Aviation Investigation Final Report

Location:	DENVER, Colorado	**Accident Number:**	DEN00FA092
Date & Time:	May 19, 2000, 06:39 Local	**Registration:**	N235BA
Aircraft:	Swearingen SA226TC	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 Minor
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

When the pilot added power for takeoff, at the origination of a cross-country cargo flight, he heard an impact sound on the right side of the airplane, and the right engine began to vibrate violently. He shut down both engines, declared an emergency, and when the engines had spooled down he exited the airplane. Inspection revealed the right hand propeller had shed a blade, which caused damage to the right engine mounts, right engine nacelle, and propeller shrapnel damage to the fuselage, right wing, and right flap. Examination provided evidence that the propeller blade fractured due to a fatigue crack that emanated from a stress corrosion crack region at the mid span portion on the flat side of the blade. The coating on the surface of the blade in the area of the stress corrosion cracking had been breached. The breach in the coating allowed corrosion media to attack the blade.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: propeller blade fatigue failure due to stress corrosion.

Findings

Occurrence #1: PROPELLER FAILURE/MALFUNCTION
Phase of Operation: TAKEOFF - ROLL/RUN

Findings
1. (C) PROPELLER SYSTEM/ACCESSORIES,BLADE - CORRODED

2. (C) PROPELLER SYSTEM/ACCESSORIES,BLADE - FATIGUE
3. (C) PROPELLER SYSTEM/ACCESSORIES,BLADE - FAILURE,TOTAL

Factual Information

HISTORY OF LFIGHT

On May 19, 2000, at 0639 mountain daylight time, a Swearingen SA226TC, N235BA, operated by Superior Aviation of Kingsford, Michigan, aborted takeoff at Denver International Airport, Denver, Colorado, when the number two engine shed a propeller blade. The aircraft sustained substantial damage and the airline transport certificated pilot and sole occupant received minor injuries. Visual meteorological conditions prevailed for this Title 14 CFR Part 135 non-scheduled, domestic, cargo flight, which was departing for Montrose, Colorado, on an instrument flight rules (IFR) flight plan.

The flight was cleared for takeoff on runway 35L. The pilot said he advanced the speed levers to high and brought the power levers to 800 foot-pounds of torque. As he was about to release the brakes to begin takeoff roll he said he felt an impact and noise like something hit the aircraft on the right side. He looked over at the right engine and observed it to be in a "severe state of vibration". He secured the right engine, declared an emergency to the tower, and then secured the left engine. Following "spool down" the pilot exited the aircraft and observed that the right engine had shed a propeller blade about 10 inches outboard from the hub.

INJURIES TO PERSONS

The pilot received minor injuries to his right hand as a result of the power lever being twisted out of his hand during the event.

DAMAGE TO AIRCRAFT

Examination of the aircraft revealed damage to the right engine mounts, right engine nacelle, and propeller shrapnel damage to the fuselage, right wing, and right flap. All pieces of the failed blade were recovered in the immediate area where the event occurred.

AIRCRAFT INFORMATION

The aircraft was a Sweringen SA226TC, serial number TC235, certificated on June 17, 1977. The engines were Garrett model TPE331-IOUA rated at 850 shaft horsepower each. The propellers were Hartzell model HC-B3TN-5C. The serial number of the right propeller was BVA6546. The propeller blade model was T10282N. The blade serial numbers on the right propeller were H21804, H22299, and H22302 (failed blade). All three blades were manufactured on January 31, 1990. They had accumulated 5,313 hours total time and 1,326 hours since overhaul.

TESTS AND RESEARCH

All propeller blades from the propeller that suffered the blade failure were taken to the Hartzell Propeller facility located in Piqua, Ohio, for detailed examination. The failed blade was further transported to the facilities of Sherry Laboratories in Muncie, Indiana, for metallurgical examination.

