

**NATIONAL TRANSPORTATIONS SAFETY BOARD
Office of Aviation Safety
Washington, DC 20594**

SUMMARY OF ACCIDENT SITE AND AIRCRAFT EXAMINATIONS

-- CEN17FA170 --

A. ACCIDENT

Location: Hollis, Oklahoma
Date: April 28, 2017
Time: 1300 central daylight time
Aircraft: Air Tractor AT-602 (s/n 602-1202), N604RH

B. PARTICIPANTS

Timothy Sorensen
Aviation Accident Investigator
National Transportation Safety Board

Kyle Schroeder
Aviation Safety Investigator
Air Tractor, Inc.

Jeff Davis
Investigator
Pratt & Whitney Canada Inc.

Les Doud
Manager, Air Safety Investigation
Hartzell Propeller Inc.

C. ACCIDENT SUMMARY

On April 28, 2017, about 1300 central daylight time, an Air Tractor AT-602 airplane, N604RH, impacted terrain while on final approach for runway 35 at the Hollis Municipal Airport (O35), Hollis, Oklahoma. The pilot was fatally injured. The airplane was substantially damaged. The airplane was registered to the pilot and operated by Gray Ag Air as a 14 Code of Federal Regulations Part 137 aerial application flight. Visual meteorological conditions prevailed at the airport about the time of the accident. The flight was not operated on a flight plan. The local flight originated from O35 about 1230.

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D. GENERAL DESCRIPTION

Airframe

The Air Tractor AT-602 is a single-place, single-engine airplane, with a conventional (tailwheel) landing gear arrangement. The airplane was designed for agricultural or firefighting operations. It is certificated as a restricted category airplane, with a maximum gross takeoff weight of 12,500 lbs.

Engine Assembly

The Pratt & Whitney Canada PT6A-65AG turboprop engine is capable of producing up to 1,300 shaft horsepower (shp) at an output speed of 1,700 rpm. It is limited to 1,050 shp for AT-602 installations. The engine is a reverse flow, free turbine design, consisting of a four-stage axial compressor, a single-stage centrifugal compressor, an annular combustion chamber, a single-stage gas generator turbine, and a two-stage power turbine.

Propeller Assembly

The Hartzell HC-B5MP-3F/M11276NS propeller assembly is a five-blade, hydraulically actuated, constant speed design, with feathering and reverse pitch capability. The propeller blades are constructed of aluminum alloy. The hub is constructed of alloy steel. Propeller rotation is clockwise as viewed from the rear (pilot seat). Propeller blade operating angles corresponded to: -10.0° for reverse (beta), 13.9° at low pitch position, and 83.1° at feather position.

E. DETAILS OF AIRCRAFT EXAMINATIONS

The on-scene examination was conducted on April 30, 2017. The airplane was relocated from the accident site to Dawson Aircraft, Clinton, Arkansas. Post-accident engine and propeller examinations were conducted on May 17, 2017.

All examinations were completed under the direct supervision of the NTSB investigator-in-charge. Air Tractor and Hartzell Propellers provided technical support to the investigation as parties to the NTSB. Pratt & Whitney Canada provided support to the investigation as a technical representative to the Transportation Safety Board of Canada (TSB), which assigned an accredited representative to the investigation.

F. DESCRIPTION OF ACCIDENT SITE

The airplane impacted a wheat field about 101 yards south of the runway 35 threshold. A depression in the vegetation consistent with being formed by the wings and fuselage nose was centered at the propeller assembly, which was separated from the engine. The depression was consistent with an airplane heading of about 220° at the time of initial impact. The engine assembly had separated from the airframe and was located about 16 yards from the initial impact.

The main wreckage came to rest about 26 yards north of the point of initial impact. The debris path was oriented on an approximate 356° magnetic bearing. The fuselage came to rest upright on an approximate 240° bearing.

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G. SUMMARY OF AIRCRAFT EXAMINATIONS¹

Airframe – Air Tractor AT-602, s/n 602-1202

The propeller assembly had separated from the engine and was partially imbedded into the ground at the initial impact point. Two propeller blades had separated from, and were located immediately adjacent to, the hub. Fragments of fuselage structure were distributed at the initial impact point. The engine assembly has separated from the airframe and exhibited damage consistent with impact forces.

The fuselage nose and cockpit area were destroyed by impact forces and the postimpact fire. The fire also consumed portions of the center and aft fuselage skin and damaged the fuselage structural tubing. The cockpit instruments were destroyed. The seat belts, shoulder harnesses, and harness airbags² were consumed by the postimpact fire. The harness buckle assembly remained buckled at all five points. Both main landing gear springs were located with the center fuselage debris. The left main wheel and tire remained attached to the spring. The right main wheel was separated and recovered about 540 feet northwest from the main wreckage. The tail wheel assembly appeared intact.

The wing assembly separated from the fuselage. It came to rest inverted, under the fuselage. The center portion of the wing structure exhibited damage consistent with the postimpact fire. The left and right wing spars were deformed but continuous. The centerline splice exhibited thermal damage but appeared otherwise intact. Both wings exhibited deformation and tearing of the skin over the entire spans.

