Log 2278

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 22, 1991

In reply refer to: A-91-25

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

On October 28, 1990, a Dassault, Falcon 50 business jet experienced an in-flight separation of part of the Number 1 (left) engine while climbing through 28,000 feet. The airplane was equipped with three Allied-Signal Aerospace Co., Garrett Engine Division (Garrett) TFE731-3-1C turbofan jet engines. At the time of the engine failure, the airplane was approximately 30 nautical miles south of Parkersburg, West Virginia. The flight diverted to Columbus, Ohio and made an uneventful engine-out landing.

Upon inspection, it was determined that the entire fan section of the Number 1 engine had departed the airplane along with the engine nacelle and portions of the forward engine mount. Additional minor damage to the empennage and fuselage had occurred.

Recorded radar data indicated that the fan section had fallen to the ground near Elmira, West Virginia. The majority of the fan section was recovered and transported to the NTSB Materials Laboratory on November 21, 1990.

Examinations determined that the engine had experienced an uncontained catastrophic failure of the first stage fan disc, p/n 3072162, in which a portion of the disc rim and five blades were expelled from the engine. The fractured fan disc had a total service time of 5193 hours and 3300 operational cycles at the time of failure.

Metallurgical examination of the fractured disc determined that a preexisting fatigue crack had initiated in the area of the aft acute (leading side) corner of one of the dovetail slots of the disc. The preexisting crack grew to a sufficient size to permit the release of a section of the disc rim containing three complete blade slots. Nondestructive inspections (fluorescent penetrant and eddy current) uncovered a small additional fatigue crack in an adjacent blade slot. Extensive testing and examination disclosed no mechanical or metallurgical abnormalities in the area of the fatigue crack. Although the microstructure of the disc was somewhat coarser than normal, the physical properties of the disc material met the manufacturer's

specifications. The investigation into this incident is continuing.

On December 21, 1985, a similar failure occurred when the fan disc, p/n 3072162-2, of a Garrett TFE731-2 engine fractured and caused the engine fan section to depart the engine. The airplane crashed at College Station, Texas.[1] Metallurgical examination of that failure determined that the disc fracture was the result of a preexisting fatigue crack that initiated near the aft acute dovetail corner in one of the blade slots of the disc. The disc had in excess of 9,000 cycles at the time of failure. As a result of the College Station accident, the service life of TFE731 fan discs (p/n 3073436-1,-2, -3 and -4 and p/n 3072162-1, -2, -3 and -4) was reduced from 10,000 cycles to 4,100 cycles by Airworthiness Directive (AD) 86-11-05 and Garrett service bulletin (SB) TFE731-A72-3328. Those discs with greater than 4,000 cycles were removed from service and inspected for cracks. Of the discs removed and inspected, 5 were found to be cracked. The discs with cracks had service histories of between 4,003 and 6,367 cycles. Subsequently, Garrett rework service bulletin, TFE731-72-3342RWK allowed a 3,000 cycle extension of a disc's service life if a disc is removed from an engine prior to 4,100 cycles, eddy current inspected and found crack free, and then locally shot peened in the dovetail slots.

On December 20, 1990, following the Parkersburg, West Virginia disc fracture, Garrett issued Service Bulletin (SB) TFE731-A72-3424. As a precautionary measure the SB called for replacement of all fan discs from the same material heat code as the fractured disc. Currently, 30 of the 56 discs with that heat code have been removed and inspected by Garrett. No crack indications have been found. Further, there is no evidence that the material from this heat code is defective. Also, there is no connection between the Parkersburg accident disc and the 5 discs previously found to have been cracked.

The Safety Board is concerned that undetected cracking of the fan discs on the approximately 5,100 Garrett TFE731 engines can lead to uncontained failures that could endanger the structural integrity of the airplane. In addition, based on the Parkersburg incident in which the disc failure occurred at 3,300 cycles, the Safety Board believes that the 4,100 service cycle interval for the initial inspection of the disc is too great to prevent catastrophic failures .

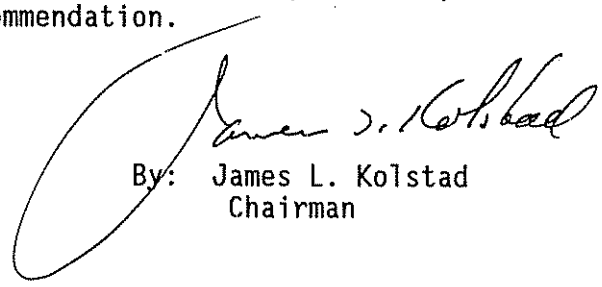
Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an Emergency Airworthiness Directive applicable to all Garrett TFE731-2, -3 and -3R engines with p/n 3072162-1, -2, -3 or -4 or 3073436-1, -2, -3 or -4 fan discs requiring: (1) an initial inspection for cracks in the blade slot area at substantially less than 3,300 service cycles, and (2) recurrent inspections at intervals that will preclude failure. (Class 1, Urgent Action) (A-91-25)

---

[1] NTSB Field Accident Report: FTW 86-F-A025. Accident Brief: File 2871

KOLSTAD, Chairman, COUGHLIN, Vice Chairman, BURNETT, HART and LAUBER, Members, concurred in this recommendation.



