



FACTUAL NOTES, ENGINE TEARDOWN INVESTIGATION IN SUPPORT OF ACCIDENT INVESTIGATION OF AIR TRACTOR AT-802F REGISTERED N397AS PERFORMED FOR NATIONAL TRANSPORTATION SAFETY BOARD (NTSB)

NTSB Identification: WPR18LA222

P&WC Reference: File No. 18-124

Customer: Air Spray Airtankers

Aircraft Model: Air Tractor AT-802F, **Registration:** N397AS, **Serial No.:** 802A-0563

Location: Stevens County, Washington, USA

Accident Date: 14 August 2018

Engine Model: PT6A-67F, **Engine Serial No.:** RZ0138

Date of Manufactured: March 2014

Logbook Available: Yes ☒ No ☐

Total Time: 559.0

Total Cycles: 321

Time Since Overhaul: N/A

Cycles Since Overhaul: N/A

1.0 ACCIDENT SYNOPSIS

On August 14, 2018, about 1500 Pacific daylight time, an Air Tractor AT802 airplane (Fire Boss), N397AS, was substantially damaged during a forced landing near Northport, Washington. The commercial pilot was seriously injured. Visual meteorological conditions prevailed for the local area flight that had originated from a water dip site near the area of an active fire.

The accident flight was a flight of 3, with the accident airplane in the number 2 position. The pilot reported that he heard a "thud" followed by a bang and the airframe began to shake. He jettisoned the water and turned away from the other two airplanes. The pilot initially was going to land on an old logging road; however, the landing area was lined with trees on both sides of the road. He opted instead to stall the airplane over the tree tops. After impact with the trees, the airplane came to rest upright at the base of the trees adjacent to the road.

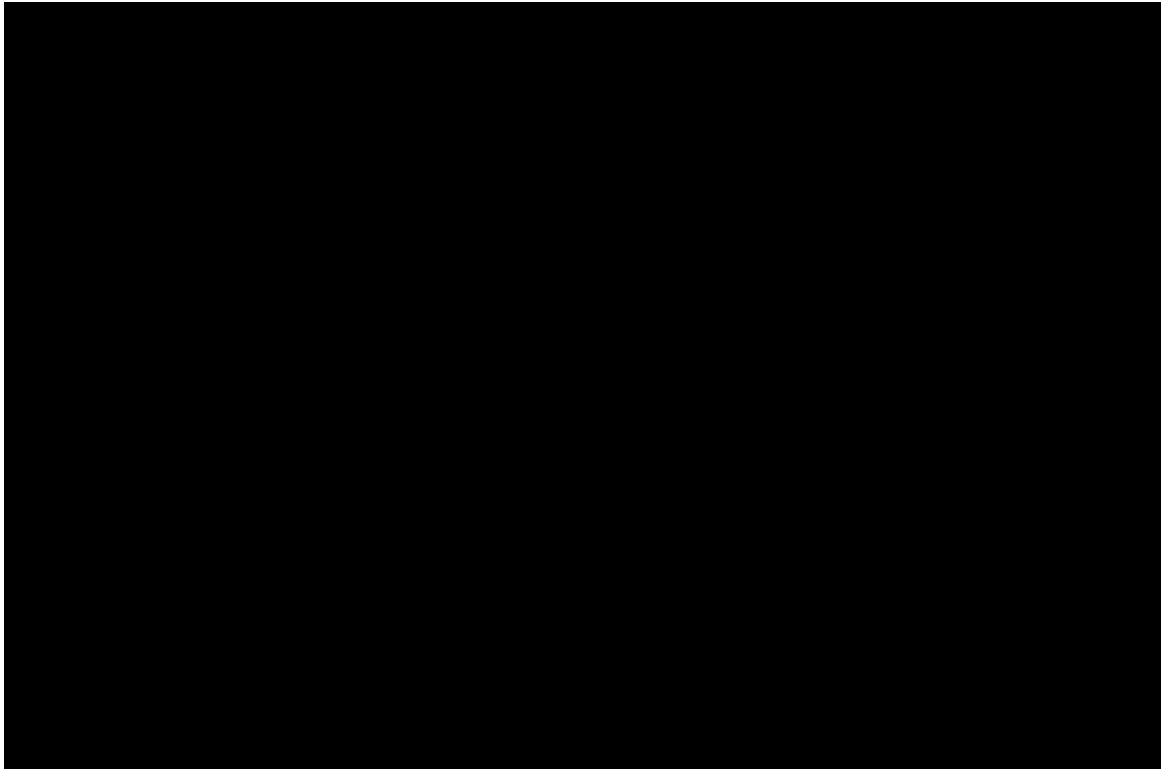
The subject engine was then submitted to Pratt & Whitney Canada (P&WC) Service Investigation for detailed examination.

