Log 2427

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 31, 1993

In reply refer to: A-93-110
through -113

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 5, 1992, a Piper Cheyenne Model PA-31T-620, N131AF, powered with Pratt and Whitney PT6A-11 turboprop engines, experienced a loss of elevator pitch control about 30 miles south of Medford, Oregon. The airplane, operated by Ameriflight, Inc., under 14 CFR Part 135, was being flown on autopilot in visual meteorological conditions at flight level 230 when it suddenly pitched up and the autopilot disengaged. The pilot applied forward pressure on the control yoke without effect but was finally able to stop the airplane from climbing at flight level 245 by substantially reducing engine power. Then, the airplane entered a series of pitch oscillations, climbing and descending, until the pilot eventually regained control and stabilized the airplane at flight level 210 through the judicious use of engine power and the elevator trim tab. He then declared an emergency, diverted to Sacramento, California, and landed without further incident.

A subsequent inspection of the airplane disclosed that the aft rod end bearing (P/N 49261-02) connecting the elevator control tube to the elevator horn had failed, separating into two pieces in the threaded section. As a result, the elevator control was mechanically disconnected from the pilot's control yoke and the elevator downspring. An examination by the National Transportation Safety Board disclosed that the failure occurred due to fatigue cracking. The fatigue crack initiated at the thread root and propagated through the rod end cross section before final separation occurred at a small ductile region. The bearing moved freely within its housing.

The airplane had accumulated a total time in service of 12,097 flight hours and had been inspected in accordance with 14 CFR 135.419, Approved Aircraft Inspection Program. That portion of the inspection program relating to the empennage, however, did not specifically address an inspection of the elevator aft rod end bearing or control tube (pushrod) assembly (P/N 40847-07). It

simply stated "inspect rudder, elevator, and trim cables, turnbuckles, guides and pulleys for safety, cable tension, damage and operation." Nor does the Piper maintenance manual address such an inspection. Moreover, when Ameriflight repaired N131AF, the forward and aft elevator pushrod attaching bolts were also found to be worn and were replaced. The forward bolt evidenced 0.073 inches of wear, about 1/3 of the shank diameter.

The Cheyenne was the only Piper PA-31T turboprop model owned by Ameriflight, but Ameriflight also operates 30 other Piper PA-31 Navajo and Chieftain airplanes with reciprocating engines. The elevator control tubes and rod end bearings in all of these airplanes are identical. Therefore, following the incident involving N131AF, Ameriflight issued Service Bulletin (SB) No. 328, "PA-31 Series Elevator Pushrod Inspection," to assure the integrity and safety of its fleet. The procedure includes periodic inspection of the rod end bearings for cracks; inspection of the control tube assembly's forward attachment holes and bushings for wear, cracks, corrosion, or elongation; and replacement of the forward and aft attachment bolts.

Service bulletins are normally prepared by the aircraft manufacturer and distributed to all affected owner/operators. Since SB No. 328 was an internal company document, distribution was limited to Ameriflight.

On June 21, 1993, Ameriflight submitted a Mechanical Reliability Report (MRR) to the Federal Aviation Administration, summarizing its inspection experience with elevator pushrod assemblies in 23 of its Piper PA-31 series airplanes. The following is an excerpt:

> Ameriflight is an all-cargo part 135 operator with a fleet of over 100 aircraft, including a large number of Piper PA-31 series aircraft.
>
> In November of 1992, Ameriflight's PA 31T Cheyenne experienced a complete loss of elevator control in flight which resulted in a sudden, uncontrollable pitch up. After struggling with the aircraft, the pilot was able to regain control, and with careful use of engine power and elevator manual trim, he was able to successfully accomplish an emergency landing.
>
> The loss of control was caused by the failure of the elevator push rod's aft rod end, approximately 1/4 inch into the threads (from the shank end), an area which was above the jam nut, thus in an area visible for inspection. It appears that the rod end had a previous crack in this location. Further, the pushrod forward attach bolt had 0.073 inch of wear (almost 1/3 of the shank diameter), and the aft attach bolt had 0.010 inch

of wear. This incident was the subject of a prior MRR and the item also appeared in the *General Aviation Airworthiness Alerts*.

There [are] no specific instructions in Piper's inspection program to periodically disassemble and inspect the components in this area. The components cannot be properly inspected without disassembly.

