Aviation Investigation Final Report

Location:	GRAND FORKS, North Dakota	**Accident Number:**	CHI96FA216
Date & Time:	June 25, 1996, 14:30 Local	**Registration:**	N2692P
Aircraft:	Fairchild SA227AC	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	19 None
Flight Conducted Under:	Part 135: Air taxi & commuter - Scheduled		

Analysis

The captain reported that the airplane was at 5,000 feet mean sea level, the propeller rpm was 100 percent, and other engine indications were normal. A loss of power on the number two engine was 'sudden and immediate.' The flightcrew declared an emergency and recovered visually to Grand Forks without further incident. Examination of the airplane revealed eleven impact marks to the right side of the fuselage. Two of the impacts penetrated the fuselage side. Examination of the engine revealed evidence of overload failure and penetration of the gear box. Fatigue fractures in the second stage compressor impeller rim emanated from a heat affected, rubbed area on the impeller blades. A corresponding rubbed area was evident on the impeller shroud, and aluminum material was fused to the titanium impeller. No evidence of material defects were noted.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: insufficient clearance between the second stage compressor impeller and the shroud. A factor was the subsequent fatigue failure of the impeller.

Findings

Occurrence #1: LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation: CLIMB

Findings

1. 1 ENGINE
2. (F) COMPRESSOR ASSEMBLY,IMPELLER - FATIGUE
3. (C) COMPRESSOR ASSEMBLY - OTHER

Factual Information

HISTORY OF FLIGHT

On June 26, 1996, at 1430 central daylight time, a Fairchild SA227AC, N2692P, operated by Mesaba Airlines as Northwest Airlink flight 3253, sustained substantial damage following an uncontained failure of the number two engine during climb. The flight returned to Grand Forks, North Dakota and landed without further incident. The flight crew and 17 passengers reported no injuries. The 14 CFR Part 135 flight departed Grand Forks, North Dakota, about 1430 with a planned destination of Minneapolis, Minnesota. Visual meteorological conditions prevailed and an IFR flight plan was filed.

The captain reported that airplane was at an altitude of 5,000 feet mean sea level. The propeller rpm was 100 percent and other engine indications were "normal." The loss of power on the number two engine was "sudden and immediate." Air traffic control transcripts indicate the airplane was ten miles south of Grand Forks. The flight crew declared an emergency and recovered visually to Grand Forks without further incident.

DAMAGE TO AIRCRAFT

Examination of the airplane by Federal Aviation Administration Inspectors revealed eleven impact marks to the right side of the fuselage. Two of the impacts penetrated the fuselage side. The propeller exhibited minor damage. The number two engine was removed and transported to Minneapolis, Minnesota for subsequent examination.

TESTS AND RESEARCH

The number two engine was examined on July 23, 1996, at Mesaba Airlines maintenance facility, Minneapolis, Minnesota. The direct drive fuel control (DDFC) idler gear assembly was dislodged and was protruding through a hole in the gearbox inlet section. Several fragments of the gearbox were recovered. The engine mounts were intact. The compressor bearing retainer was fractured. The tie-bolt was fractured forward of the center curvic splines. The high speed pinion was fractured at the shear section. The compressor bearing outer race was fragmented and the balls were missing. The turbine bearing was fractured in several places. The second stage compressor impeller rim was fractured. Several fragments of the impeller were imbedded in the transition liner and the diffuser. The impeller shroud exhibited a circumferential rub. Corresponding rubbing was evident on the "shroud line edge" of the impeller and impeller fragments. "Thick layers of aluminum rich deposits" were fused to the impeller.

Examination of the impeller and impeller fragments revealed multiple fatigue fractures

emanating from the rubbed shroud line edge. Scanning electron microscopic examination of the fatigue areas revealed evidence of "high cycle fatigue." A section of one of the impeller fragments revealed "highly heat affected (transformed) structure emanating from the heavily rubbed shroud line edge." No material defects were noted.

Examination of the gear box fragments revealed fracture surfaces "indicative of an overload fracture mode... no material defects or cyclic fatigue propagation were observed."

An Allied Signal product integrity engineer reported that the tolerance between the impeller and shroud is accomplished via shims during engine assembly. He reported that the shims in the number two engine were all within acceptable limits. Additionally he reported that the dynamic clearance can be affected by operational conditions such as extended use of engine anti-ice at excessive temperatures. Examination of Mesaba Airlines SA-227 Pilot Operating Handbook revealed "the use of engine inlet anti-ice is restricted to ten seconds of use on the ground when the OAT is above +5 degrees Celsius regardless of engine RPM."The TPE331 installation manual specifies "inlet anti-icing should not be used above 50 F ambient conditions for more than ten seconds."

ADDITIONAL INFORMATION

Parties to the investigation were the Federal Aviation Administration, Mesaba Airlines, the Airline Pilots Association, and Allied Signal Aerospace.

Pilot Information

Certificate:	Airline transport	**Age:**	34,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):		**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):		**Toxicology Performed:**	No
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	March 6, 1996
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	4074 hours (Total, all aircraft), 2727 hours (Total, this make and model), 1765 hours (Pilot In Command, all aircraft), 229 hours (Last 90 days, all aircraft), 53 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Fairchild	**Registration:**	N2692P
Model/Series:	SA227AC SA227AC	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	AC6588
Landing Gear Type:	Retractable - Tricycle	**Seats:**	21
Date/Type of Last Inspection:	June 9, 1996 Continuous airworthiness	**Certified Max Gross Wt.:**	16000 lbs
Time Since Last Inspection:	125 Hrs	**Engines:**	2 Turbo prop
Airframe Total Time:	16127 Hrs	**Engine Manufacturer:**	Garrett
ELT:	Installed, not activated	**Engine Model/Series:**	TPE331
Registered Owner:	LEE FARM CORP.	**Rated Power:**	1100 Horsepower
Operator:	MESABA AIRLINES	**Operating Certificate(s) Held:**	Commuter air carrier (135)
Operator Does Business As:	NORTHWEST AIRLINK	**Operator Designator Code:**	MALA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Unknown	**Visibility**	15 miles
Lowest Ceiling:	Broken / 4000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	150°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	17°C / 12°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	, ND (KGFK)	**Type of Flight Plan Filed:**	IFR
Destination:	MINNEAPOLIS , MN (KMSP)	**Type of Clearance:**	IFR
Departure Time:	14:30 Local	**Type of Airspace:**	Class E

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	
Runway Length/Width:		**VFR Approach/Landing:**	

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	17 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	19 None	**Latitude, Longitude:**	47.910511,-97.069229(est)

Administrative Information

Investigator In Charge (IIC):	Robbins, Wesley
Additional Participating Persons:	
Original Publish Date:	March 31, 1998
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=10093