



National Transportation Safety Board

Washington, D. C. 20594

Safety Recommendation

Log 2043

Date: October 19, 1988

In reply refer to : A-88-147 through -152

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

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.¹

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° 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 1932, 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

¹For more detailed information, read Field Accident Brief No. 2065 (attached).

airplanes. Again, most of the reports related to failures of the left intermediate exhaust pipes and the V-band couplings.

Service instructions, service bulletins (SB), and airworthiness directives (AD) relating to the above problems include: Piper SB No. 884, *Lock-Wiring of V-Band Couplings* (April 1988); Lycoming Service Instruction No. 1422, *Exhaust System Inspection* (July 1982); Piper SB No. 657A, *Turbo-Charger Exhaust Coupling and Tailpipe Flange Inspection* (August 1979); Airworthiness Directive 80-20-05 (requiring compliance with Piper SB 657A); Lycoming Service Instruction No. 1238A, *Assembly and Torque Procedures for V-Band Couplings* (April 1977); and Lycoming Service Instruction No. 1320, *Tightening Procedures for Exhaust Manifold Components* (March 1975).

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 view of the propensity for failure of these exhaust pipes and V-band couplings and the consequent hazards of an in-flight fire, the Safety Board believes that the design-service reliability of these assemblies should be improved. Therefore, the Piper Aircraft Corporation should review the design of these components and the design-installation aspects of the exhaust system which may be causing or contributing to such failures and incorporate appropriate component or exhaust system design changes as necessary. In the interim, an airworthiness directive should be issued requiring routine, periodic inspection of all V-band coupling joints for evidence of V-band cracks, distortion, or improper torque; loose, cracked, or misaligned elbow/exhaust pipe flanges; and misaligned or deformed flange gaskets.

There are several V-band sealed joints in the exhaust systems of the Piper Models PA-32RT-300T, PA-32-301T, and PA-32R-301T, e.g., at the right and left intermediate exhaust pipes and at the turbocharger wastegate and tailpipe exhaust outlet, and it is essential to correctly assemble these joints to ensure a high degree of integrity and reliability. For example, if the flanges and/or gaskets are not properly aligned at installation; if the coupling segments and pipe flanges do not comply with certain critical dimensional specifications; if the band tension is not distributed uniformly; if the proper, new crush-proof gasket is not used; or if the coupling is incorrectly torqued, the joint will not seal properly but may later loosen, causing cracking of the flanges or couplings and, eventually, catastrophic separation of the joint itself. Although the provisions of Lycoming Service Instructions Nos. 1238A and 1320 are applicable to some of these installation problems, they do not relate specifically to the PA-32 series airplanes. Therefore, because these V-band joints are so critically related to safety, the Safety Board believes that Piper should issue a service bulletin detailing the proper procedures for their assembly. The service bulletin, when available, should be incorporated in an airworthiness directive.

Several failures of V-band couplings were noted in the SDRs in which the coupling's T-bolt broke and allowed the coupling to separate from the joint. The simple expedient of lock wiring V-band couplings, as outlined in Piper SB No. 884, can prevent separation of the coupling and should be accomplished

routinely any time a V-band coupling is installed. As a result, the Safety Board believes that the FAA should issue an airworthiness directive requiring compliance with this bulletin.

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

Require the Piper Aircraft Corporation to conduct a design review of the exhaust systems in Piper Models PA-32RT-300T, PA-32-301T, and PA-32R-301T airplanes, particularly in connection with 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 supplemental structural support of the exhaust pipe. Any deficiencies found in the design or installation of the exhaust systems should be corrected as necessary. (Class II, Priority Action) (A-88-147)

Issue an airworthiness directive applicable to Piper Models PA-32RT-300T, PA-32-301T, and PA-32R-301T airplanes requiring at each 100-hour or annual inspection, whichever occurs first, an inspection of exhaust system V-band coupled joints for evidence of coupling damage, distortion, or improper torque; loose, cracked, or misaligned intermediate exhaust pipe or tailpipe flanges; improper flange thickness; and misaligned or deformed flange gaskets. (Class II, Priority Action) (A-88-148)

