

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



CEN23LA223

EXAMINATION SUMMARY

October 17 - 19, 2023

TABLE OF CONTENTS

A. ACCIDENT	3
B. EXAMINATION PARTICIPANTS	3
C. SUMMARY	3
D. DETAILS OF THE EXAMINATION	4
1.0 ENGINE EXAMINATION	4
2.0 PROPELLER EXAMINATION	36

A. ACCIDENT

Location: Lake Village, Arkansas
Date: June 3, 2023
Time: 1158 CDT
Airplane: Air Tractor AT-502B, N509HB

B. EXAMINATION PARTICIPANTS

IIC	Brian Rutt National Transportation Safety Board Denver, Colorado
Investigator	Joshua Lindberg National Transportation Safety Board Denver, Colorado
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C. SUMMARY

On June 3, 2023, about 1158 central daylight time, an Air Tractor AT-502B airplane, N509HB, was substantially damaged when it was involved in an accident near Lake Village, Arkansas. The pilot was uninjured. The aircraft was operated as a 14 *Code of Federal Regulations* (CFR) Part 137 aerial application flight.

The pilot reported that shortly after departure, the airplane lost thrust, but the engine remained operating. Unable to continue flight with diminished thrust, the pilot executed a forced landing to a field, which resulted in substantial damage to the fuselage and both wings. During a postaccident examination, engine and propeller control continuity was established from the cockpit controls to their respective engine

and propeller controls with no anomalies noted. The propeller appeared at or near the feathered position.

A review of maintenance records indicated that the airplane had undergone maintenance the day before at a 14 CFR Part 145 Repair Station, which included an adjustment to the propeller beta plunger. The extent of the work was not documented on the work order and no logbook entries were made.

D. DETAILS OF THE EXAMINATION

1.0 Engine Examination

The engine was still within the air frame (Figure 1). The propeller was still attached to the engine and showed some damage to the propeller tips (Figure 2). The data plate confirmed the engine S/N was PCE-PH0492 (Figure 3).