The failed blade had a large portion of the tip destroyed due to impact forces. It had fractured approximately 12.75 inches from the butt end (17.25 blade station, about 1 inch inboard from the outer end of the de-ice boot). There was no visual indication of corrosion on the blade surface, and the blade did not have any evident nicks, gouges, or corrosion pitting at the surface near the fracture line. The material properties (2025-T6 alloy) were normal. The only noted abnormal condition was the presence of four layers of reflective tape over the area of the fracture line.

The original vibration approval data for this blade type and application were reviewed. While stresses were within approved levels, it was noted that relatively high stress occurs in the area of the fracture. (The mid-blade area is a common location for relatively high stress in turbine engine propellers.)

As previously documented, the failed blade had four pieces of overlapping reflective tape in the center of the flat side of the blade, over the fracture surface. The other two blades each had adhesive residue in the same location that suggested tape had been installed at least once since the last overhaul. This provided and indication that the propeller had been dynamically balanced as many as six times in the past 1,326 hours of operation (since the last propeller overhaul).

This issue was discussed with the maintenance representative from Superior Aviation. He said that these aircraft are routinely balanced every 200 hours of operation. According to the Superior representative, the frequent dynamic balancing is believed to improve service life of the engine/propeller. He also said that these aircraft are sometimes exposed to sanded runways in the winter, which can cause rapid deterioration of propeller blades, thus dictating frequent balancing.

The examination conducted at Hartzell provided findings that all the blade leading edges were worn back at the tip to nearly the minimum allowable width and they were thin in the tip region. The trailing edge of blade serial number 21804 was thin enough that the tip area could be deformed with thumb pressure. According to Hartzell, the wear was abnormally high for a blade with the reported 5,313 hours total time and indicated that the blades had been operated in a harsh environment.

Sherry Laboratories was requested to perform hardness testing, chemical analysis, and failure analysis on the failed blade. Based on their tests and analysis, they came to the conclusion that the propeller had small foreign object damage indentations in the surface that penetrated

through the blade coatings and into the aluminum base material. The penetration of the propeller coating allowed a corrosive media containing chloride contamination to attack the aluminum. The fracture initiated by intergranular stress corrosion cracking. The fracture then propagated via corrosion-fatigue to the point of final tensile overload of the propeller.

The National Transportation Safety Board Materials Laboratory conducted a review of the Sherry Laboratories examination and conclusions.

ADDITIONAL INFORMATION

The propeller was returned to Superior Aviation following the examination.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	45,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	August 9, 1999
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	2740 hours (Total, all aircraft), 354 hours (Total, this make and model), 2035 hours (Pilot In Command, all aircraft), 200 hours (Last 90 days, all aircraft), 65 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Swearingen	**Registration:**	N235BA
Model/Series:	SA226TC SA226TC	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	TC235
Landing Gear Type:	Retractable - Tricycle	**Seats:**	3
Date/Type of Last Inspection:	May 17, 2000 100 hour	**Certified Max Gross Wt.:**	12500 lbs
Time Since Last Inspection:	2 Hrs	**Engines:**	2 Turbo prop
Airframe Total Time:	26778 Hrs	**Engine Manufacturer:**	Garrett
ELT:	Installed, not activated	**Engine Model/Series:**	TPE331-IOUA
Registered Owner:	SUPERIOR AVIATION, INC.	**Rated Power:**	850 Horsepower
Operator:		**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	EATA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	DEN ,5431 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	06:29 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	Broken / 15000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	230°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	43°C / 27°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	(DVX)	**Type of Flight Plan Filed:**	IFR
Destination:	MONTROSE , CO (MJT)	**Type of Clearance:**	IFR
Departure Time:	06:35 Local	**Type of Airspace:**	Class B

Airport Information

Airport:	DENVER INTERNATIONAL DVX	**Runway Surface Type:**	Concrete
Airport Elevation:	5431 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	35L	**IFR Approach:**	
Runway Length/Width:	12000 ft / 150 ft	**VFR Approach/Landing:**	

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	39.789047,-104.840171(est)

Administrative Information

Investigator In Charge (IIC):	Wiemeyer, Norman
Additional Participating Persons:	JIM FINN; DENVER , CO
Original Publish Date:	January 2, 2002
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=49234