Additional investigation showed that the affected portion of the elevator control system is identical to that on the PA 31-310 Navajo and the PA 31-350 Chieftain. With this in mind, [Ameriflight] proceeded to campaign all our PA 31 series aircraft by means of a Company Service Bulletin.

The 23 aircraft checked ranged in total time from 5,522 to 19,980 hours, with a fleet average of 10,300 hours total time. None of the piston-powered PA31s had wear or damage approaching the severity of that found on the Cheyenne, but this was as expected, due to the fact that the Cheyenne has much higher loads on the system, due to its power and speed.

A complete listing of the discrepancies found is included at the end of this report, and the following is a summary:

* Only 2 aircraft out of the 23 sampled were found to not have any discrepancies in this area.

* 13 aircraft were found to have incorrect push rod connecting bolts installed in the forward, aft or both positions. AN 174 close tolerance bolts are required, AN 4 standard bolts were found.

* 12 aircraft were found with push rod connecting bolts to have wear in the shank area and/or pitting corrosion.

* 13 aircraft were found to have excessive play in the aft rod end bearing, ranging from moderate to severe with the retaining rings loose.

* 7 aircraft were found with aft rod ends having moderate to severe wear and/or corrosion on the bearing ball, with much of the chrome worn away.

* Three rod ends were found to be binding, one of which was frozen completely.

The Safety Board believes that specific inspection of elevator control tube assemblies and rod end bearings should be referenced in all Piper PA-31 airplane maintenance manuals. These airplanes are frequently used in commuter operations under 14 CFR Part 135 where excessive wear or failure may occur because of the accumulation of relatively large total flight times and/or cycles of operation. The Safety Board is especially concerned about the integrity of these elevator components in Piper Cheyenne PA-31T series turboprop airplanes with Pratt and Whitney PT6A engines. These airplanes are subject to greater flight speeds and structural loads and their turboprop engines are much more powerful than the reciprocating engines in other PA-31 series airplanes. As a result, the dynamic loading effects on the empennage are more severe because of the more powerful propeller slipstream and high frequency engine dynamics. The latter may couple with airframe vibratory response modes to produce panel vibration, flutter, or buzz, and eventually result in metal fatigue. In addition to utilizing identical elevator control tubes and rod end bearings, the empennage on the Cheyenne airplane is structurally similar to that on the Navajo and Chieftain models. Certain parts of the empennage assemblies are also identical.

Flight surface control tubes and rod end bearings similar to those attached to the elevator are also used to actuate the ailerons and the various control surface trim tabs in Piper PA-31 series airplanes. Failure of these control tube assemblies could result in airframe flutter or flight control problems as hazardous as those experienced by N131AF.

The Safety Board's concern regarding the lack of a detailed inspection procedure for flight surface control tubes and rod end bearings in PA-31 series airplanes is further heightened by two recent fatal accidents involving Cheyenne airplanes. The Safety Board determined the probable cause of each of these accidents to be an in-flight loss of control for undetermined reasons. The first accident occurred at Swanton, Ohio, on January 31, 1992, involving N6038A (three fatalities). The airplane, manufactured in 1978 and operated routinely under 14 CFR Part 91, was powered by PT6A-28 engines and had accumulated about 3,185 flight hours at the time of the accident. The second accident occurred at Ninilchik, Alaska, on December 13, 1991, involving N307SC (one fatality). This airplane, manufactured in 1982 and operated routinely in connection with 14 CFR Part 135 operations, was powered by PT6A-11 engines and had accumulated 9,745 flight hours at the time of the accident. The primary and secondary (trim) flight control systems in both airplanes were damaged extensively by ground impact and postimpact fire.

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

Issue an airworthiness directive applicable to all Piper Cheyenne PA-31T series turboprop airplanes requiring an inspection of the elevator control tube assembly (PN 40847-07) and rod end bearing (PN 49261-02). The shank and threaded portion of the rod end should be examined for evidence of cracks, and the bearing should move freely within its housing. The control tube assembly, bushings, and attaching bolts should be examined for cracks, elongation, or other excessive wear. This inspection should be performed within the next 10 flight hours and at appropriate intervals thereafter to assure integrity of the flight control system. (Class I, Urgent Action) (A-93-110)