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	ECCN or USML (ITAR) #	
	P-ECCN or P-USML (Non US Origin)	9E991



2.0 INVESTIGATION PARTICIPANTS

The powerplant investigation was performed on 14 to 16 May 2019 at the Pratt & Whitney Canada (P&WC) St-Hubert facility. The following individuals participated in the investigation as representatives of their respective organizations.



3.0 ENGINE EXAMINATION SINGLE ☒ LEFT ☐ RIGHT ☐

All positional references are in relation to view from aft looking forward. Upstream and downstream references are in relation to gas path flow from the compressor inlet to exhaust.

External Condition

The shipping box was in good condition. Removal of the shipping box, revealed the engine with parts of the airframe mount, some airframe accessories, wiring harnesses, and firewall still attached. The gas generator case (GGC) and exhaust case upper external surfaces, mainly in the fuel nozzles area, showed signs of post-impact fire (PIF). The lower portion of the reduction gearbox (RGB) was covered with a mixture of environmental debris and oil. The RGB was found cracked at the 6 O'clock position close to the propeller shaft flange. The compressor rotor and the power turbine (PT) / propeller shaft rotor were both seized. The PT blades were examined on the downstream side through the exhaust duct ports. The first stage PT (PT1) and second stage PT (PT2) blades were all fractured. The exhaust duct was fractured from impact and showed mechanical damages from blade release. The GGC was displayed impact damages. The fuel line and oil scavenge lines were mechanically deformed. The inlet screen was not punctured, but was slightly soiled. A portion of the inlet screen and wash ring had been compressed inwards from impact. The internal gas path of the inlet case was generally clean. The gas generator module data plate confirmed the engine serial No. RZ0138.

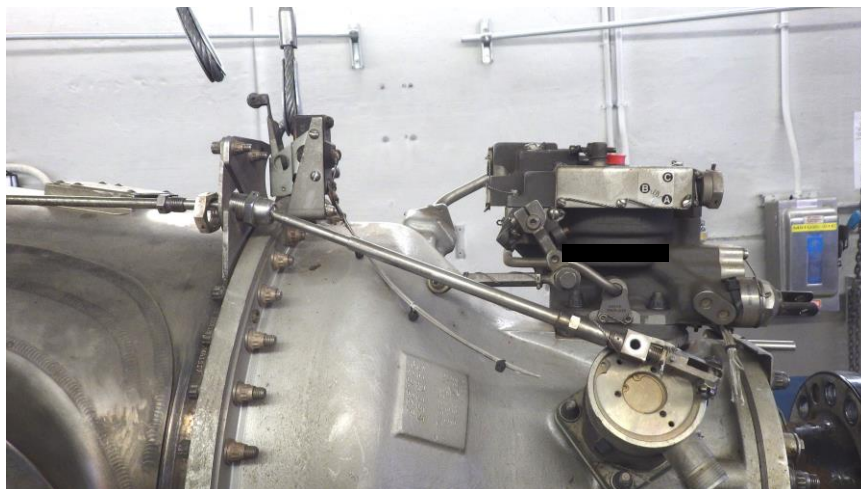




Linkages

Power Control Linkage: No damage was observed and it was continuous from the CAM box up to the Fuel Control Unit (FCU).

Reversing Linkage: The reversing cable was disconnected from the beta lever and propeller speed control lever. The reversing cable was attached to the CAM box and secured to the reversing CAM.



Pneumatic Lines

Compressor Discharge Air (P3): The P3 pneumatic line was continuous from the GGC to the FCU. All the "B" nuts were secured with lockwire and found tight. Leak check was performed on P3 line and no leak was found.