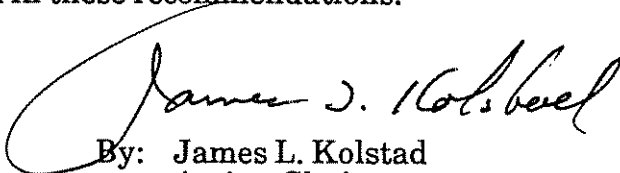
Require the Piper Aircraft Corporation to issue a service bulletin applicable to Piper Models PA-32RT-300T, PA-32-301T, and PA-32R-301T outlining the proper installation procedures to be used in assembling the V-band coupled exhaust system joints in these airplanes. (Class II, Priority Action) (A-88-149)

Issue an airworthiness directive applicable to Piper Models PA-32RT-300T, PA-32-301T, and PA-32R-301T requiring at 100-hour/annual inspections, or whenever exhaust system V-band couplings are installed, compliance with the Piper service bulletin regarding proper installation of these assemblies (referred to in Safety Recommendation A-88-149) or an equivalent procedure. (Class II, Priority Action) (A-88-150)

Issue an airworthiness directive applicable to Piper Models PA-32RT-300T, PA-32-301T, and PA-32R-301T airplanes requiring at each 100-hour or annual inspection, whichever occurs first, compliance with Piper Service Bulletin No. 884, *Lock-Wiring of V-Band Couplings*. (Class II, Priority Action) (A-88-151)

Issue an advisory in Advisory Circular No. 43-16, *General Aviation Airworthiness Alerts*, relating to the exhaust systems in Piper Models PA-32RT-300T, PA-32-301T, PA-32R-301T, and other turbocharged airplanes, emphasizing the importance of proper assembly of V-band coupled joints; conditions which may cause failure of the joints and the potential fire hazards associated with such failures; and the need for periodic, detailed inspection of these joints. (Class II, Priority Action) (A-88-152)

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



By: James L. Kolstad
Acting Chairman

ACCIDENTS AND INCIDENTS INVOLVING EXHAUST SYSTEM
 FAILURES IN TURBOCHARGED
 PIPER PA-32 SERIES AIRPLANES
 1982 THROUGH 1987

Accidents¹

Date	Location	Model	Registration
06/22/82	Durango, CO	PA-32RT-300T	N31912
05/02/83	Murfreesboro, TN	PA-32RT-300T	N22011
01/11/84	Albuquerque, NM	PA-32R-301T	N81753
04/06/86	Fort Deposit, AL	PA-32R-301T	N22370
04/10/86	Perry, IA	PA-32R-301T	N8178N
07/29/86	Morris, IL	PA-32R-301T	N81753
08/12/87	Mexia, TX	PA-32R-301T	N8159S
10/13/87	Lincoln, NE	PA-32RT-300T	N39922

Incidents²

Date	Location	Model	Registration
01/02/83	San Antonio, TX	PA-32R-301T	N82273
10/30/85	Hesperia, CA	PA-32R-301T	N43850
05/03/86	Bakersfield, CA	PA-32R-301T	N3579Q
07/27/86	Michigan City, IN	PA-32RT-300T	N39628

¹NTSB Accident File.

²FAA Incident File.

Brief of Accident

File No. - 2065 10/17/87 LINCOLN, NE A/C Reg. No. N39922 Time (Lcl) - 1530 CDT

Basic Information

Type Operating Certificate - NONE (GENERAL AVIATION)
Type of Operation - BUSINESS
Flight Conducted Under - 14 CFR 91
Accident Occurred During - LANDING

Aircraft Damage
Fire DESTROYED
Crew 0
Pass 1
Fatal 1
Serious 0
Minor 0
None 0

Aircraft Information

Make/Model - PIPER PA-32RT-300T Eng Make/Model - LYCOMING TIO-540-S1AD ELI Installed/Activated - YES/NO
Landing Gear - TRICYCLE-RETRACTABLE Number Engines - 1 Stall Warning System - YES
Max Gross Wt - 3400 Engine Type - RFCIP-FUEL INJECTED
No. of Seats - 6 Rated Power - 300 HP

