



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety

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AIRFRAME AND ENGINE EXAMINATION

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This document contains 25 embedded photos.

(19 Pages)

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2.0 SUMMARY

The wreckage of N593MS was recovered from the Atlantic Ocean. A portion of the right wing was found floating and was recovered the day of the accident. The left wing, including the engine and propeller, was recovered about 5 weeks after the accident. The remaining wreckage could not be located. Therefore, the examination included only the left wing and a portion of the right wing.

The examination of N593MS was conducted on December 10, 2018, at Anglin Aircraft Recovery, Clayton, DE. Examination of the wings revealed fracture surfaces consistent with overload. Examination of the engine revealed no preaccident anomalies. The vacuum pump was separated from its mounting pad and displayed damage consistent with impact and was retained for further examination along with the engine interface unit. Examination of the propeller revealed damage consistent with high impact forces with a feathered blade position.

3.0 DETAILS OF THE INVESTIGATION

3.1 Wreckage Background

The wreckage of N593MS was recovered from the Atlantic Ocean. According to the divers who were dispatched after the airplane impacted the ocean, the fuselage, tail and inboard right wing and engine were submerged and inverted at a depth of about 25 feet. The left wing was located about 250 yards southwest of the fuselage at a similar depth. The locations of the fuselage and left wing were noted and buoyed for later recovery. A portion of the right wing outboard of the engine was found floating nearby shortly after impact and was recovered the day of the accident.

When recovery of the submerged wreckage was attempted five weeks later, the left wing, including the engine and propeller, was located at its previously marked coordinated and was recovered. The fuselage, tail and inboard right wing and engine were no longer at their previous coordinates. A review of maritime tracks revealed that a fishing vessel and a dredging vessel were tracked in close proximity to the wreckage coordinates during the five weeks the airframe was submerged. The wreckage was believed to have been dragged by one of these vessels and could not be relocated. Therefore, the examination included only the left wing and a portion of the right wing.

3.2 Airframe Examination

The left engine was removed for transport. The left wing's forward fuselage attach point remained attached to its fuselage attach point which was pulled from the fuselage. Its aft attach point was separated from the wing and was not recovered. The wing spar was deformed downward and separated at the attach bolts with a fracture surface consistent with overload. The wing displayed multiple skin separations and compression buckling on the lower skin at stations 158 and 125, and from the forward attach point to about station 50. About 2 feet of the outboard leading edge displayed fractures and upward deformation. The landing gear was folded in its well but could be moved to the extended position by hand. Its preimpact position could not be determined. The flap was separated from the wing and displayed skin separations and impact damage. Damage to the deice boots precluded field testing. The outboard and interconnect fuel tanks were pillowed, and no major impact damage or deformation was noted to the inboard fuel tank. The fuel vent was clear of obstruction. The gascolator bowl and filter were clear of debris, although the gascolator housing contained material consistent with sand. The fuel selector was in the 'ON' position. 38" of inboard aileron remained intact, while 37" of the outboard aileron was not intact/located. There was no evidence of aileron travel to stops. The bell crank was deformed with cables attached. The separated cable ends displayed a broomstrawed appearance consistent with tension overload.

The outboard 10 ½ feet of the right wing, minus the wingtip, was examined. The remaining 6 ½ feet of inboard right wing, including the right engine, was missing. The wing was separated at station 105. Forward deformation aft of the main wing spar was observed along with a "W" shaped deformation of the leading edge. The top of the wing spar was fractured about station 104, and the bottom of the spar was fractured about station 115, both deformed downward. The fracture surfaces were consistent with overload separation. Damage to the deice boot precluded field testing. The fuel tank displayed pillowing. The pick-up screen and fuel tank vent were clear of obstructions and the fuel cap was secured. No fuel was observed in the tank. The aileron remained attached with "W" shaped deformation and multiple skin separations. The aileron's control rod was attached to the deformed bellcrank. The bellcrank's drive cable attach point arm was fractured and not recovered. There was no evidence of aileron travel to stops. The drive cable was not observed. The aileron balance cable remained attached to the bellcrank and was separated about 54 inches from the bellcrank. The cable end displayed a broomstrawed appearance, consistent with overload. The flap was pulled from its outer two hinges and was not intact/located.

Airframe Examination Photos



Figure 1: Right Wing Upper Leading Edge View (Photo Courtesy of Piper Aircraft)



Figure 2: Right Wing Upper Trailing Edge View (Photo Courtesy of Piper Aircraft)



Figure 3: Right Wing Inboard Upper View (Photo Courtesy of Piper Aircraft)



Figure 4: Right Wing Outboard Lower View (Photo Courtesy of Piper Aircraft)



Figure 5: Right Wing Fracture Surface (Photo Courtesy of Piper Aircraft)



Figure 6: Right Wing Upper Fracture Surface



Figure 7: Right Wing Upper Fracture Surface (Photo Courtesy of Piper Aircraft)



Figure 8: Right Wing Lower Fracture Surface (Photo Courtesy of Piper Aircraft)