Figure 1 - Engine as presented



Figure 2 - Propeller and exhaust stacks

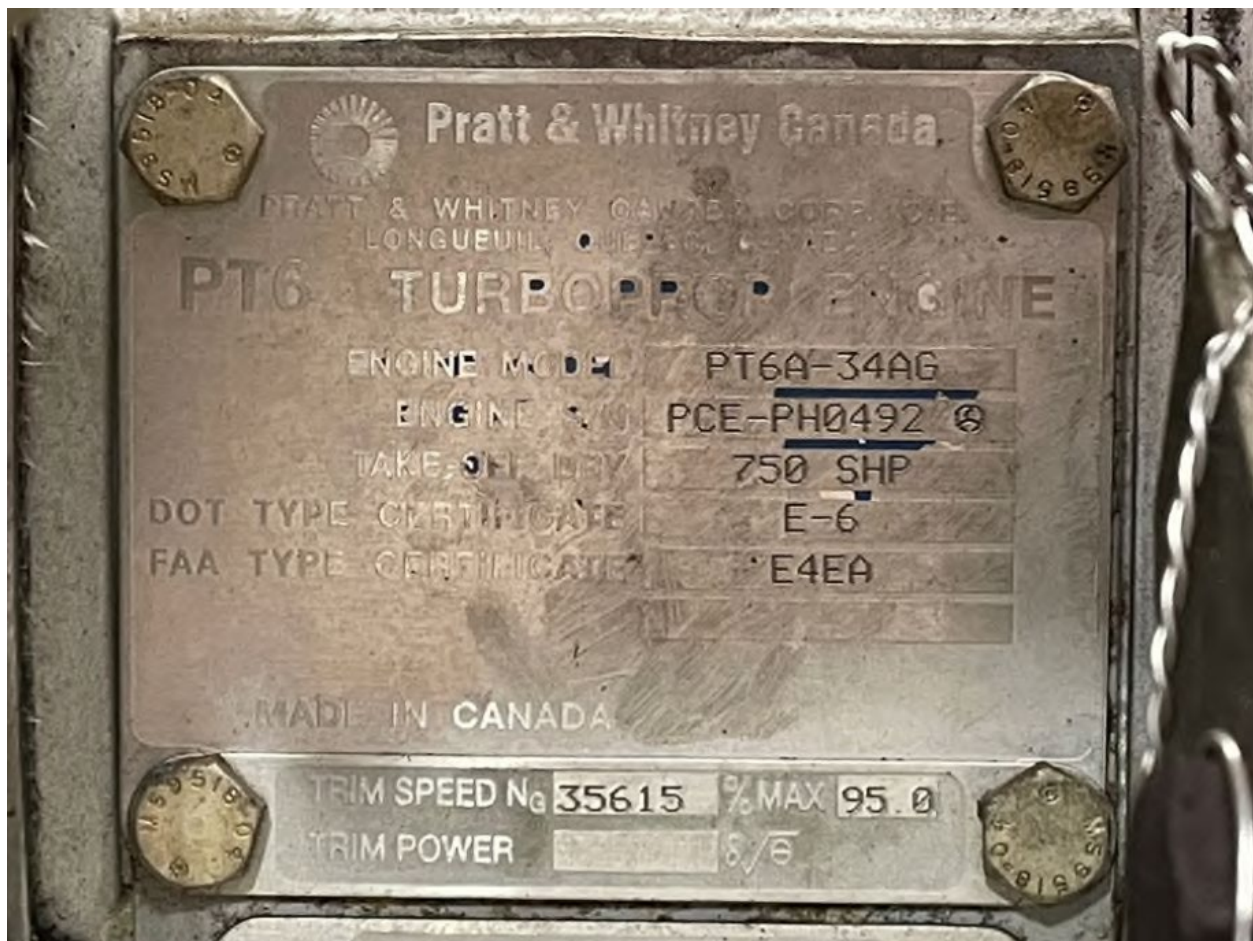


Figure 3 - Data Plate

Reduction Gearbox (RGB): The RGB could not be rotated, however no external damages were observed (Figure 4).



Figure 4 - Reduction Gear Box

Exhaust Duct: The exhaust duct exhibited some deformation to the top and bottom surface regions (circled, Figures 5 and 6). The exhaust stack showed occasional dents on the front surfaces that did not appear recent in coloration (red arrows, Figure 2).

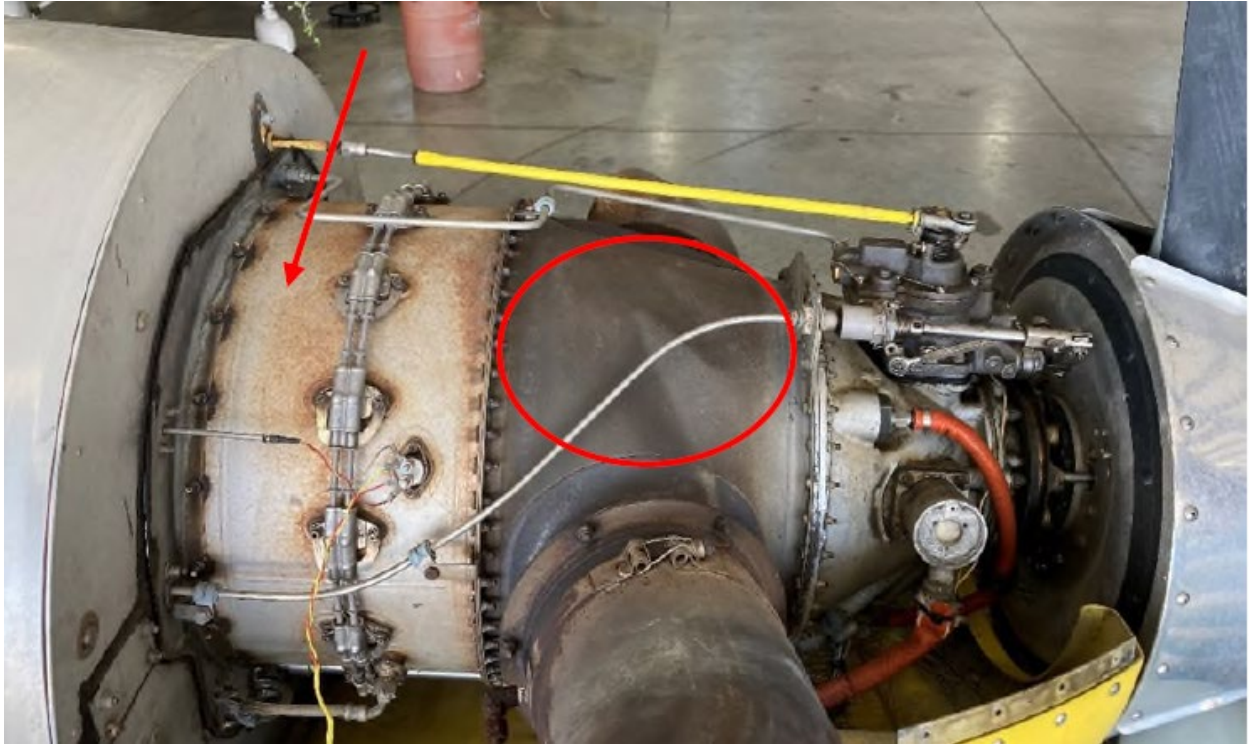


Figure 5 - Exhaust Case Top View



Figure 6 - Exhaust Case Bottom View

Gas Generator Case (GGC): The GGC case showed no damages (red arrows, Figures 5 and 7).