Require that the maintenance inspection program of all certificate holders operating Piper PA-31 series airplanes under 14 CFR Part 135 include requirements to inspect primary and secondary flight surface control tube assemblies (pushrods) and rod end bearings in these airplanes. The inspections should be performed at appropriate periodic intervals to assure continued integrity of the flight control system. (Class I, Urgent Action) (A-93-111)

Require the Piper Aircraft Corporation to issue a service bulletin applicable to all PA-31 series airplanes containing a detailed procedure for inspection of the elevator control tube assemblies and rod end bearings in these airplanes for evidence of cracks or excessive wear. (Class II, Priority Action) (A-93-112)

Require the Piper Aircraft Corporation to amend the maintenance manuals for all PA-31 series airplanes by including requirements for periodic inspection of primary and secondary flight surface control tube assemblies and rod end bearings for evidence of cracks or excessive wear. (Class II, Priority Action) (A-93-113)

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

By: Carl W. Vogt
Chairman

National Transport[illegible] Safety Board
Washington, D.C. 20594

Brief of Incident

File No. - 5049 11/05/92 MEDFORD,OR A/C Reg. No. N131AF Time (Lcl) - 0230 PST

----Basic Information----
Type Operating Certificate-ON-DEMAND AIR TAXI
Name of Carrier -AMERIFLIGHT INC.
Type of Operation -NON SCHED,DOMESTIC,CARGO
Flight Conducted Under -14 CFR 135
Incident Occurred During -CRUISE

Aircraft Damage
NONE
Fire
NONE

	Injuries			
	Fatal	Serious	Minor	None
Crew	0	0	0	1
Pass	0	0	0	0

----Aircraft Information----
Make/Model - PIPER PA-31T-620
Landing Gear - TRICYCLE-RETRACTABLE
Max Gross Wt - 9000
No. of Seats - 2

Eng Make/Model - P&W PT6A-28
Number Engines - 2
Engine Type - TURBOPROP
Rated Power - 620 HP

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

----Environment/Operations Information----
Weather Data
Wx Briefing - COMPANY
Method - TELETYPE
Completeness - WEATHER NOT PERTINENT
Basic Weather - VMC
Wind Dir/Speed- 340/020 KTS
Visibility - 75.0 SM
Lowest Sky/Clouds - CLEAR
Lowest Ceiling - NONE
Obstructions to Vision- NONE
Precipitation - NONE
Condition of Light - NIGHT(DARK)

Itinerary
Last Departure Point
PORTLAND,OR
Destination
OAKLAND,CA

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

Airport Proximity
OFF AIRPORT/STRIP

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

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

Age - 25
Biennial Flight Review
Current - YES
Months Since - 3
Aircraft Type - BE-99

Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT
Flight Time (Hours)
Total - 4813
Make/Model- 280
Instrument- 898
Multi-Eng - 2732
Last 24 Hrs - 6
Last 30 Days- 100
Last 90 Days- 301
Rotorcraft - UNK/NR

Instrument Rating(s) - AIRPLANE

----Narrative----
DURING CRUISE FLIGHT AT FLIGHT LEVEL 230, THE AIRPLANE SUDDENLY PITCHED UP AND THE AUTOPILOT DISENGAGED. THE PILOT WAS UNABLE TO CONTROL THE AIRPLANE WITH THE CONTROL YOKE. USING POWER AND TRIM CONTROL, HE FINALLY REGAINED CONTROL OF THE AIRPLANE AND MADE AN EMERGENCY LANDING AT SACRAMENTO WITHOUT FURTHER INCIDENT. INVESTIGATION REVEALED THAT THE THREADED PORTION OF THE ROD END BEARING, P/N 49261-02, HAD SEPARATED AT THE POINT WHERE THE THREADS ARE INSERTED INTO THE AFT END OF THE ELEVATOR CONTROL TUBE ASSEMBLY, P/N 40847-07. THE ELEVATOR CONTROL TUBE CONNECTS TO THE ELEVATOR PITCH HORN. METALLURGICAL EXAMINATION SHOWED THAT THE SEPARATION WAS DUE TO A FATIGUE FAILURE. THE AIRCRAFT HAD BEEN INSPECTED AT 37 HRS AND 134 HRS BEFORE THE INCIDENT IN ACCORDANCE WITH AN APPROVED AIRCRAFT INSPECTION PROGRAM. NEITHER INSPECTION SPECIFICALLY ADDRESSED AN INSPECTION OF THE ELEVATOR CONTROL TUBE ASSEMBLY.