Power Turbine Control (Py): The Py pneumatic line was not received. Based on cleanliness of the FCU and propeller governor (CSU) fittings threads, the Py line was likely removed post-accident during engine removal





Chip Detectors and Filters

Reduction Gearbox Chip Detector: The magnetic chip detector (MCD) showed only some “Fuzz”.

Accessories Gearbox Chip Detector: The MCD showed only some “Fuzz”.

Oil Filter: The oil filter was dirty. The oil filter housing showed some metallic particles.

Fuel Filter: The fuel pump outlet filter and inlet screen were not removed. The fuel filters will be inspected as part of the accessories investigation.

P3 Air Filter: The P3 air filter was dry and free of contaminants.





The accessories gearbox (AGB) and oil tank oil samples were clean and free of contaminants. The RGB oil sample displayed a darker discoloration, but was free of contaminants.

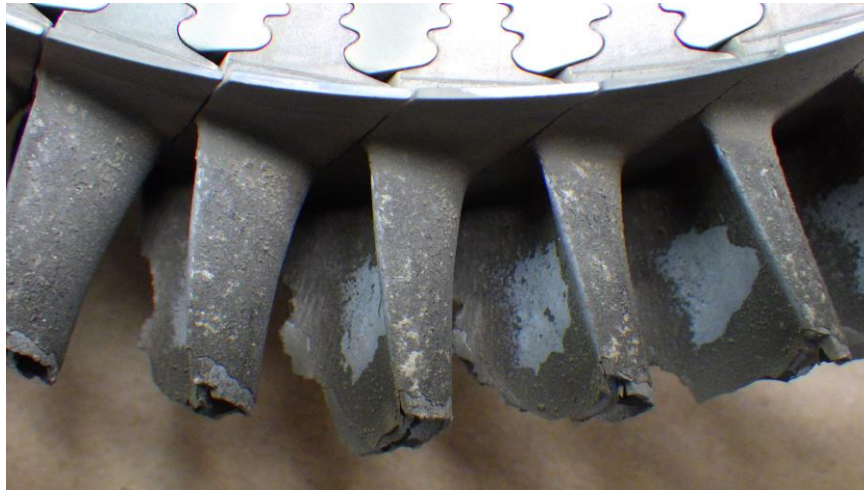
Disassembly Observations

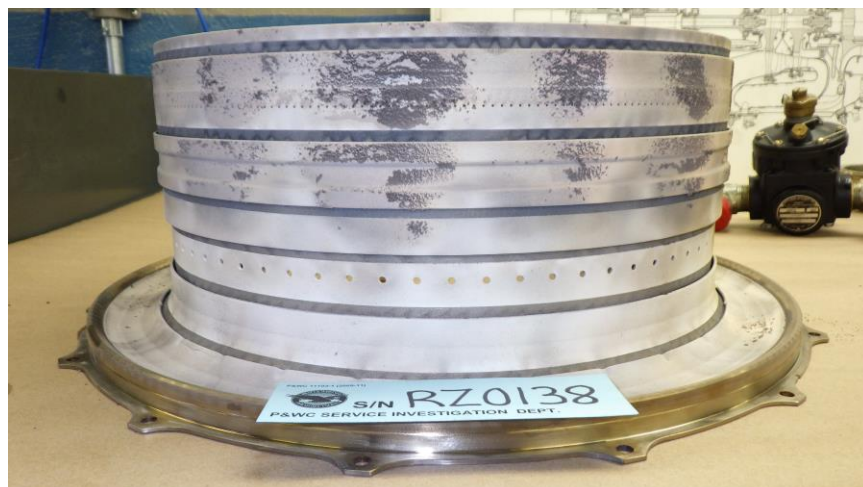
The compressor bleed valve (BOV) was removed and was found in the open position. The BOV was generally clean. Both igniter plugs and all fuel nozzle manifolds were still secured and tightened.

The engine was split at “C” flange to access the hot section components. The compressor turbine (CT) blades were all fractured. All CT blades were coated with fused/stuck debris, dark grey in appearance. The CT disk downstream side exhibited heat discoloration and severe circumferential rubbing. The CT shroud segments presented rub, material transfer and fused debris accumulation. The combustion chamber displayed a significant accumulation of dislodged “unknown” melted/molten debris, dark grey and tan in appearance. The combustion chamber did not show evidence of overtemperature exposure. The CT vane ring showed normal operational wear, but displayed fused debris build-up. The small exit duct showed normal operational wear, but also displayed stuck debris build-up.