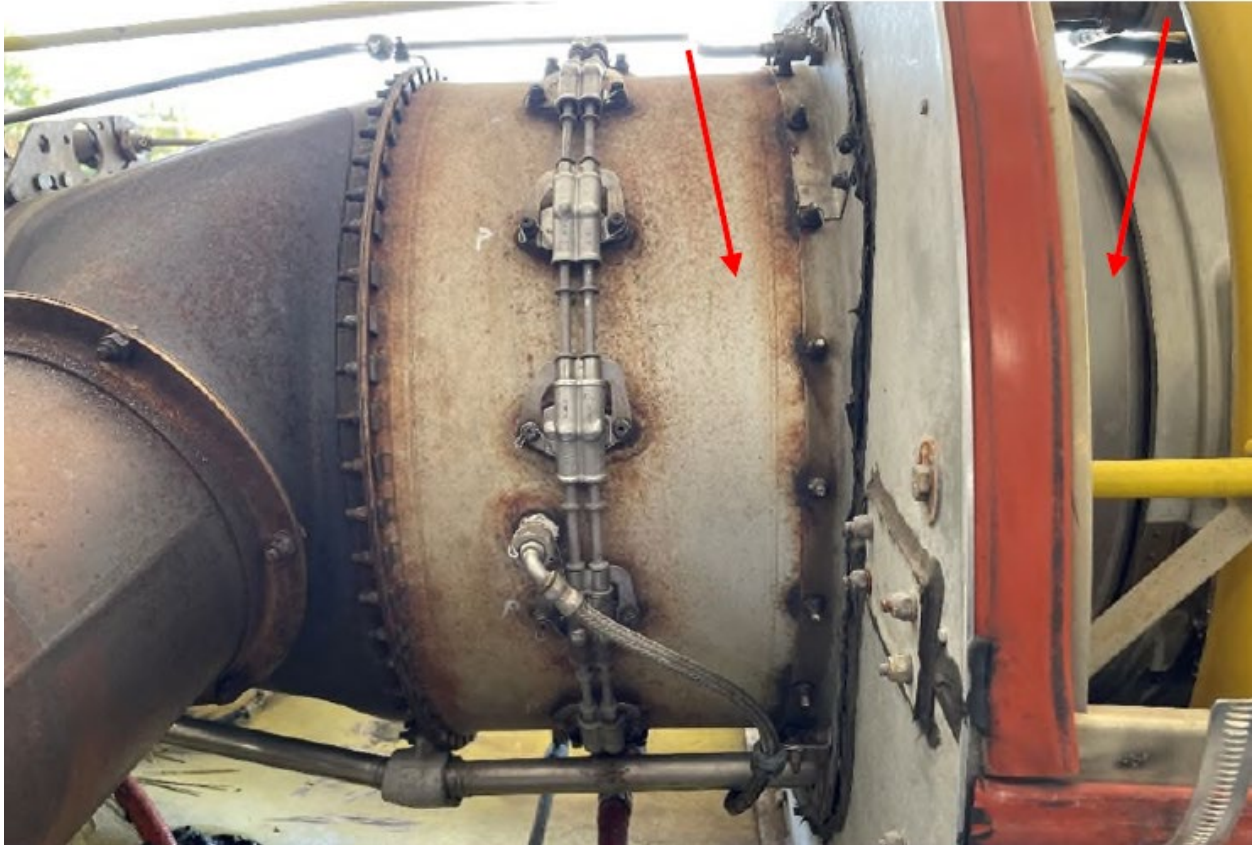


Figure 7 - GGC

Accessory Gearbox (AGB) and Inlet Case: The AGB and inlet case showed no damages (Figures 8 and 9 respectively).



Figure 8 - AGB



Figure 9 - Inlet Case

Power Control Linkage and Reversing Linkage

The CAM box (red circle), fuel control unit (FCU) connecting rod (red arrow) and FCU Arm (red square) were undamaged (Figure 10). The reversing cable (dashed red arrow), interconnect rod (red arrow), propeller governor (CSU) reset arm (white

arrow) and Beta Valve (dashed white arrow) showed no damages (Figure 11). The beta valve movement was verified with no abnormality in its movement observed. The beta lever (red arrow) and reversing lever guide (white arrow) were found displaced but still underneath the reversing lever guide pin (dashed red arrow), which was mechanically bent (Figure 12). Moving the power lever angle (PLA), which was found at the flight idle position, showed continuity and ease of movement throughout the PLA range with the CAM box, FCU and reversing linkage.