Figure 9: Left Wing Lower Leading Edge View (Photo Courtesy of Piper Aircraft)



Figure 10: Left Wing Lower Outboard Lower View (Photo Courtesy of Piper Aircraft)



Figure 11: Left Wing Lower Trailing Edge View (Photo Courtesy of Piper Aircraft)



Figure 12: Left Wing from Root

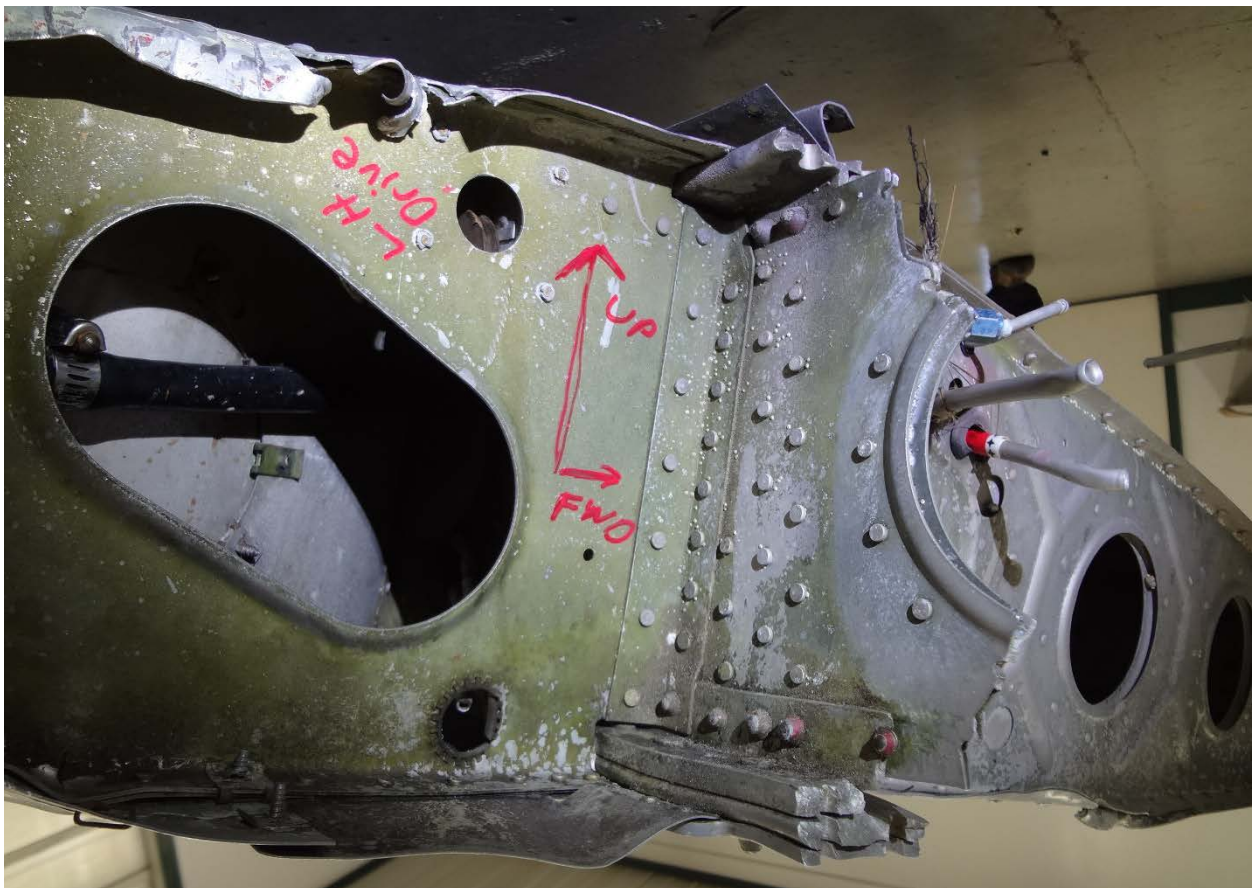


Figure 13: Left Wing Fracture Surface (Photo Courtesy of Piper Aircraft)