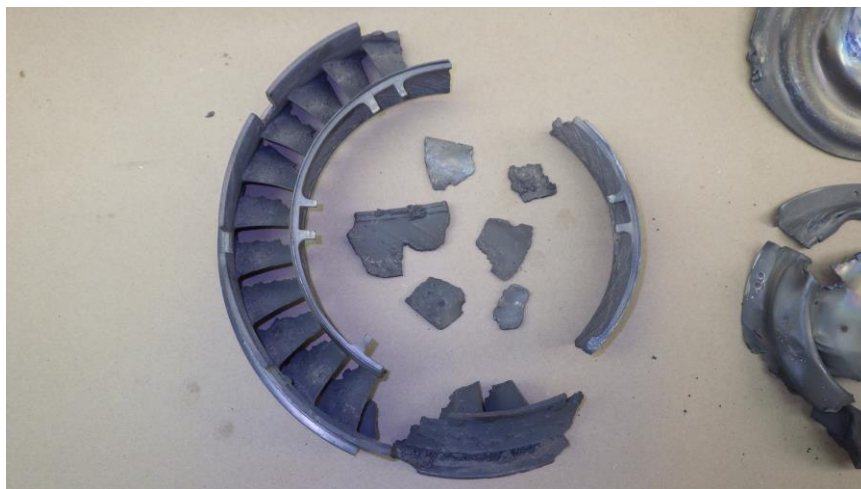






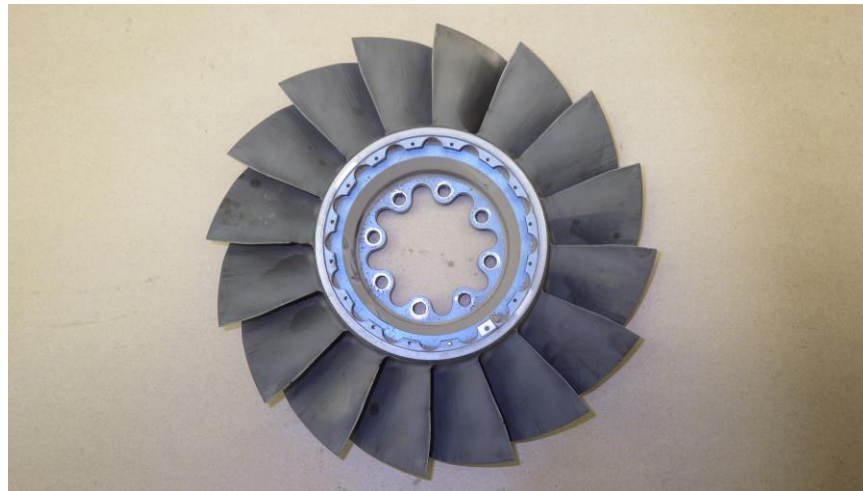
All T5 probes had fractured. The PT stator housing internal surface showed some scoring marks. The PT vane ring was fractured and some fragments were not retrieved. The interstage baffle was severely deformed, battered and showed severe circumferential rubbing marks due to contact with the CT disk assembly on the upstream side and the PT1 disk assembly on the downstream side. The PT shroud was deformed and fractured. The PT1 and PT2 blades were all fractured. All PT1 blades were pushed backward. The PT1 blades were fractured at about the same airfoil heights, close to the base. The PT1 disk downstream and upstream sides showed circumferential rubbing. The upstream side of the PT disk showed severe circumferential rubbing marks at the bore and serrations due to the contact with the interstage baffle downstream side. The balancing rim was deformed and fractured. Some PT2 blades were pushed backward. The PT2 blades were fractured at various airfoil heights. The PT2 disk downstream and upstream sides showed circumferential rubbing.