The inboard portion of the left aileron was damaged but remained partially attached to the wing. The outboard portion was separated and fragmented; it was located in the debris path. The right aileron was deformed but remained attached at all three hinge points. The left flap was separated and located under the left wing. The right flap was partially separated. Both flaps were deformed.

The vertical stabilizer remained attached to the fuselage and the rudder remained attached to the stabilizer. Both the stabilizer and rudder exhibited downward crushing damage and deformation to the right at the top of the assemblies. The right horizontal stabilizer remained attached at the forward spar attachment. It was separated at the aft spar attachment point; the fracture surface appeared consistent with an overstress separation. The right elevator remained attached to the stabilizer; the elevator torque tube was separated at the inboard flange consistent with overstress. The left horizontal stabilizer and elevator were separated from the fuselage and fragmented. They were located in the debris path.

The cockpit control stick was separated at the lower end of the component. The fracture surface appeared consistent with an overstress separation. The housing mating to the lower end of the control stick was consumed. Aileron continuity was confirmed from the cockpit control torque tube assembly to the main aileron push rod assemblies. The main push rods were separated near the wing root consistent with impact and post-impact fire damage. The remaining portion of both main push rods remained attached to the aileron

¹ Directions related to accident site placement and component damage/deformation are with respect to an intact airframe unless otherwise noted.

² The airplane was equipped with the AmSafe inflatable restraint system.

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G. SUMMARY OF AIRCRAFT EXAMINATIONS *(continued)*

bellcranks. The left aileron push rod from bellcrank to the control surface remained attached; the push rod was deformed consistent with impact forces. The right aileron push rod remained attached to the bellcrank and the aileron; however, it was separated near the aileron attachment rod end. The aileron-wing flap interconnect push rods were separated at three points consistent with impact forces.

Elevator control continuity was confirmed from the control stick to the forward portion of the push rod assembly. The push rod was separated aft of the forward idler assembly. Push rod damage was consistent with thermal effects due to the post-impact fire. Continuity was confirmed from the aft section of the push rod to the elevator torque tube. The flange portion of the both the left and the right torque tube assemblies had separated consistent with overstress; the flanges were deformed. The rudder pedals were consumed by the post-impact fire. The rudder cables remained attached to the forward attachment plate and were continuous to the rudder horn.

The wing flap actuator was separated from the airframe structure consistent with impact and thermal damage. The screwshaft was separated near the actuator consistent with impact forces. The screwshaft appeared to be fully extended at the time of the accident; approximately 3.7 inches.³ The left and right flap control arm assemblies were consumed by the post-impact fire.

Engine – Pratt & Whitney Canada PT6A-65AG, s/n PCE-PN0134

The engine has separated from the airframe. The accessory gearbox was separated from the gas generator case. Portions of the accessory gearbox exhibited thermal damage consistent with the post-impact fire. The gas generator case and the exhaust duct were deformed and torn. The reduction gearbox was damaged; a portion of the exhaust duct mating flange was fractured.

The first and second stage compressor rotor blades exhibited bending opposite the direction of rotation. Several first stage compressor rotor blades tips were fractured. The compressor was not disassembled and the third and fourth stage rotors were not observed. The first stage stator airfoil tips exhibited bending in the direction of rotation. The first stage shroud exhibited scoring damage consistent with contact from the first stage rotor blade tips. The no. 1 bearing was free to rotate. The combustion chamber liner was deformed aft consistent with contact from the power turbine housing.

The compressor turbine shroud exhibited scoring damage. Deposits consistent with re-hardened molten material were present adjacent to the blade path. The downstream side of the compressor turbine disc and blades exhibited circumferential scoring consistent with contact from the upstream side of the first stage power turbine vane and baffle.

All first stage power turbine blades were fractured. The fracture surfaces appeared consistent with overload separations. The blades were displaced both forward and aft within the disc. The disc and blades exhibited circumferential scoring consistent with contact from the first stage power turbine vane and baffle. The first stage power turbine interstage baffle exhibited corresponding circumferential scoring consistent with contact

³ The airframe manufacturer noted that full extension of the flap actuator corresponded to full flap deflection (28 degrees).

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G. SUMMARY OF AIRCRAFT EXAMINATIONS *(continued)*

from the compressor turbine. The inner rim and airfoils were fractured from about the 11-o'clock to the 3-o'clock positions. The power turbine shaft and turbine retention nut exhibited wear consistent with contact from the vane baffle and the compressor turbine disc.

All second stage turbine blades were fractured. The fracture surfaces appeared consistent with overload separations. Several turbine blade fragments were recovered from the exhaust duct. The blades and disc exhibited circumferential scoring consistent with contact from the no. 3 bearing airseal cover and the exhaust duct. Several vane airfoils exhibited trailing edge damage consistent with contact from the second stage power turbine blades. The second stage power turbine shroud exhibited 360° scoring consistent with contact from the second stage power turbine blades.