Figure 14: Left Wing Lower Fracture Surface



Figure 15: Left Wing Lower fracture Surface

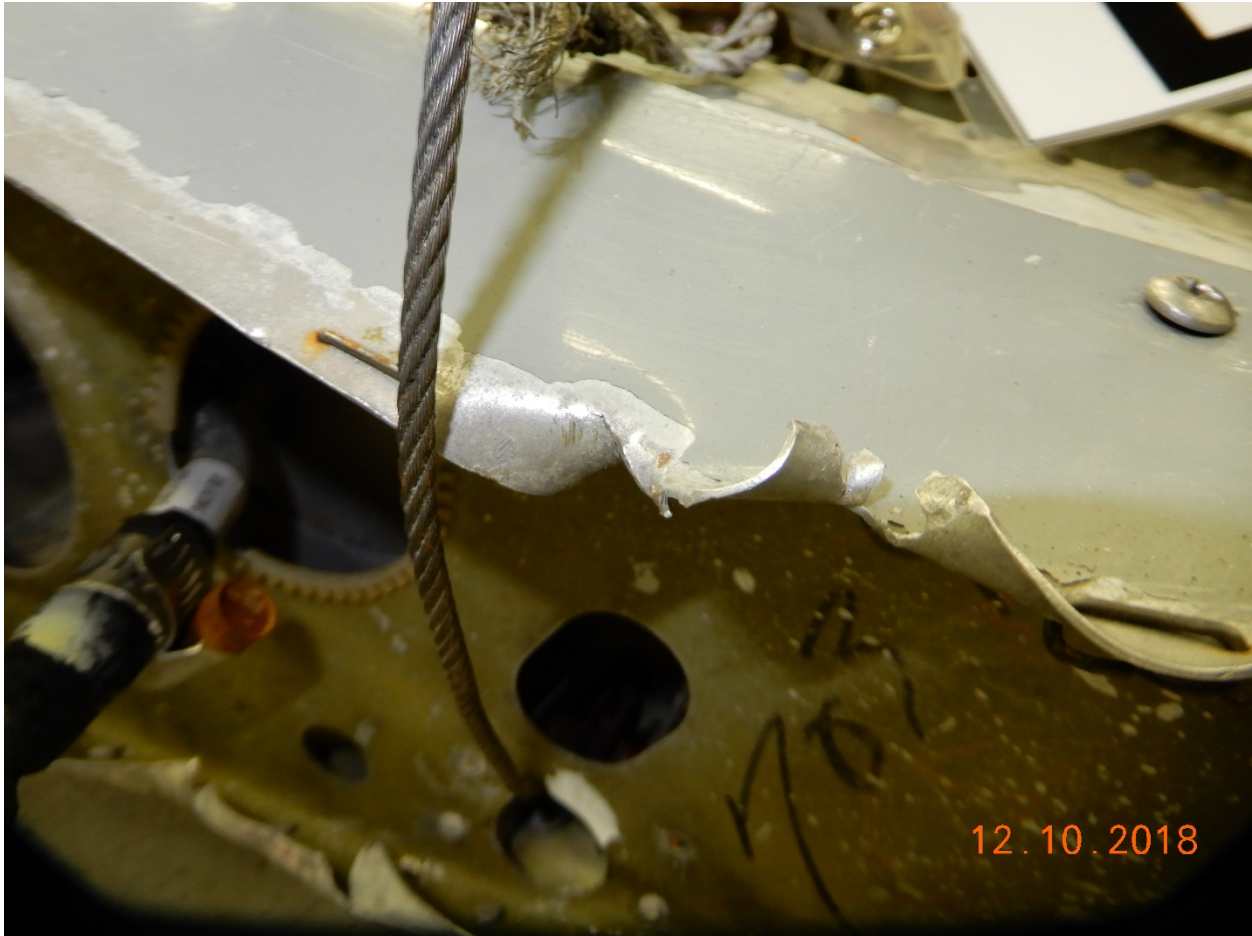


Figure 16: Left Wing Aileron Cable

3.3 Left Engine Examination

The left engine was removed for transport. The engine was equipped with a 3-bladed constant speed propeller, which remained attached. The exterior of the engine showed no evidence of preaccident anomalies. Borescope examination of the cylinders revealed no anomalies that would have precluded operation. All lifters were intact, and all cylinder rocker arms were attached. The fuel pump drive coupling was intact along with the draft shaft and vanes. Disassembly of the fuel manifold revealed a fuel smell consistent with saltwater immersion. The magneto points and distributor gear were intact. The crankshaft could not be rotated. No inductor or exhaust system anomalies were noted. The turbo charger impeller and turbines were intact and impacted with debris and sand. The disassembly of the vacuum pump revealed a fractured rotor, two fractured vanes, and a missing drive coupling.

Engine Examination Photos



Figure 17: Engine and propeller (Photo Courtesy of Continental Motors)



Figure 18: Top of engine with cowling removed (Photo Courtesy of Continental Motors)



Figure 19: Vacuum Pump (Photo Courtesy of Continental Motors)



Figure 20: Disassembled Vacuum Pump



Figure 21: Vacuum pump vanes

3.4 Propeller Examination

Examination of the propeller revealed that it was attached to the engine and in the feathered position. The spinner was crushed and torn adjacent to one blade. There was no indication of rotational deformation. External corrosion was consistent with saltwater immersion. One blade was bent forward, one was bent aft, and one showed no damage. There was no remarkable blade twisting or leading edge damage. Teardown examination revealed no discrepancies with the pitch change mechanism. Examination and logbook review indicate that the propeller did not

appear to have been overhauled since 1994. The recommended time-between-overhaul for these models is 2400 hours or six years. All damage was consistent with high impact forces.

Propeller Examination Photos



Figure 22: Propeller (Photo Courtesy of Hartzell)



Figure 23: Spinner (Photo Courtesy of Hartzell)



Figure 24: Propeller Blades (Photo Courtesy of Hartzell)



Figure 25: Propeller Blades (Photo Courtesy of Hartzell)

Submitted by: Lynn Spencer