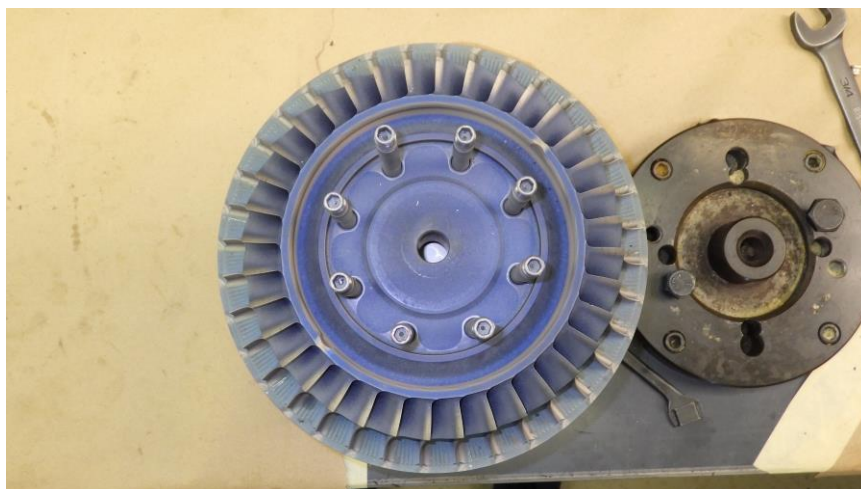






Some compressor 1st, 2nd, 3rd, 4th stages airfoils presented evidence of pre-impact foreign object damage (FOD) and displayed light erosion. The 1st, 2nd, 3rd, 4th stages stators showed environmental dust (light brown / tan) accumulation on the outer diameter (OD) (P2.5 area). The 1st stage inner bore showed a significant amount of dust accumulation. The impeller presented evidence of pre-impact foreign object damage (FOD) and displayed light erosion. The back face of the impeller showed environmental dust (light brown / tan) accumulation.





The RGB and AGB gears showed normal operational wear. The No. 1, 2, 3, 4 bearing also showed normal operational wear. The No. 4 bearing oil nozzle was intact.

4.0 ACCESSORIES INVESTIGATION

Accessory	
Fuel pump	
Fuel control unit (FCU)	
Compressor bleed valve (BOV)	
Flow divider and dump valve (FDV)	
Fuel oil heat exchanger (FOHE)	
Propeller governor (CSU)	
Fuel nozzles	
Over-speed governor (OSG)	

Fuel pump

Note: This unit was on the engine at initial engine delivery

The fuel pump was removed from the engine attached to the fuel control unit. The exterior of the fuel pump was soiled. The driveshaft could not be turned by hand (this is normal for this pump configuration). Lockwire was present at all locations. Prior to testing the fuel pump the outlet filter and inlet screen were removed for inspection and a small amount of fuel residue was collected. There was no significant debris in the outlet filter or inlet screen and no evidence of water or solid contamination in the fuel residue. A slave outlet filter was installed and the fuel pump was tested in accordance with [REDACTED].

Fuel control unit (FCU)

Note: This unit was on the engine at initial engine delivery

The FCU was removed from the engine attached to the fuel pump. The exterior of the FCU was soiled. The condition lever, power lever and manual override lever moved freely over their full ranges. The condition lever was bent and the gap between the lever and the housing was greater than would normally be present. There was un-broken orange anti-tamper paint in the socket of the condition lever shut-down stop screw. There was unbroken orange anti-tamper paint in the socket of the base screws, and on the bellows locknut. Lockwire was present at all locations. The lockwire seals were marked [REDACTED]. Prior to testing the FCU the P3 inlet elbow, Py outlet elbow, fuel inlet elbow and fuel outlet elbow were removed for inspection. No contamination was present in the elbows. The tach-valve inlet screen was examined and confirmed to have no contamination present. The FCU was tested in accordance with [REDACTED]. In order to determine if the test observations were influenced by field adjustment the power lever low idle stop, maximum Ng stop, dead-band and the condition lever high idle were adjusted and the relevant test points were repeated.

Compressor bleed valve (BOV)

Note: This unit was on the engine at initial engine delivery

The exterior of the BOV was lightly soiled. The piston moved freely and there was a light ring of ash around the sides of the piston and slightly heavier ash deposits on the bottom of the piston. A packing was present on the seat at the guide-pin. Lockwire was present between the primary and secondary



orifice plugs. The BOV was disassembled to inspect the components. The sealing rings were present and intact. There was no significant wear or damage observed on the piston, housing, screws or seat.