The power turbine shaft was fractured. The fracture surface exhibited rotational scoring consistent with contact from adjacent components, which altered the fracture surface. The no. 3 bearing was damaged. The bearing components with exception of the roller elements were observed with the turbine section.

The reduction gearbox housings were damaged. The propeller shaft flange was deformed and fractured. The fracture surfaces appeared consistent with an overload separation. The propeller thrust bearing cover was fractured. The propeller governor had separated; the governor retention studs were fractured at the mounting pad surface. The overspeed governor remained secured to the gearbox. The drive couplings for the propeller and overspeed governors were displaced aft. The chip detector was fractured.

The propeller governor housings were separated and some of the internal components, including the beta valve, were not recovered. The governor housings remained attached to the gearbox by an oil line. The impeller gears remained in place and were damaged. The governor flyweight assembly was separated and not recovered. The shutoff solenoid valve was separated from the governor.

The overspeed governor was removed from the gearbox and disassembled. Damage to the drive splines was consistent with displacement of the mating gearbox drive splines. The internal components including the drive shaft, fly weights and spring, appeared intact. No anomalies were observed.

The fuel pump remained attached to the accessory gearbox; however, the fuel control unit had separated from the fuel pump consistent with impact forces. In addition, the fuel pump and fuel control unit exhibited thermal damage consistent with the post-impact fire. Most of the fuel nozzles remained in place; however, several were fractured or displaced consistent with impact forces. The fuel and oil filters sustained thermal damage.

The compressor discharge air (P3) line was deformed and fractured. The filter housing remained attached to the accessory gearbox; it exhibited thermal damage consistent with exposure to the post-impact fire. The power turbine control (Py) line was separated from the fuel control and the propeller governor. The line remained attached to the intermediate airframe hardware.

Summary of Accident Site and Aircraft Examinations

G. SUMMARY OF AIRCRAFT EXAMINATIONS *(continued)*

Propeller Assembly – Hartzell HC-B5MP-3F/M11276NS, s/n EVA3120

The propeller was fractured from the engine propeller shaft consistent with impact forces. Two blades had separated from the hub.⁴ The spinner dome was torn and fragmented with portions formed around the blades and clamps. The spinner bulkhead remained attached to the propeller; however, the dome attachment flange was bent. The propeller mounting flange was damaged. Seven of the eight propeller mounting bolts had pulled from their mounting holes and remained in the engine propeller shaft flange. One bolt had fractured with a portion remaining in the propeller hub. The dowel pins had separated and were not recovered with the wreckage. The hub was damaged. The pilot tubes corresponding to blades 3, 4 and 5 were fractured. Blade arms 3 and 5 exhibited impact crescents at helical angles of 49° and 51.5°. The cylinder attachment threads were damaged.

The hydraulic unit had separated from the propeller assembly. The cylinder was deformed. A mark consistent with impact from the bottom portion of the piston was located approximately 2.59 inches from the top corner of the cylinder. The piston was fragmented. The pitch change rod was bent but appeared otherwise intact. It remained attached to a large piston fragment. The piston fragment exhibited a cylinder impact mark approximately 1.91 inches from the internal, forward corner of the piston.⁵ The area between the cylinder and the large piston fragment was packed with dirt. Two piston guide rods were bent. The piston nut remained in place with the large portion of the piston retained. The feathering spring appeared intact, with minor surface corrosion on the exposed end.

Two link arms remained attached to the propeller assembly, while the remaining three link arms had separated. Each link arm remained attached to a piston fragment. One was bent. Three were bent and exhibited elongation of the link screw hole. One appeared undeformed, with exception of elongation of the screw hole.

The reverse stop sleeve remained on the pitch change rod and appeared bent. All three low-pitch stop nuts were present. The feather-stop screws remained in the forward spring cup. One of the four screws appeared bent; however, each screw head appeared intact. All three beta rods remained attached to the beta ring; two were bent. The beta rod return springs remained in place. The beta rod support ring was fragmented; the attachment nuts remained in place. The beta ring remained in place; however, approximately 40% was fractured and not recovered.

The blade clamps in position nos. 1 through 4 appeared intact. The clamp in position no. 5 was bent with the top/forward half of the clamp separated from the propeller assembly. The position no. 5 clamp bolts were fractured. Each counterweight appeared intact. However, the no. 1 and no. 5 position counterweights were loose on the mounting bolts.

⁴ Both blades were located immediately adjacent to the propeller hub at the accident site.

⁵ According to the manufacturer, this equated to approximately 2.53 inches from the bottom edge of the piston. The relative position between the cylinder and the piston corresponded to a blade angle of 24.5° to 26.5°, which was within the normal operating range of the propeller assembly.

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G. SUMMARY OF AIRCRAFT EXAMINATIONS *(concluded)*

The propeller blades were identified no. 1 through no. 5 counterclockwise as viewed from the rear, with the hub serial number positioned between blades nos. 4 and 5. Each blade exhibited chordwise/rotational scoring, with exception of blade no. 2. Blade no. 2 exhibited paint abrasion on the blade face. Blade nos. 1, 2, and 3 exhibited S-bending; blade nos. 4 and 5 exhibited bending in the forward/thrust direction.