Environment/Operations Information

Weather Data
Wx: Briefing - UNK/NR Itinerary
Method - UNK/NR Last Departure Point
Completeness - UNK/NR SAME AS ACC/INC
Basic Weather - VMC Destination
Wind Dir/Speed - 200/014 KTS KANSAS CITY, MO
Visibility - 15.0 SM ATC/Airspace
Lowest Sky/Clouds - 12000 FT SCATTERED Type of Flight Plan - UNK/NR
Lowest Ceiling - 25000 FT OVERCAST Type of Clearance - VFR
Obstructions to Vision - NONE Type Appch/Lnds - FORCED LANDING
Precipitation - NONE
Condition of Light - DAYLIGHT

Airport Proximity
OFF AIRPORT/STRIP

Airport Data

Runway Ident - N/A
Runway Lth/Wid - N/A
Runway Surface - GRASS/TURF
Runway Status - DRY
HIGH VEGETATION

Personnel Information

Pilot-In-Command
Certificate(s)/Rating(s)
COMMERCIAL
SE LAND
Age - 64 Medical Certificate - VALID MEDICAL-WAIVERS/LIMIT
Biennial Flight Review Flight Time (Hours)
Current - UNK/NR Total - 3300 Last 24 Hrs - UNK/NR
Months Since - UNK/NR Make/Model - UNK/NR Last 30 Days - UNK/NR
Aircraft Type - UNK/NR Instrument - 0 Last 90 Days - UNK/NR

Instrument Rating(s) - AIRPLANE

Particulate

DURING CLIMBOUT, SMOKE BEGAN FILLING THE CABIN AND SHORTLY THEREAFTER THE ENG STOPPED. GROUND WITNESSES OBSERVED SMOKE COMING FROM THE ENG COMPARTMENT JUST BEFORE THE ACFT IMPACTED A LARGE WOODPILE BEHIND A HOUSE LOCATED 1/2 MILE EAST OF THE ACFT. EXAMINATION DISCLOSED THAT THE LEFT INTERMEDIATE EXHAUST PIPE (A HEAVY FLOW) HAD SEPARATED FROM THE EXHAUST CROSSOVER TUBE LEADING TO THE TURBOCHARGER AND ALLOWED EXHAUST, HOT EXHAUST GASES FLOWING FROM THE ELBOW TO OPEN DIRECTLY INTO THE ENG COMPARTMENT. THE FLAME AT THE OTHER END OF THE FLOW WAS INKED AND EVIDENCE INDICATED THAT THE GASETS, AS WELL AS THE FLAMES, HAD BEEN MISCELLANEOUSLY A DETAILS HAD BEEN MADE TO THE EXHAUST SYSTEM ABOUT A MONTH BEFORE THE ACCIDENT.

Brief of Accident (Continued)

File No. - 2065 10/13/87 LINCOLN, NE A/C Reg. No. N70932 Time (L-1) 1510 (H)

Occurrence #1 FIRE
Phase of Operation TAKEOFF - INITIAL CLIMB

- Findings(s)
1. EXHAUST SYSTEM, GASKET - OTHER
 2. EXHAUST SYSTEM, MANIFOLD - OTHER
 3. MAINTENANCE, SERVICE OF AIRCRAFT - IMPROPER - OTHER MAINTENANCE PSNL
 4. EXHAUST SYSTEM, MANIFOLD - CRACKED
 5. EXHAUST SYSTEM, MANIFOLD - SEPARATION

Occurrence #2 LOSS OF ENGINE POWER (TOTAL) - MECH FAILURE/MALF
Phase of Operation TAKEOFF - INITIAL CLIMB

- Findings(s)
6. EXHAUST SYSTEM, MANIFOLD - FIRE
 7. IGNITION SYSTEM, HIGH TENSION WIRING - BURNED

Occurrence #3 FORCED LANDING
Phase of Operation LANDING

Occurrence #4 IN FLIGHT COLLISION WITH OBJECT
Phase of Operation LANDING

- Findings(s)
8. FUSELAGE, CREW COMPARTMENT - SMOKE
 9. OBJECT - RESIDENCE
 10. TERRAIN CONDITION - HIGH OBSTRUCTION(S)

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

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are finding(s) 5,6,7

Factor(s) relating to this accident is/are finding(s) 1,2,3,4,8,10