File No. - 5049 11/05/92 MEDFORD.OR A/C Reg. No. N131AF Time (Lcl) - 0230 PST

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

Finding(s)
1. FLT CONTROL SYST,ELEVATOR CONTROL - FATIGUE

Occurrence #2 LOSS OF CONTROL - IN FLIGHT
Phase of Operation CRUISE - NORMAL

Finding(s)
2. FLT CONTROL SYST,ELEVATOR CONTROL - DISCONNECTED

----Probable Cause----

The National Transportation Safety Board determines that the Probable Cause(s) of this incident was:
FATIGUE FAILURE OF THE ELEVATOR CONTROL TUBE ROD END BEARING RESULTING IN A LOSS OF ELEVATOR CONTROL.

National Transporta Safety Board
Washington, . 20594

PIPER PA-31 AIRCRAFT SERIES INVOLVING SELECTED OCCURRENCES

File No. - 2285 12/13/91 NINILCHIK,AK A/C Reg. No. N307SC Time (Lcl) - 1907 AST

----Basic Information----
Type Operating Certificate-

Type of Operation -BUSINESS
Flight Conducted Under -14 CFR 91
Accident Occurred During -CRUISE

Aircraft Damage
DESTROYED
Fire
ON GROUND

	Injuries			
	Fatal	Serious	Minor	None
Crew	1	0	0	0
Pass	0	0	0	0

----Aircraft Information----
Make/Model - PIPER PA-31T3, T1040
Landing Gear - TRICYCLE-RETRACTABLE
Max Gross Wt - 9000
No. of Seats - 10

Eng Make/Model - PRATT & WHITN PT-6A-11
Number Engines - 2
Engine Type - TURBOPROP
Rated Power - 500 HP

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

----Environment/Operations Information----
Weather Data
Wx Briefing - FSS
Method - TELEPHONE
Completeness - PARTIAL,LMTD BY PILOT
Basic Weather - IMC
Wind Dir/Speed- 050/005 KTS
Visibility - 1.000 SM
Lowest Sky/Clouds - UNK/NR
Lowest Ceiling - 1000 FT OBSCURED
Obstructions to Vision- FOG
Precipitation - SNOW
Condition of Light - NIGHT(DARK)

Itinerary
Last Departure Point
KODIAK,AK
Destination
KENAI,AK

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

Airport Proximity
OFF AIRPORT/STRIP

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

----Personnel Information----
Pilot-In-Command
Certificate(s)/Rating(s)
ATP
SE LAND,ME LAND

Age - 36
Biennial Flight Review
Current - YES
Months Since - 6
Aircraft Type - PA31-T3

Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT

Flight Time (Hours)

Total	- 9425	Last 24 Hrs	- 2
Make/Model	- 1900	Last 30 Days	- 40
Instrument	- 990	Last 90 Days	- 144
Multi-Eng	- 5680	Rotorcraft	- UNK/NR

Instrument Rating(s) - AIRPLANE

----Narrative----
THE FLIGHT WAS LEVEL AT 10,000 FEET MSL IN IMC CONDITIONS WHEN THE CONTROLLER NOTICED THE AIRPLANE TAKE A SHARP RIGHT TURN AND DESCEND RAPIDLY. ATTEMPTS TO CONTACT THE FLIGHT WERE NEGATIVE. EXAMINATION OF THE ACCIDENT SHOWED ALL THE MAJOR COMPONENTS PRESENT, HOWEVER, IMPACT DAMAGE PRECLUDED ANY FLIGHT CONTROL CONTINUITY CHECK. THE ENGINES COULD NOT BE RECOVERED FROM THE IMPACT CRATER. THE ACCIDENT SITE WAS NOT ACCESSIBLE WITH SPECIALIZED EQUIPMENT.

File No. - 2285 12/13/91 NINILCHIK,AK A/C Reg. No. N307SC Time (Lcl) - 1907 AST

Occurrence #1 LOSS OF CONTROL - IN FLIGHT
Phase of Operation CRUISE - NORMAL

Finding(s)
1. WEATHER CONDITION - TURBULENCE IN CLOUDS
2. WEATHER CONDITION - ICING CONDITIONS
3. REASON FOR OCCURRENCE UNDETERMINED

Occurrence #2 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 was:
UNDETERMINED.