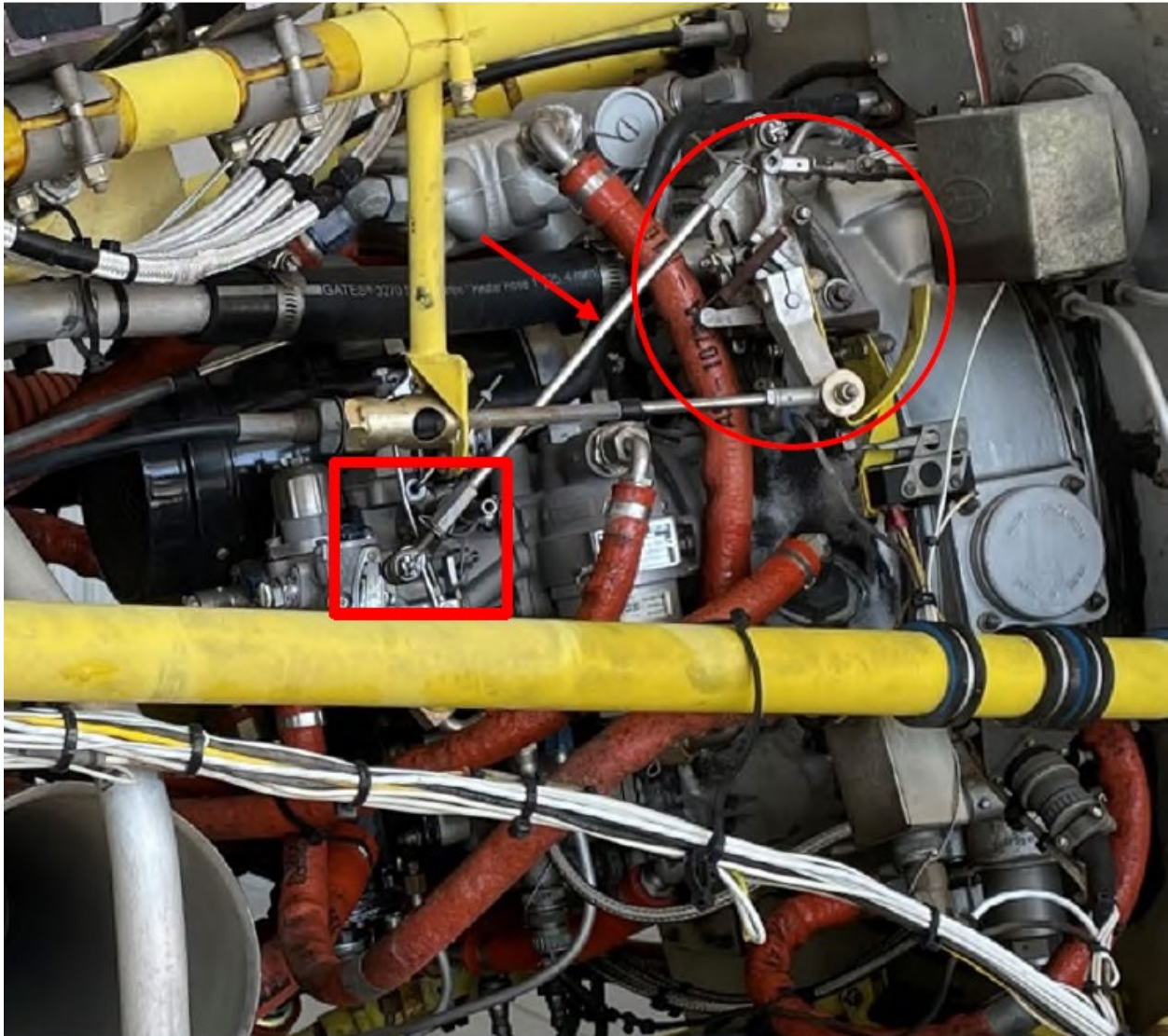


Figure 10 - CAM Box, Fuel Control Unit (FCU) Connecting Rod, and FCU Arm.

