093-5 and 78084, respectively. However, about three-fourths of the elbow's flange was cracked, and the evidence indicated that the crush-proof gasket, as well as the flanges, had not been centered or concentric, but had been misaligned.

The Turbocharged Piper Models PA-32RT-300T (Turbo Lance II), PA-32-301T (Turbo Saratoga), and PA-32R-301T (Turbo Saratoga SP) are all powered with Lycoming Model TIO-540-S1AD engines. Since 1982, the PA-32RT-300T and PA-32R-301T have been involved in seven other accidents and four incidents involving the engine exhaust system. The causal circumstances in a majority of the occurrences bear a striking resemblance to those of N39922 and relate chiefly to loose or separated left intermediate exhaust pipes, cracked flanges, loose or broken V-band couplings, and misaligned gaskets. Moreover, during the same period, 26 service difficulty reports (SDR) were filed with the Federal Aviation Administration (FAA) regarding problems with the engine exhaust systems in these airplanes. Again, most of the reports related to failures of the left intermediate exhaust pipes and the V-band couplings.

Frequent failures of the left intermediate exhaust pipe (looseness, cracked flanges, separation) and V-band couplings may be caused by improper torque on the V-band couplings; failure of the couplings because of cracked segments or missing T-bolts; misaligned elbow/exhaust pipe flanges or gaskets or use of the wrong type of gaskets; vibration and fatigue of the elbow flanges; inadequate support of the elbow/crossover tube; a loose or inadequately sized slip joint; or inadequate exhaust system tolerances to ensure the proper fit and alignment of the elbow.

In response to these recommendations, Textron Lycoming, on January 30, 1989, issued Service Bulletin No. 484, "Inspection, Alignment and Modification of Crossover Exhaust Assembly." Part I of the bulletin outlines an inspection and alignment of the crossover exhaust system to be performed at the first 25-hour inspection and each 100 hours thereafter. Part II of the bulletin provides for a modification of the crossover exhaust system which consists of replacing the single-piece crossover pipe (Part No. LW-15810) with a new two-piece crossover pipe assembly (Part Nos. LW-16103 and LW-16102) and replacing the left intermediate exhaust pipe (Part No. LW-15811) with a new, zero time in-service part. Additionally, Airworthiness Directive (AD) 89-12-04, effective June 9, 1989, was issued by the FAA requiring repetitive inspections of the Model TIO-540-S1AD engine crossover exhaust assembly in order "to prevent cracking or distortion of engine exhaust system flanges, V-band coupling, and pipes, which could result in separation of exhaust pipes releasing hot exhaust gases into the engine compartment." Modification of the exhaust system, as referenced in Service

Bulletin No. 484, was considered terminating action for the repetitive inspections.

The circumstances relating to the most recent accidents are as follows:

On September 7, 1990, a Piper Model PA-32RT-300T, N393HM, crashed into Prince William Sound near Glacier Island, about 30 miles southwest of Valdez, Alaska, killing both the pilot and his passenger. The airplane, en route from Valdez to Palmer, Alaska, had been airborne 20 minutes when the pilot reported a rough-running engine and smoke in the cockpit. Five minutes later he declared an emergency. Shortly thereafter, he apparently attempted to ditch the airplane and/or lost control of the airplane and crashed. Only the passenger's body and a 4-foot section of the wing were recovered from the water. The Safety Board's investigation of the accident (ANC90LA173) is continuing.

On July 9, 1990, a Piper Model PA-32RT-300T, N30511, crashed 10 miles southeast of Prineville, Oregon. The pilot was killed and the aircraft was destroyed. Witnesses reported hearing a rough-running engine and observed the airplane trailing white smoke and performing erratic maneuvers at low altitude. One of the witnesses, a pilot, reported that the cabin of the airplane was filled with smoke. The Safety Board's investigation of the accident (SEA90FA129) is continuing.

On April 8, 1990, a Piper Model PA-32R-301T, N363CC, sustained an engine fire resulting in a complete loss of engine power during climbout, shortly after departing Hanscom Field, Bedford, Massachusetts. The pilot was able to return to the airport and execute an emergency landing without injury, but the landing gear collapsed resulting in substantial damage to the airplanes wings and fuselage. The Safety Board's investigation of the accident (NYC90LA084) is continuing.