National Transportat Safety Board
Washington, D.C. 20594

PIPER PA-31 AIRCRAFT SERIES INVOLVING SELECTED OCCURRENCES

File No. - 2460 1/31/92 SWANTON,OH A/C Reg. No. N6038A Time (Lcl) - 1606 EST

----Basic Information----
Type Operating Certificate-NONE (GENERAL AVIATION)

Type of Operation -BUSINESS
Flight Conducted Under -14 CFR 91
Accident Occurred During -TAKEOFF

Aircraft Damage
DESTROYED
Fire
ON GROUND

	Injuries			
	Fatal	Serious	Minor	None
Crew	1	0	0	0
Pass	2	0	0	0

----Aircraft Information----
Make/Model - PIPER PA-31T
Landing Gear - TRICYCLE-RETRACTABLE
Max Gross Wt - 5110
No. of Seats - 6

Eng Make/Model - P&W PT6A-28
Number Engines - 2
Engine Type - TURBOPROP
Rated Power - 620 HP

ELT Installed/Activated - YES-UNK/NR
Stall Warning System - YES

----Environment/Operations Information----
Weather Data
Wx Briefing - FSS
Method - TELEPHONE
Completeness - FULL
Basic Weather - IMC
Wind Dir/Speed- CALM
Visibility - 1.500 SM
Lowest Sky/Clouds - 800 FT PART OBS
Lowest Ceiling - 1100 FT OVERCAST
Obstructions to Vision- FOG
Precipitation - SNOW
Condition of Light - DAYLIGHT

Itinerary
Last Departure Point
TOLEDO,OH
Destination
WASHINGTON,PA

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

Airport Proximity
OFF AIRPORT/STRIP

Airport Data
TOLEDO EXPRESS
Runway Ident - 25
Runway Lth/Wid - 10600/ 150
Runway Surface - ASPHALT
Runway Status - N/A

----Personnel Information----
Pilot-In-Command
Certificate(s)/Rating(s)
COMMERCIAL,ATP
SE LAND,ME LAND,SE SEA

Age - 45
Biennial Flight Review
Current - YES
Months Since - 12
Aircraft Type - UNK/NR

Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT

Flight Time (Hours)

Total	- 6850	Last 24 Hrs	- UNK/NR
Make/Model	- UNK/NR	Last 30 Days	- UNK/NR
Instrument	- UNK/NR	Last 90 Days	- UNK/NR
Multi-Eng	- UNK/NR	Rotorcraft	- UNK/NR

Instrument Rating(s) - AIRPLANE

----Narrative----
THE PILOT MADE ROUTINE RADIO COMMUNICATIONS IN PREPARATION FOR TAKEOFF. THE AIRPLANE DEPARTED FROM RUNWAY 25 IN DAYLIGHT INSTRUMENT METEOROLOGICAL CONDITIONS (IMC) WITH LIGHT SNOW AND FOG. SHORTLY AFTER TAKEOFF, THE AIRPLANE'S RADAR TARGET DISAPPEARED FROM THE CONTROLLER'S SCOPE. THE AIRPLANE CRASHED ON WOODED TERRAIN ABOUT TWO MILES SOUTH-SOUTHWEST OF THE DEPARTURE END OF RUNWAY 25. IMPACT OCCURRED IN AN STEEP, NOSE DOWN, LEFT WING LOW ATTITUDE. THE AIRPLANE WAS DESTROYED BY GROUND IMPACT FORCES AND A POST-IMPACT FIRE. NO PHYSICAL INCAPACITATION OF THE PILOT-IN-COMMAND WAS DETERMINED. NO CONTRIBUTORY MECHANICAL MALFUNCTIONS OF THE AIRPLANE WERE DISCOVERED.

File No. - 2460 1/31/92 SWANTON,OH A/C Reg. No. N6038A Time (Lcl) - 1606 EST

Occurrence #1 LOSS OF CONTROL - IN FLIGHT
Phase of Operation TAKEOFF - INITIAL CLIMB

Finding(s)
1. REASON FOR OCCURRENCE UNDETERMINED
2. WEATHER CONDITION - FOG
3. WEATHER CONDITION - SNOW

Occurrence #2 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 was:
LOSS OF AIRCRAFT CONTROL FOR AN UNDETERMINED REASON.