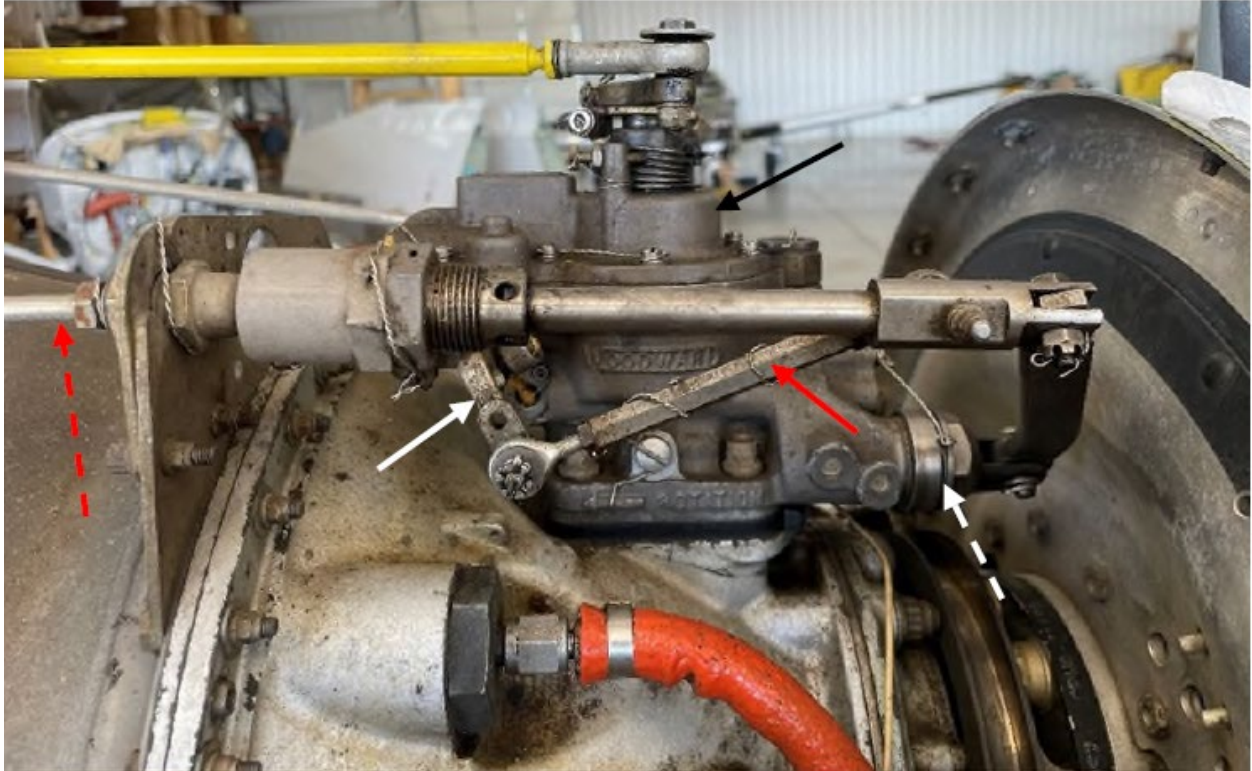


Figure 11 - Reversing Cable, Interconnect Rod, Propeller Governor (CSU) Reset Arm, Beta Valve and CSU

