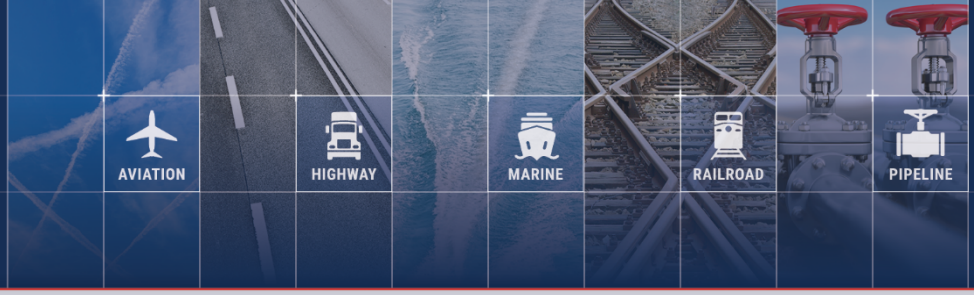

Aviation Investigation Final Report

Location:	EUGENE, Oregon	**Incident Number:**	SEA96IA074
Date & Time:	March 31, 1996, 06:30 Local	**Registration:**	N334PH
Aircraft:	Dornier DO 328-100	**Aircraft Damage:**	Minor
Defining Event:		**Injuries:**	27 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

The flight crew reported that as the airplane was climbing between 14,000 feet and 16,000 feet in light icing conditions, they felt a moderate shudder. The autopilot disconnected, and the airplane immediately rolled 15 degrees to the left. An emergency was declared, and the flight was diverted with no further incident. After landing, examination revealed that a section of the left wing de-icing boot had delaminated. When pressure was applied to the system, a bubble was created. When pressure was off, the delaminated plies were stretched beyond their elastic limits and would not return to the normal shape, thus creating wrinkles. Examination of the plies revealed that there was no evidence of contamination. The separation occurred between the adhesion coat and the knit fabric. The manufacturer of the boot reported that this mode of failure was consistent with an elastromeric construction that had reached the end of its useful life. The outer delaminated plies were found to be unusually durable, which resulted in a large bubble instead of the normally expected 'burst' of the outer plies.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: delamination of the wing de-icing boot, due to the boot reaching its life limit.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: CLIMB - TO CRUISE

Findings
1. (C) ANTI-ICE/DEICE SYSTEM,WING - LIFE EXPIRED
2. (C) ANTI-ICE/DEICE SYSTEM,WING - DELAMINATION

Factual Information

On March 31, 1996, at 0630 Pacific standard time, a Dornier Luftfahrt GMBH DO 328-100, N334PH, flight number 2620, registered to First Security Bank of Utah, operated by Horizon Air as a 14 CFR Part 121 passenger flight, diverted to Portland, Oregon, after the flight crew felt a shudder and an immediate roll to the left. The flight crew declared an emergency and landed at Portland without further incident. Visual meteorological conditions prevailed at the time and an instrument flight rules flight plan was filed. The airplane received minor damage and there were no injuries to the 24 passengers, one flight attendant, and the two airline transport pilots. The flight originated from Eugene, Oregon, about 30 minutes before the incident.

The flight crew reported that as the airplane was climbing between 14,000 feet and 16,000 feet, at 200 KIAS in light icing conditions, they felt a moderate shudder. The auto pilot disconnected and the airplane immediately rolled 15 degrees to the left. An emergency was declared and the flight was diverted to Portland. After landing, it was found that a portion of the left wing leading edge de-icing boot was loose. When air pressure was applied to the boot, a 12 inch diameter "bubble" formed six inches in from the outboard section of the middle boot. When air pressure was removed, that portion of the boot remained loose.

The boot was removed from the wing and transported to Daimler-Benz Aerospace, Germany. The boot was installed on a test airplane and wind tunnel tested. The test revealed that the airplane was controllable even with the delamination in front of the aileron.

The boot was removed and transported to BFGoodrich Ice Protection Systems, Uniontown, Ohio to determine the reason for the delamination. Preliminary inspection determined that the delaminated plies had stretched beyond their elastic limits and would not return to the normal shape upon deflation. The result was permanent wrinkles in the affected area. Samples of the affected area were taken and examined under optical microscopy and scanning electron microscopy. The result of the examination revealed no evidence of contamination. Peel adhesion samples were then constructed and found that the separation occurred between the adhesion coat and the knit fabric. BFGoodrich reports that this mode of failure is consistent with an elastromeric construction de-icer that has reached the end of its useful life. The outer delaminated plies were found to be unusually durable which resulted in a large bubble instead of the normally expected "burst" of the outer plies.

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	32,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	January 12, 1996
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	5266 hours (Total, all aircraft), 1897 hours (Pilot In Command, all aircraft), 178 hours (Last 90 days, all aircraft), 59 hours (Last 30 days, all aircraft), 7 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Dornier	**Registration:**	N334PH
Model/Series:	DO 328-100 DO 328-100	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	3012
Landing Gear Type:	Retractable - Tricycle	**Seats:**	34
Date/Type of Last Inspection:	March 28, 1996 Continuous airworthiness	**Certified Max Gross Wt.:**	30071 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo prop
Airframe Total Time:	4331 Hrs	**Engine Manufacturer:**	P&W
ELT:	Installed, not activated	**Engine Model/Series:**	119B
Registered Owner:	FIRST SECURITY BANK OF UTAH	**Rated Power:**	2180 Horsepower
Operator:	HORIZON AIR	**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:		**Operator Designator Code:**	OXCA

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**	
Lowest Ceiling:	Unknown	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	0°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:		**Temperature/Dew Point:**	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	, OR (EUG)	**Type of Flight Plan Filed:**	IFR
Destination:	SEATTLE , WA (SEA)	**Type of Clearance:**	IFR
Departure Time:	06:00 Local	**Type of Airspace:**	Class E

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	3 None	**Aircraft Damage:**	Minor
Passenger Injuries:	24 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	27 None	**Latitude, Longitude:**	44.039054,-123.219619(est)

Administrative Information

Investigator In Charge (IIC):	Eckrote, Debra
Additional Participating Persons:	ROBERT MABREY; HILLSBORO , OR
Original Publish Date:	February 28, 1997
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=42293