

NATIONAL TRANSPORTATION SAFETY BOARD

OFFICE OF AVIATION SAFETY
WASHINGTON, D.C. 20594

September 12, 2018

FIELD NOTES

NTSB ID No.: WPR18FA200

A: ACCIDENT

Location: Sheboygan, Wisconsin
Date: July 20, 2018
Time: 1604 central daylight time
Aircraft: DeHavilland DH112 Venom, N747J

B: GROUP

Investigator-in-Charge:

[REDACTED]

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C: SUMMARY

On July 20, 2018, about 1604 central daylight time, a DeHavilland DH112 Venom airplane, N747J, impacted a structure shortly after takeoff near Sheboygan, Wisconsin. The pilot was fatally injured. Two people in the structure sustained serious injuries. The airplane was destroyed during the post impact fire. The airplane was registered to the World Heritage Air Museum and operated by the pilot as a 14 Code of Federal Regulations Part 91 personal formation training flight. Visual meteorological conditions prevailed about the time of the accident and no flight plan was filed. The flight was originating at the time.

The airplane departed Sheboygan Airport as part of a formation training flight; the accident airplane was in the number two position and staggered to the right of the lead airplane. Review of a video provided by a witness showed the lead airplane depart followed by the accident airplane about 8 seconds later. About 6 seconds after accident airplane lifted off, the left wing rocked downward then upward.

Multiple witnesses reported that the airplane appeared to be sluggish and not climbing. The airplane climbed to about 200 feet above ground level, then started a descent. The airplane impacted flat vegetated terrain, slid through the structure, and continued about another 175 feet before coming to a stop. The airplane came to rest on a magnetic heading of 140°; the debris path was 200 feet by 40 feet. The entire airplane was located at the accident site.

The engine was disassembled by the investigation team at Oshkosh, Wisconsin on September 10 to 12, 2018. The engine did not have any apparent damage to the compressor impeller or to the turbine airfoils.

D: DETAILS OF INVESTIGATION

The airplane was powered by a DeHavilland Ghost 48 Mk 1 engine. The Ghost engine is a single-spool turbojet engine that features a single-stage, single-sided centrifugal compressor, 10 straight flow combustion chambers, and a single-stage axial flow turbine. The Ghost engine has a maximum thrust of 5,000 pounds.

Exterior

The engine as received was from the forward bearing on the front of the compressor impeller to the aft edge of the tailpipe. On the front of the engine, there was also the cartridge starter with the associated gearing including the tower shaft to the angle drive gear at about 12 o'clock.¹ The gearbox housing and associated gears at about 6 o'clock were thermally destroyed.

The engine was received with part of the aircraft around the tailpipe still in place. The exterior of the skin was burned and blistered, but there was no linearity to the burn pattern. There was no burn damage to the interior surface of the skin. The heatshield over the tailpipe

¹ All references to position or directions, as referenced to the clock, will be as viewed from the front, looking rearward, unless otherwise specified.

was still in place and the four bolts securing the heatshield to the tailpipe were in place. The heatshield was buckled in several places at the forward end. The heatshield did not have any thermal damage. On the inside of the heatshield, there was a large clump of what appeared to be fiberglass strands, hair, and pieces of paper.

The compressor impeller and turbine disk could not be rotated.²

Inlet

The bifurcated inlet duct at the front of the engine was thermally destroyed.

Compressor

The front bearing could be rotated, but it was rough and there was some resistance when it was rotated.

The compressor impeller was intact. Of the 19 impeller vanes, there was a continuous sector of 8 vanes from about 6 to 11 o'clock that had the leading edge corner between about 1 by 1.5 inches up to about 2 by 2.5 inches missing that were coincident with where the compressor shroud was burned away. Of those eight vanes, there were seven adjacent vanes from about 6 to 10:30 o'clock that had metal spray on the convex surface adjacent to missing corner. There were two impeller vanes at about 11 o'clock that had metal slag hanging from the burned corner. All of the leading edges of the impeller vanes had pitting and erosion. There were three impeller vanes that had dents, between about 0.10 and 0.12-inches in diameter, on the leading edge. There were four consecutive impeller vanes that had circumferential rubbing on the leading edge with metal displaced opposite the direction of rotation.

The impeller shroud was in place, but the forward part was partially burned away between about 6 and 10 o'clock. The remaining visible portions of the impeller shroud did not have any circumferential rub marks.