Flow divider and dump valve (FDV)

Note: This unit was on the engine at initial engine delivery

The flow-divider valve (FDV) was removed from the engine attached to the No.8 (inlet) fuel manifold adapter. The exterior of the FDV was generally clean and fuel wetting was observed. The coupling nipple at the dump port was loose and could be turned by hand.

Lockwire was present at the dump-port fitting screws and the inlet adapter screws. Following separation of the FDV from the inlet manifold adapter no significant scratches or leak-paths were observed on the sealing faces and the primary and secondary port passage packings were present and intact. The FDV was tested in accordance with [REDACTED].

Fuel oil heat exchanger (FOHE)

Note: This unit was on the engine at initial engine delivery

The exterior of the fuel oil heat exchanger (FOHE) was soiled. The identification label was present, intact and legible. There were two impact marks on the bottom of the tank. Lockwire was present at the thermal element cap and the core flight-plug. A low-pressure air supply was connected to the FOHE fuel inlet, the fuel outlet port was blanked and the unit was immersed in a water bath to check for bubbles that could indicate a breach between the oil and fuel cores. No bubbles were observed. The thermal element was removed from the unit and tested in accordance with [REDACTED].

Propeller governor (CSU)

Note: This unit was on the engine at initial engine delivery

The exterior of the propeller governor (CSU) was soiled. The speed setting lever and top of the cover were missing and a red-shipping cap had been placed in the hole. The driveshaft turned freely. The reset arm moved freely and returned under the influence of its spring. The beta-valve clevis moved freely and returned under the influence of its spring. The feathering valve plunger moved freely and returned under the influence of its spring. There was an incomplete tie-wrap around the beta-valve housing. There was no debris observed in the gasket screen. There was unbroken red anti-tamper paint of the feathering stop screw and the reset-arm stop screw. There was an impact mark on the wiring pocket cover. Lockwire was present at all locations. The lockwire seal was marked [REDACTED]. The inside of the ball-head cavity was clean and oil wetting was observed. There were impact marks in the drive-gear pocket (suggesting sudden stoppage) but no evidence of cavitation on the gears or in the pockets. The pilot valve slid freely in the gear-shaft. The packings were present on the beta-valve plunger and sleeve. The cover and bottom gaskets were present and intact. The reset rod was correctly engaged with the pilot-valve and slid freely on the bore of the housing. The packing was present and intact on the pressure relief valve housing.

Fuel nozzles

Note: It was not possible to determine if this hardware was on the engine at initial engine delivery

The No. 8 (inlet) fuel nozzle was removed from the engine attached to the flow divider valve. Powdered residue was present between the nozzle sheath and the adapter stem on the No. 2, 3, 4, 5, 6, 11, 12 nozzles. Soot accumulation was notable on the crowns of the No. 13 and 14 nozzle sheaths.



Lock-washers were present at each nozzle tip. The fuel nozzles were tested in accordance with [REDACTED].

Over-speed governor (OSG)

Note: This unit was on the engine at initial engine delivery

The exterior of the OSG was lightly soiled. The driveshaft turned with slight resistance. There was unbroken orange anti-tamper paint on the pilot-valve stop screw. The inside of the solenoid electrical connector was lightly soiled and the pins were present and straight. Lockwire was present at all locations. The OSG was tested in accordance with [REDACTED].
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4.0 ADDITIONAL ACTIVITIES / FURTHER ANALYSIS

Samples of the debris collected in the hot section were submitted to the P&WC Chemical Laboratory for further analysis.

Samples of the debris collected in the cold section will be submitted to the P&WC Chemical Laboratory for further analysis.

The CT, PT1 and PT2 blade sets will be sent to the P&WC Materials Laboratory for further analysis.

As part of the accessories investigation, residues from the fuel nozzles were sent to the P&WC Chemical Laboratory for analysis.

5.0 CLOSING REMARK

These preliminary findings are based on engine examination conducted on 14 to 16 May 2019.

PRATT & WHITNEY CANADA CORP.

[REDACTED]
Investigator
Service Investigation
22 May 2019