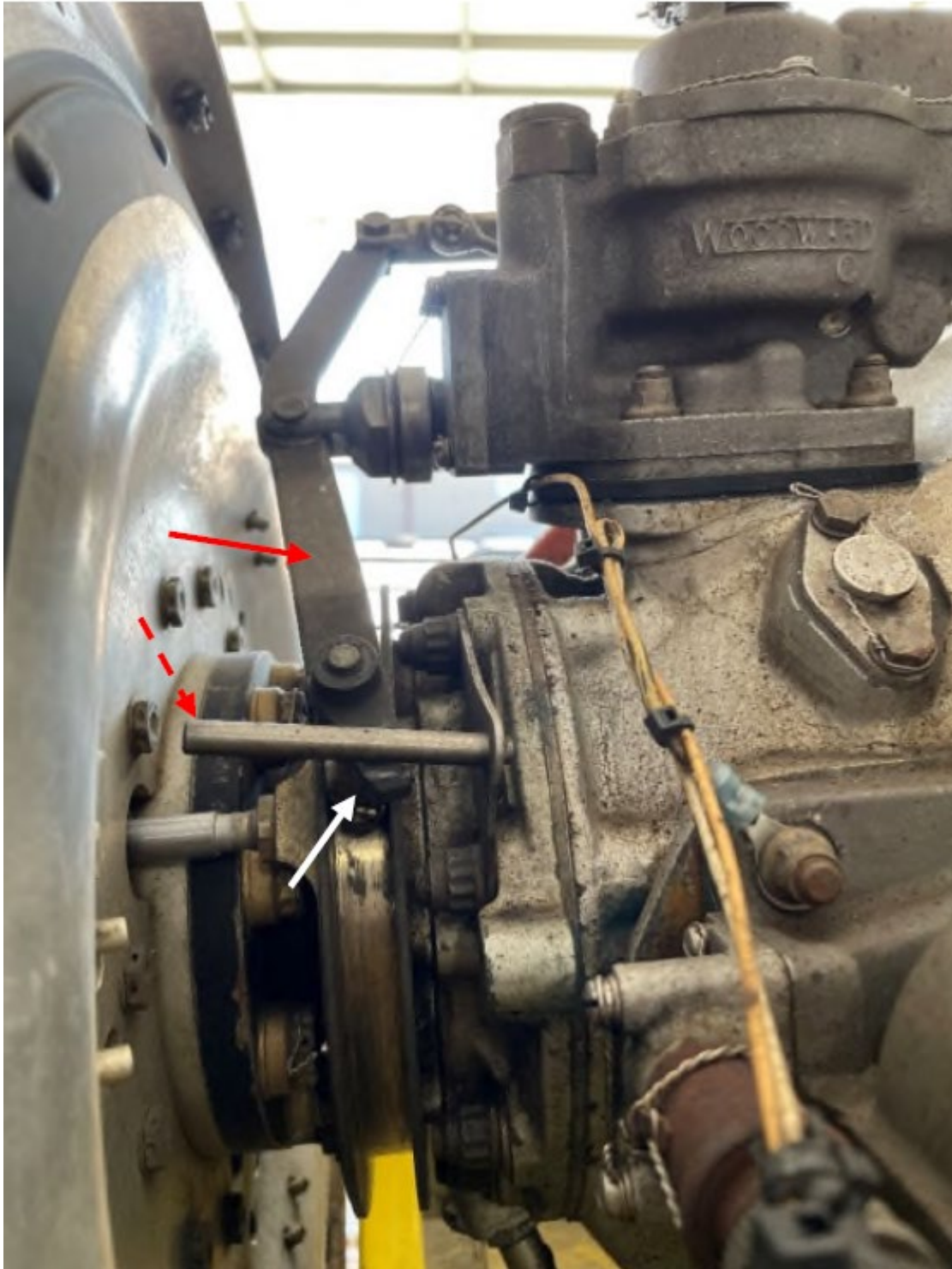


Figure 12 - Beta Lever, Reversing Lever Guide and Reversing Lever Guide Pin.

Pneumatic Lines

Compressor Discharge Air (P3) and P3 Filter: The P3 lines and fittings from the GGC (red arrow) to the P3 filter (dashed red arrow) and to the FCU (white arrow) were

found tight and secured (Figures 13 and 14). The P3 filter and bowl, which was tight and secured, were clean and dry (Figure 15).