On February 3, 1990, the pilot of a Piper Model PA-32RT-300T, N21492, en route from Salt Lake City, Utah, to Moab, Utah, diverted to Provo, Utah, after observing a decrease in engine manifold pressure during cruise flight. However, just prior to landing at Provo, dense smoke filled the cockpit forcing him to open the small side vent window in order to see the runway and complete the landing.¹ The pilot was uninjured but the airplane was substantially damaged.¹

Based on its investigations of these accidents, the Safety Board has determined that modification of the crossover exhaust assembly had been accomplished on N30511, N363CC, and N21492. Records/engine wreckage from N393HM, which crashed in the water, have not been recovered. However, because of the timeframe involved since issuance of Service Bulletin No. 484 and AD 89-12-04, the Board believes that the modification had probably also been accomplished on this airplane. Nonetheless, an examination of the engine exhaust systems from N30511, N363CC, and N21492, disclosed that the engine fires in these airplanes resulted from fatigue cracking of the left

¹ See Attached Accident Brief No. 440 for additional details

intermediate (Part No. LW-15811) exhaust pipe attachment flanges. Cracking of the flange allows excessive movement of the pipe and may result in separation at the aft slip joint connection to the crossover tube (Part No. LW-16103). It was also determined that the pipes had been improperly engaged at this slip joint for an extended period of time. Additionally, other similar failures of these exhaust pipes, including cracked attachment flanges and separated slip joints, have been the subject of several recent service difficulty reports (SDR) submitted to the FAA.

In view of the continued propensity for failure of the left intermediate exhaust pipes, it is clear that the modification described in Service Bulletin No. 484 and AD 89-12-04 is not an effective solution to the problem and that the design-service reliability of these parts must be improved. Textron Lycoming should reevaluate the design of these components and the design installation aspects of the exhaust system that may be causing or contributing to such failures. Appropriate components or exhaust system design changes should be incorporated as necessary. However, until such design changes have been implemented, it is essential that the exhaust system (crossover exhaust components) continue to be periodically inspected in accordance with Part I of Lycoming Service Bulletin No. 484, or an updated equivalent procedure. The continuing inspections are necessary, irrespective of compliance with the modification described in the service bulletin, to ensure the alignment and integrity of the exhaust pipe flanges and the proper engagement (a minimum of 1 1/2 inches) at several slip joints.

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

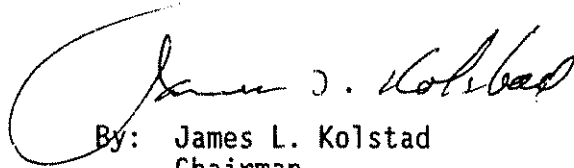
Issue an airworthiness directive applicable to Textron Lycoming Model TIO-540-SIAD engines requiring within the next 10 hours of flight, and at appropriate recurring intervals thereafter, an inspection and alignment of the crossover exhaust assembly in accordance with Part I of Textron Lycoming Service Bulletin No. 484 regarding this subject or an updated equivalent procedure to ensure the alignment and integrity of exhaust pipe flanges and proper engagement at the slip joints. (Class I, Urgent Action) (A-90-164)

Require Textron Lycoming to issue a service bulletin incorporating a new, improved design modification to the Model TIO-540-SIAD engine exhaust system in order to prevent in-flight engine fires resulting from failure/separation of the left intermediate exhaust pipe. The modification should be based on consideration of those aspects which may affect the assembly, installation, and integrity of the left intermediate exhaust pipe, e.g., exhaust pipe flange thickness/flatness, V-band coupling design, exhaust pipe alignment tolerances, vibration, fatigue characteristics, adequacy of slip joints, and the need for any

supplemental structural support of the exhaust pipe
(Class I, Urgent Action) (A-90-165)

Issue an airworthiness directive applicable to Textron
Lycoming Model TIO-540-SIAD engines requiring
modification of the engine exhaust system in accordance
with the Textron Lycoming service bulletin referenced in
Safety Recommendation A-90-164. (Class I, Urgent Action)
(A-90-166)

KOLSTAD, Chairman, COUGHLIN, Vice Chairman, and LAUBER, BURNETT, AND
HART, Members, concurred in these recommendations.