By: James L. Kolstad
Chairman

National Transport Safety Board
Washington, 20594

Brief of Accident

File No. - 2871 12/12/85 COLLEGE STATION,TX A/C Reg. No. N723GL Time (Lcl) - 1921 CST

----Basic Information----

Type Operating Certificate-NONE (GENERAL AVIATION)
Type of Operation -EXECUTIVE/CORPORATE
Flight Conducted Under -14 CFR 91
Accident Occurred During -DESCENT

Aircraft Damage
DESTROYED
Fire
ON GROUND

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

----Aircraft Information----

Make/Model - GATES LEARJET 35A
Landing Gear - TRICYCLE-RETRACTABLE
Max Gross Wt - 17000
No. of Seats - 5
Eng Make/Model - GARRETT AIRES TFE-731-2-2BELT Installed/Activated - NO -N/A
Number Engines - 2 Stall Warning System - YES
Engine Type - TURBOFAN
Rated Power - 3500 LBS THRUST

----Environment/Operations Information----

Weather Data
Wx Briefing - FSS
Method - TELEPHONE
Completeness - WEATHER NOT PERTINENT
Basic Weather - IMC
Wind Dir/Speed- 320/007 KTS
Visibility - 6.0 SM
Lowest Sky/Clouds - UNK/NR
Lowest Ceiling - 900 FT OVERCAST
Obstructions to Vision- FOG
Precipitation - DRIZZLE
Condition of Light - NIGHT(DARK)

Itinerary
Last Departure Point
SAME AS ACC/INC
Destination
HOUSTIN,TX

ATC/Airspace
Type of Flight Plan - IFR
Type of Clearance - IFR
Type Arch/Lnds - NONE

Airport Proximity
ON AIRPORT

Airport Data
EASTERWOOD
Runway Ident - 28
Runway Lth/Wid - 5161/ 150
Runway Surface - ASPHALT
Runway Status - DRY

----Personnel Information----

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

Age - 43
Biennial Flight Review
Current - YES
Months Since - 10
Aircraft Type - G-159

Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT

Flight Time (Hours)			
Total -	20500	Last 24 Hrs -	2
Make/Model-	4000	Last 30 Days-	24
Instrument-	0	Last 90 Days-	260

Instrument Rating(s) - AIRPLANE

----Narrative----

THE ACFT ROLLED TO THE RIGHT AND CRASHED AFTER A CATASTROPHIC FAILURE OF THE RT ENG DURING TAKEOFF FOR A NIGHT FLT. THE RT ENG FAN ROTOR DISC SEPARATED FROM THE HUB WHICH DAMAGED THE COWLING AND SOME DISC FRAGMENTS BURIED IN THE FUSELAGE BUT WITHOUT DAMAGE TO THE FLT CONTROLS. THE DRAG CREATED BY THE LOSS OF THRUST AND THE DISTORTED COWLING LED TO YAW AND ROLL WITH LOSS OF CONTROL OF THE ACFT. THE FAN FAILURE PROPAGATED FROM A LOW GRADE FATIGUE CRACK ON THE HIGH TIME FAN WHICH WAS NOT DETECTED BY THE VISUAL INSPECTION PROCEDURES EXISTING AT THE TIME. THE MAUNUFACTURER HAS SINCE IMPROVED THE MANUFACTURING AND INSPECTION TECHNIQUES. AN AD 86-04-02 WAS ISSUED ON 2/14/86 WHICH DEALS WITH FAN REMOVAL FROM SERVICE ACCORDING TO AN OPERATING CYCLE SCHEDULE.

File No. - 2871 12/12/85 COLLEGE STATION,TX A/C Reg. No. N723GL Time (Lcl) - 1921 CST

Occurrence #1 LOSS OF POWER(TOTAL) - MECH FAILURE/MALFUNCTION
Phase of Operation TAKEOFF - INITIAL CLIMB

Finding(s)
1. COMPRESSOR ASSEMBLY,FORWARD FAN - FATIGUE
2. COMPRESSOR ASSEMBLY,FORWARD FAN - FAILURE,TOTAL
3. COMPRESSOR ASSEMBLY,FORWARD FAN - SEPARATION
4. INSUFFICIENT STANDARDS/REQUIREMENTS - MANUFACTURER

Occurrence #2 LOSS OF CONTROL - IN FLIGHT
Phase of Operation TAKEOFF - INITIAL CLIMB

Finding(s)
5. DIRECTIONAL CONTROL - NOT POSSIBLE - PILOT IN COMMAND

Occurrence #3 IN FLIGHT COLLISION WITH TERRAIN
Phase of Operation DESCENT - UNCONTROLLED

----Probable Cause----

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

Factor(s) relating to this accident is/are finding(s) 4