



National Transportation Safety Board Aviation Accident Final Report

Location:	Missoula, MT	Accident Number:	WPR17LA031
Date & Time:	12/05/2016, 1300 MST	Registration:	N909PW
Aircraft:	PIPER PA 31T	Aircraft Damage:	Substantial
Defining Event:	Part(s) separation from AC	Injuries:	2 None
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The private pilot reported that, during cruise flight, the left windshield suddenly departed the airplane. The airplane was below its published service ceiling of 29,000 ft and the windshield was not subjected to internal pressure above its limitations at the time of the failure. The pilot entered an emergency descent and landed the airplane at an airport without further incident. The lack of windshield debris in the cockpit and the glass embedded in the left propeller indicated that the left windshield blew outward. Examination of the right windshield, which remained on the airplane, revealed evidence of moisture ingress into the laminate, to include cloudiness in the vinyl layer, interlayer cracking, delamination around the edges of the windshield, and corrosion of the aluminum retainer. Remnants of the left windshield were insufficient to establish if the laminate exhibited the same evidence of moisture ingress. Examination of the right windshield showed that the discrepancies were consistent with delamination as defined in the manufacturer's service manual. The discrepant areas had only progressed up to 1/2 inch into the daylight opening. The cloudiness, interlayer cracking, and delamination noted along the upper and lower edges of the right windshield were visible to the pilot before the accident flight. However, the delamination of the right windshield would not have necessitated immediate replacement based on the published service information, and although it is impossible to determine the condition of the left windshield before the flight, it was likely similar to that of the right windshield.

The left windshield aluminum retainer exhibited corrosion around the periphery that was more extensive than that on the right windshield. The corrosion of the aluminum retainer is impossible to see with the windshields installed in the airplane, since the fuselage windshield frame covers the entire flange area.

Windshields were designed in a manner to transfer their internal stresses equally around the windshield into the airframe structure. The corrosion of the aluminum retainer eliminated the load path for the internal windshield stresses to be transferred to the airframe. For each of the corroded areas on the aluminum retainer, there would have to be a redistribution of the internal stresses toward the intact areas, which would cause significant stress concentrations in

the windshield laminate. These stress concentrations could be high enough to exceed the capabilities of the laminate in local areas. If coupled with a fracture of one glass layer, the stress concentration would be intensified even more adjacent to the corroded retainer areas. The corroded retainer on the left windshield led to areas of stress concentration within the windshield laminate.

The precise initiation of the left windshield failure could not be conclusively determined. The little amount of glass remaining suggested that the fracture of the glass layers initiated in the aft portion of the windshield near the center. It is possible there was a peel chip that began the event, or simply that the stress concentrations adjacent to the corroded retainer were high enough to cause failure of the windshield laminate.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

Failure of the left windshield due to moisture ingress into the windshield laminate, which deteriorated the strength of the windshield.

Findings

Aircraft	Flight compartment windows - Fatigue/wear/corrosion (Cause)
	Flight compartment windows - Damaged/degraded (Cause)

Factual Information

On December 5, 2016, about 1300 mountain standard time, a Piper PA-31T airplane, N909PW, made an emergency landing at Missoula International Airport (MSO), Missoula, Montana, following a fracture and separation of the left windshield from the airframe. The private pilot and passenger were not injured. The airplane was registered to and operated by the pilot under the provisions of 14 *Code of Federal Regulations* Part 91 as a personal flight. Instrument meteorological conditions prevailed, and an instrument flight rules flight plan was filed. The flight originated from Kalispell City Airport (S27), Kalispell, Montana at 1215.

The pilot reported that he was in cruise flight at flight level 230 for about 10 minutes, with an outside air temperature of - 40 ° Fahrenheit, when suddenly the left windshield departed the airplane. At the time of the windshield failure, the pilot heard an abrupt "swish" sound, followed by an instantaneous "loud roar" with a simultaneous blast of freezing air. The pilot and passenger donned their oxygen masks, and the pilot initiated an immediate descent. He made a distress radio call to air traffic control (ATC) declaring an emergency, and stated his intention to divert to Missoula, Montana; however, he was not able to hear a response from ATC due to the noise in the airplane. The pilot landed at MSO without further incident.

The propeller driven, twin engine, low wing, pressurized airplane equipped with a retractable tricycle landing gear system, was manufactured in 1977. It was powered by two Pratt & Whitney Canada PT6 engines, each rated at 620 horsepower. The airplane was equipped with right and left electrically heated main windshields that were manufactured with two layers of glass. Data plates indicated that both windshields were manufactured by PPG Industries in Huntsville, Alabama. The left windshield was manufactured in January 1977 and the right windshield was manufactured in August 1981. A review of maintenance records indicated that the airplane was issued a standard airworthiness certificate on August 26, 1977 and mentioned that the airplane was exported. The next entry in the logbook was dated December 8, 1981, with the total time of 1712.12 hours. The airplane was ferried back to the United States and issued a Standard Airworthiness Certificate on December 17, 1981, with the total time of 1734 hours. There were no logbooks supplied for the period when the airplane was registered overseas. No information was found in the records to indicate when or why the right windshield was replaced. The most recent inspection of the airplane was accomplished on February 1, 2016, at a total time of 6267.5 hours with no discrepancies reported.

The examination of the airplane revealed that most of the left windshield glass and vinyl departed the airframe during the event. The aluminum retainer and the vinyl beneath the fuselage windshield frame remained installed. Small areas of glass and vinyl were present around the edge of the windshield frame. Only a few small glass fragments were found in the cockpit. The right windshield remained intact and installed in the airplane. There was no evidence of impact damage to the fuselage aft of the windshield or the tail of the airplane. There were small fragments of glass embedded in the left propeller blades. No evidence of bird impact was noted anywhere on the airplane. The fuselage windshield frame, sealant, and paint around both windshields were intact. The fractured remains of the left windshield and the

intact right windshield were removed and subsequently examined at PPG Aerospace Transparencies, Huntsville, Alabama.