Diffuser

The front face of the diffuser box had numerous circumferential and radial cracks. The front of the diffuser box had burn throughs at about 2:30, 8, and 9 o'clock exposing the turning vanes inside. The compressor shroud was burned away essentially in line with the leading edge of the impeller vanes except between about 11 and 4 o'clock where the shroud was burned away to the face of the diffuser. Although the diffuser was burned, there was no axial linearity to the burn pattern. The turning vanes inside the diffuser box did not have any damage except those that were adjacent to the burn through areas and sustained thermal damage.

The No. 6³ clockwise diffuser tube had a large wad of what appeared to be fiberglass strands, hair, and pieces of paper. There was no material in the No. 6 diffuser tube turning vanes. The No. 2 diffuser tubes had metal spatter on the interior surface.

² The forward bearing housing and support that would support the front of the impeller was missing.

Combustor

The 10 combustion chambers were in place and did not have any thermal distress. The No. 8 combustion chamber had an axial scratch and the tube was dented inward at the scratch.

The interior of the flame tubes did not have any thermal distress or burn patterns. The No. 7 flame tube had some sand and dirt inside the tube.

The fuel nozzles were all in place in the dome of the flame tubes. The domes and visible portions of the flame tubes did not have any thermal distress. There was no material built up on the outside of the flame tube domes. The fuel nozzles in flame tubes Nos. 10 through 4 had a black plastic like material from the nozzle across the inside of the flame tube dome. The flexible fuel lines between the metal manifolds and the fuel nozzles were in place. It was noted that the plastic lining in the flexible fuel lines between the manifolds and the nozzles was melted away.

Turbine

The turbine nozzle and turbine cases were in place and did not have any thermal distress.

The turbine disk was intact. The front and rear faces of the turbine disk were almost completely covered with surface corrosion. There was corrosion in all of the turbine blade slots between the slot and blade fir tree. The front face of the turbine disk had oil staining radiating from the center outwards to the rim.⁴

All of the turbine blades were in place and were full length. The turbine blades did not have any indications of thermal distress or metal spray on the airfoil surfaces. The turbine blades were tight in the blade slots.

The turbine vanes were all in place and did not have any damage or thermal distress. The turbine vanes did not have any metal spray on the airfoils.

The turbine vane inner support and turbine vane aft heatshield were intact. The center of both the rear face of the inner support and the forward face of the heatshield had coke⁵ peeling off the surface.

Tailpipe

The tailpipe was in place on the rear of the turbine case. The tailpipe was buckled and wrinkled around its circumference. The rear of the tailpipe was bent radially inward between about 9 and 11 o'clock and about 12 and 3 o'clock. The tailpipe did not have any thermal distress.

³ The front of the diffuser box was numbered from 1 to 10 for each diffuser tube and combustion chamber in a clockwise direction starting at 12 o'clock going in a clockwise direction as viewed from the front.

⁴ The bearings are constant loss bearings meaning that oil is consumed through normal engine operation.

⁵ Coke is the hard, crystalline residue of turbine engine oil.

The tailcone was in place in the tailpipe. The forward edge of the tailcone had three sectors of circumferential rubbing with heat discoloration. One of the sectors with the circumferential rubbing also had material transfer. The diameter of the forward edge of the tailcone corresponded to an approximately 90° arc of turbine blades that had an approximately 0.5-inch wide circumferential rub on the trailing edge. The diameter of the circumferential rubmarks on the forward edge of the tailcone and the front face of the front bulkhead were off set from the engine 's centerline and corresponded to the circumferential rub marks on the rear face of the turbine disk rim. The front face of the tail cone bulkhead had circumferential scoring that corresponded to the diameter of the bolt circle and the width of the bolts on the rear of the turbine disk. The circumferential rubmarks on the tailcone forward edge and the scoring on the bulkhead were concentric.

The rear bearing oil line was in place. There was oil in the line and it did not have an acrid odor.

Accessories

The fuel distributor was in place on the front of the diffuser case. The fuel manifolds were in place to the combustion chambers between about 9 and 3 o'clock. The fuel manifolds to the combustion chambers between 3 and 9 o'clock were broken.

The front of the ignition exciter box was burned away exposing the inside of the box. The igniter leads were separated from the exciter box. The igniter plug at about 2 o'clock had a dark coating on the shank that was flaking off. The igniter plug at about 7 o'clock had a light tan colored powdery coating on the shank of the plug. The two plugs did not have any debris on the exterior.