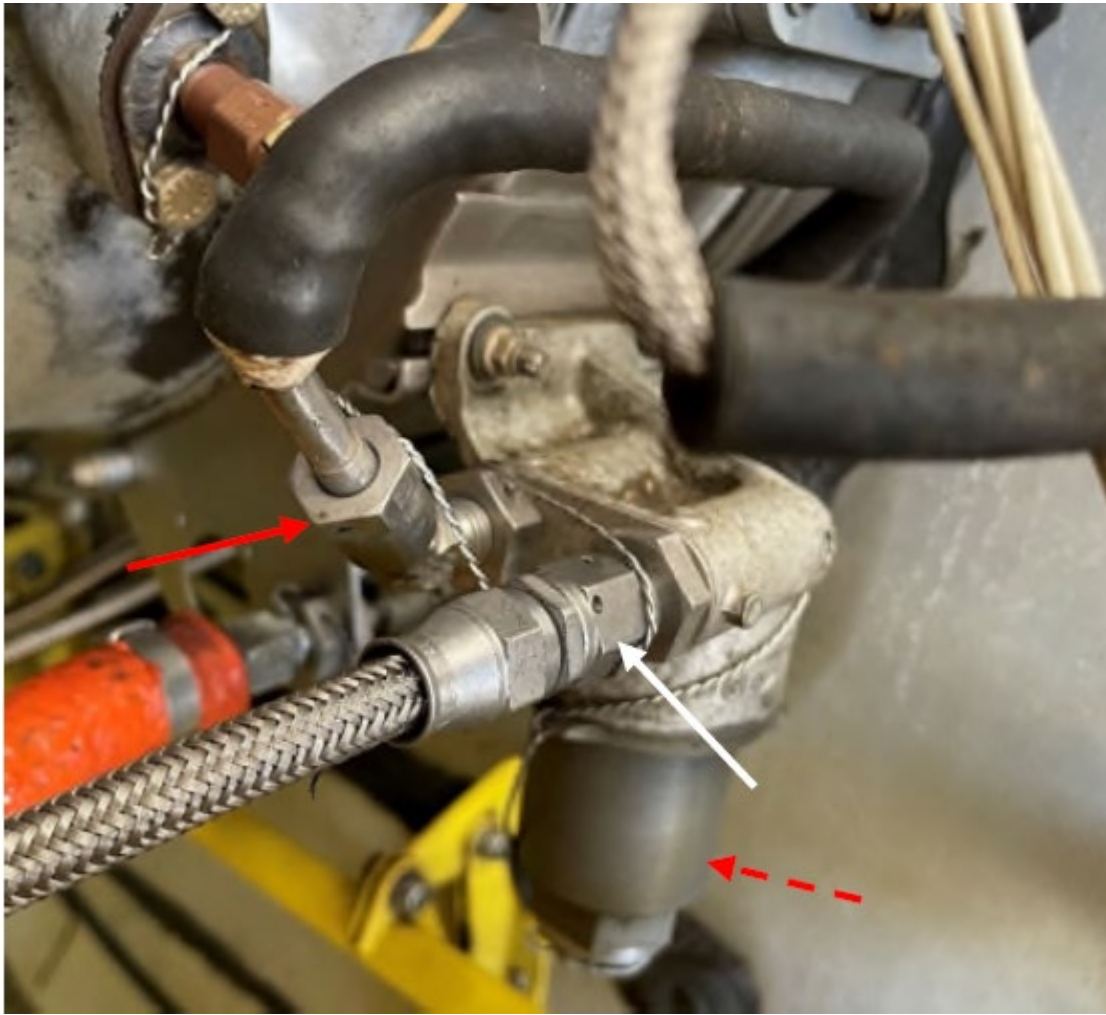


Figure 13 - P3 lines to P3 Filter



Figure 14 - P3 Fitting at FCU



Figure 15 - P3 Filter



Figure 16 - P3 Filter bowl

Power Turbine Control (Py): The Py line fittings from the FCU, through the front firewall to the CSU were found tight and secured (white arrow, Figures 17 to 19).



Figure 17 - Py Fitting at FCU



Figure 18 - Py Fitting at Front Firewall



Figure 19 - Py fitting at CSU

Chip Detector and Filters

Chip Detector: The RGB magnetic chip detector poles showed only "Fuzz" (Figure 20).



Figure 20 - Magnetic Chip Detector

Oil Filter: The main oil filter was clean and showed no debris contamination (Figure 21).



Figure 21 - Oil Filter

Fuel Filter: Was not removed from the FCU.

Disassembly Observations

Compressor Turbine (CT) Section

The engine was split at the "C" flange. The CT disc and CT blades showed no evidence of distress. No evidence of CT blade tip rubbing with the CT shroud segments was observed (Figure 22). The CT was freely rotated by hand and showed continuity with the AGB. The CT disc retaining nut was secure. The CT stator was not accessed for the purpose of this investigation.



Figure 22 - CT disc and blades

Combustion Section

The combustion chamber other than operational wear showed no evidence of distress and was not accessed further for the purpose of this investigation (Figure 23).



Figure 23 - Combustion Chamber

Power Turbine (PT) Section

The PT could not be rotated by hand. The upstream side of the PT vane ring showed no damages (Figure 24). The inter turbine temperature (ITT) Probes, Busbar, and Harness showed no damages. The PT vane ring was removed, after which the PT could be rotated by hand and showed continuity with the propeller shaft. The downstream side of the PT vane ring shroud lip showed circumferential contact with the PT Blades over an arc of approximately 180° (red arrow Figure 25). The PT blades showed no distress (Figure 26). The PT blades shroud tips showed no significant rubbing, however the shroud tips upstream face showed circumferential rubbing wear from contact with the PT vane ring outer shroud lip (red arrow Figure 27). The PT stator housing, PT shaft, PT shaft housing and Nos. 3 & 4 bearings were not accessed for the purpose of this investigation.



Figure 24 - PT Vane Ring, ITT Probes and Busbar



Figure 25 - PT Vane Ring Downstream



Figure 26 - PT blades



Figure 27 - PT vane ring outer shroud lip

Compressor Section

The compressor could be rotated by either the CT or through the AGB and showed continuity with both. The compressor was not accessed further for the purpose of this investigation.