By: James L. Kolstad
Chairman

Brief of Accident

File No. - 440 2/03/90 PROVO,UT

A/C Res. No. N21492

Time (Lcl) - 0830 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-32RT-300T
Landing Gear - TRICYCLE-RETRACTABLE
Max Gross Wt - 3600
No. of Seats - 7

Aircraft Damage
SUBSTANTIAL
Fire
IN FLIGHT

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

End Make/Model - LYCOMING TIO-540-S1AD
Number Engines - 1
Engine Type - RECIP-FUEL INJECTED
Rated Power - 300 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 - UNK/NR
Visibility - 50.0
Lowest Sky/Clouds - SM
Obstructions to Vision - NONE
Precipitation - NONE
Condition of Light - DAYLIGHT

Itinerary

Last Departure Point
SALT LAKE CITY,UT
Destination
MOAB,UT

Airport Proximity
OFF AIRPORT/STRIP

Airport Data

PROVO
Runway Ident - 13
Runway Lth/Wid - 7096/ 150
Runway Surface - ASPHALT
Runway Status - DRY

Personnel Information

Pilot-In-Command
Certificate(s)/Ratings(s)
COMMERCIAL
SE LAND

Age - 60

Biennial Flight Review
Current - YES
Months Since - 1
Aircraft Type - PA-28

Medical Certificate - VALID MEDICAL-WAIVERS/LIMIT
Flight Time (Hours)
Total - 1682

Make/Model -
Instrument -
Multi-Eng -
Last 24 Hrs - 1
Last 30 Days - 4
Last 90 Days - 9
Rotorcraft - 0

Instrument Rating(s) - AIRPLANE

Narrative

DURING FLT, THE FLT NOTED A DROF IN MANIFOLD PRESSURE & DECIDED TO MAKE A PRECAUTIONARY LANDING. WHILE ON A BASE LEG TO LAND, HEAVY SMOKE & FUMES FILLED THE CABIN & REQUIRED THE FLT TO LOOK OUT THE SIDE VENT WINDOW TO COMPLETE THE LANDING. AFTER THE AIRCRAFT STOPPED ON THE RUNWAY, A FIRE IN THE ENGINE COMPARTMENT WAS EXTINGUISHED. AN EXAM REVEALED THAT THE LEFT INTERMEDIATE EXHAUST PIPE (LYCOMING PART NO: LW-15811) HAD PARTIALLY SEPARATED AT THE FLANGE. THE ENGINE CROSSOVER EXHAUST ASSEMBLY HAD BEEN MODIFIED IN ACCORDANCE WITH AD 89-12-04 & TEXTRON LYCOMING SERVICE BULLETIN #484, WHICH WERE INTENDED TO PREVENT THIS KIND OF FAILURE/SEPARATION.

Brief of Accident (Continued)

File No. - 440 2/03/90 PRUDD, UT

A/C Reg. No. N21492

Time (LCL) - 0830 MST

Occurrence #1 AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation CRUISE - NORMAL

Findings(s)

1. MAINTENANCE, INSTALLATION - IMPROPER - COMPANY MAINTENANCE PSNL
2. MAINTENANCE, SERVICE BULLETINS - INADEQUATE - MANUFACTURER INSUFFICIENT STANDARDS/REQUIREMENTS - FAA(ORGANIZATION)
- 3.
4. EXHAUST SYSTEM, MANIFOLD - FATIGUE
5. EXHAUST SYSTEM - LEAK
6. FLIGHT TO ALTERNATE DESTINATION

Occurrence #2 FIRE
Phase of Operation APPROACH - VFR PATTERN - BASE LEG/BASE TO FINAL

Findings(s)

7. ENGINE COMPARTMENT - FIRE

Occurrence #3 FORCED LANDING
Phase of Operation LANDING

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

The National Transportation Safety Board determines that the Probable Cause(s) of this accident was:
IMPROPER INSTALLATION BY MAINTENANCE PERSONNEL AND FATIGUE FAILURE AND LEAKAGE OF THE LEFT INTERMEDIATE EXHAUST PIPE, WHICH RESULTED IN AN IN-FLIGHT FIRE IN THE ENGINE COMPARTMENT. CONTRIBUTING FACTORS WERE:
INADEQUATE SERVICE BULLETIN PROVIDED BY THE MANUFACTURER AND INSUFFICIENT STANDARDS PROVIDED BY THE (FAA)
AIRWORTHINESS DIRECTIVE.