The fractured left windshield aluminum retainer and flange area was intact. Several areas of retainer discoloration with a lighter color (white versus gray) were noted in the flange area on the inboard and outboard sides of the retainer. The largest discolored area was located along the lower flange and extended across the width of the retainer for about 6 inches on both the inboard and outboard sides of the retainer. The area was examined and a white powdery residue consistent with corrosion of the aluminum retainer was present, and the vinyl was no longer adhered to the aluminum.

The right windshield was intact with no fracture of the inboard or outboard glass layers. Areas of retainer discoloration with a lighter color (white versus gray) were noted in the flange area on the inboard and outboard sides of the retainer though it was less severe than the left windshield. These areas were scattered around the periphery of the windshield with varying sizes and there was no large single area like noted on the left windshield. There was cloudiness, interlayer cracking, and delamination noted along the top and bottom edges of the windshield consistent with moisture ingress into the laminate. The discrepancies were noted along the entire upper edge and extended about 3/8 inch from the edge of the outboard glass layer towards the center of the windshield. The same discrepancies were also noted along the forward 13 inches of the lower edge and extended about 1/2 inch from the edge of the outboard glass layer towards the center of the windshield. Delamination was also noted at all four corners and along the bus bars at the lower forward and lower aft ends of the glass area.

The Piper Cheyenne Service Manual provides guidance to operators for window inspection and repair. The manual defines three areas of the windshields: the critical area of the windshield defined as the viewing area used for taxiing, takeoff, climb, cruise and landing; the semi-critical area defined as the viewing area used for general flight vision and the non-critical areas defined as viewing areas normally not used for flight operations. Furthermore, the manual defines anomalies such as distortion, cracks, crazing, scratches, chips, haze, blemishes, mark-off, and delamination for use when inspecting the windshields. Cracks are considered critical for the glass windshields. Cracking of either the inboard or outboard glass layer is cause for immediate replacement. Delamination as evidenced by a cloudy or milky appearance is indicative of moisture or solvent penetration into the windshield laminate. Any delamination present in the critical and semi-critical areas should be replaced at the earliest opportunity. In addition, if the semi-critical section exhibits evidence of chipping of the inner glass surface, the windshield should be replaced.

History of Flight

Enroute-cruise

Part(s) separation from AC (Defining event)

Pilot Information

Certificate:	Private	Age:	43, Male
Airplane Rating(s):	Single-engine Land	Seat Occupied:	Left
Other Aircraft Rating(s):	Glider; Gyroplane	Restraint Used:	3-point
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 3 Without Waivers/Limitations	Last FAA Medical Exam:	04/19/2013
Occupational Pilot:	No	Last Flight Review or Equivalent:	04/01/2016
Flight Time:	2235 hours (Total, all aircraft), 132 hours (Total, this make and model), 2104 hours (Pilot In Command, all aircraft), 26 hours (Last 90 days, all aircraft), 0 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Pilot-Rated Passenger Information

Certificate:	Private	Age:	39, Female
Airplane Rating(s):	Single-engine Land	Seat Occupied:	Right
Other Aircraft Rating(s):		Restraint Used:	3-point
Instrument Rating(s):		Second Pilot Present:	No
Instructor Rating(s):		Toxicology Performed:	
Medical Certification:		Last FAA Medical Exam:	
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:	70 hours (Total, all aircraft), 30 hours (Pilot In Command, all aircraft), 0 hours (Last 90 days, all aircraft), 0 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	PIPER	Registration:	N909PW
Model/Series:	PA 31T UNDESIGNAT	Aircraft Category:	Airplane
Year of Manufacture:	1977	Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	31T-7720060
Landing Gear Type:	Tricycle	Seats:	
Date/Type of Last Inspection:	03/01/2016, Annual	Certified Max Gross Wt.:	
Time Since Last Inspection:		Engines:	2 Turbo Prop
Airframe Total Time:	6850 Hours	Engine Manufacturer:	P&W
ELT:	Installed, not activated	Engine Model/Series:	PT6A SER
Registered Owner:	On file	Rated Power:	620 hp
Operator:	On file	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument Conditions	Condition of Light:	Day
Observation Facility, Elevation:	KMSO, 3189 ft msl	Distance from Accident Site:	5 Nautical Miles
Observation Time:	1253 MST	Direction from Accident Site:	305°
Lowest Cloud Condition:		Visibility	10 Miles
Lowest Ceiling:	Broken / 6000 ft agl	Visibility (RVR):	
Wind Speed/Gusts:	7 knots /	Turbulence Type Forecast/Actual:	/ None
Wind Direction:	10°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.02 inches Hg	Temperature/Dew Point:	-3° C / -12° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	KALISPELL, MT (S27)	Type of Flight Plan Filed:	IFR
Destination:	LAS VEGAS, NV (LAS)	Type of Clearance:	IFR
Departure Time:	1215 MST	Type of Airspace:	Class A

Wreckage and Impact Information

Crew Injuries:	1 None	Aircraft Damage:	Substantial
Passenger Injuries:	1 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 None	Latitude, Longitude:	46.875833, -113.996944 (est)

Administrative Information

Investigator In Charge (IIC):	Maja Smith	Report Date:	11/06/2018
Additional Participating Persons:	John Rasmussen; Helena FSDO; Helena, MT		
Publish Date:	11/06/2018		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=94465		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).