Reduction Gearbox (RGB)

The RGB initially could not be rotated, however once the PT vane ring was removed the PT could be freely rotated by hand showing continuity through the RGB with propeller shaft. The RGB was not accessed further for the purpose of this investigation.

Accessory Gearbox (AGB)

The AGB showed no distress and could be rotated by hand with continuity observed.

Controls and Accessories

Ignition System

Ignition Plugs, Leads and Exciter: The ignition plugs and leads showed operational wear (Figures 28 and 29 respectively). The exciter showed no damages.



Figure 28 - Ignition Plugs

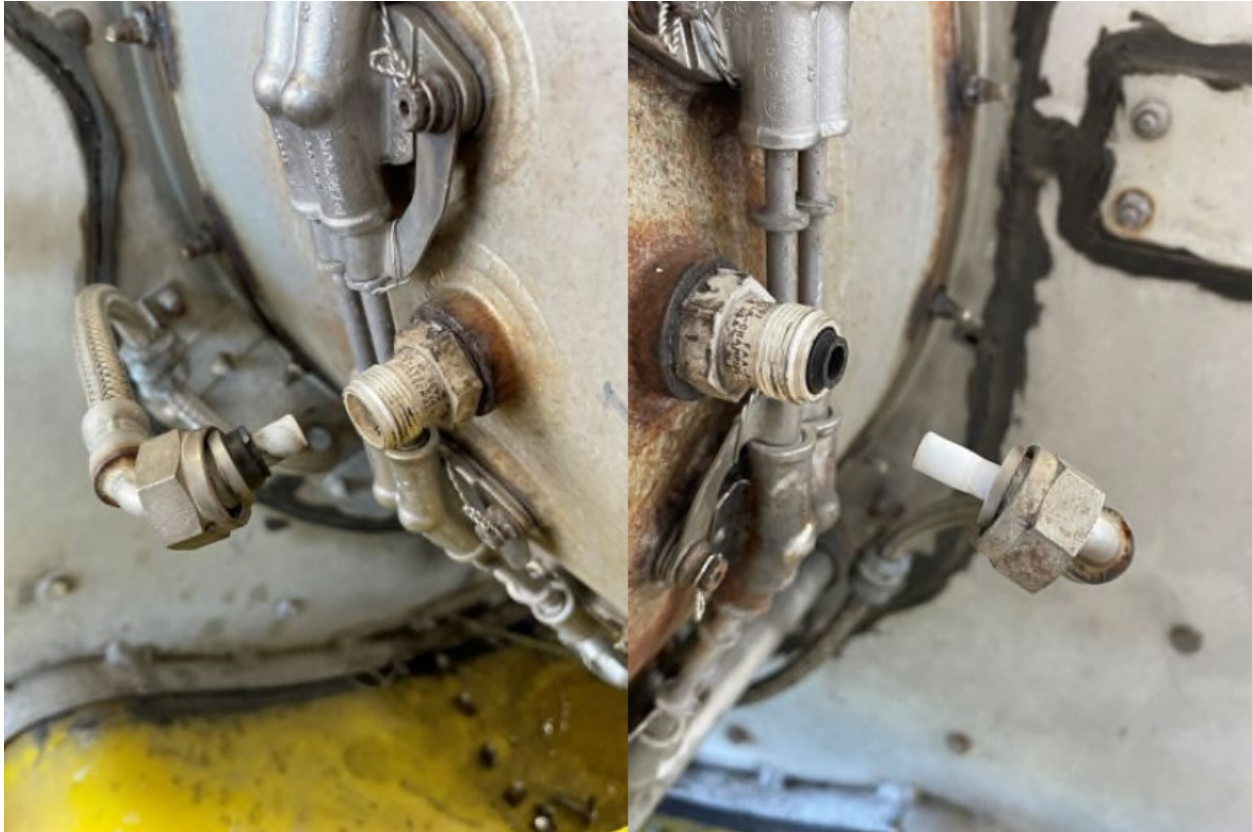


Figure 29 - Ignition Leads

Fuel System

Fuel Oil Heat Exchanger (FOHE): The FOHE was found fractured from its mounting on the AGB rear housing (red arrow, Figure 30). The FOHE was removed and sent by the NTSB to PWC for further analysis (Figure 31).



Figure 30 - FOHE



Figure 31 - FOHE

Fuel Pump: The fuel pump (red arrow, Figure 32) showed no damages and was removed with the FCU attached. The fuel pump with the FCU was sent to P&WC Accessories Investigation for further analysis (Figure 33).



Figure 32 - Fuel Pump and FCU

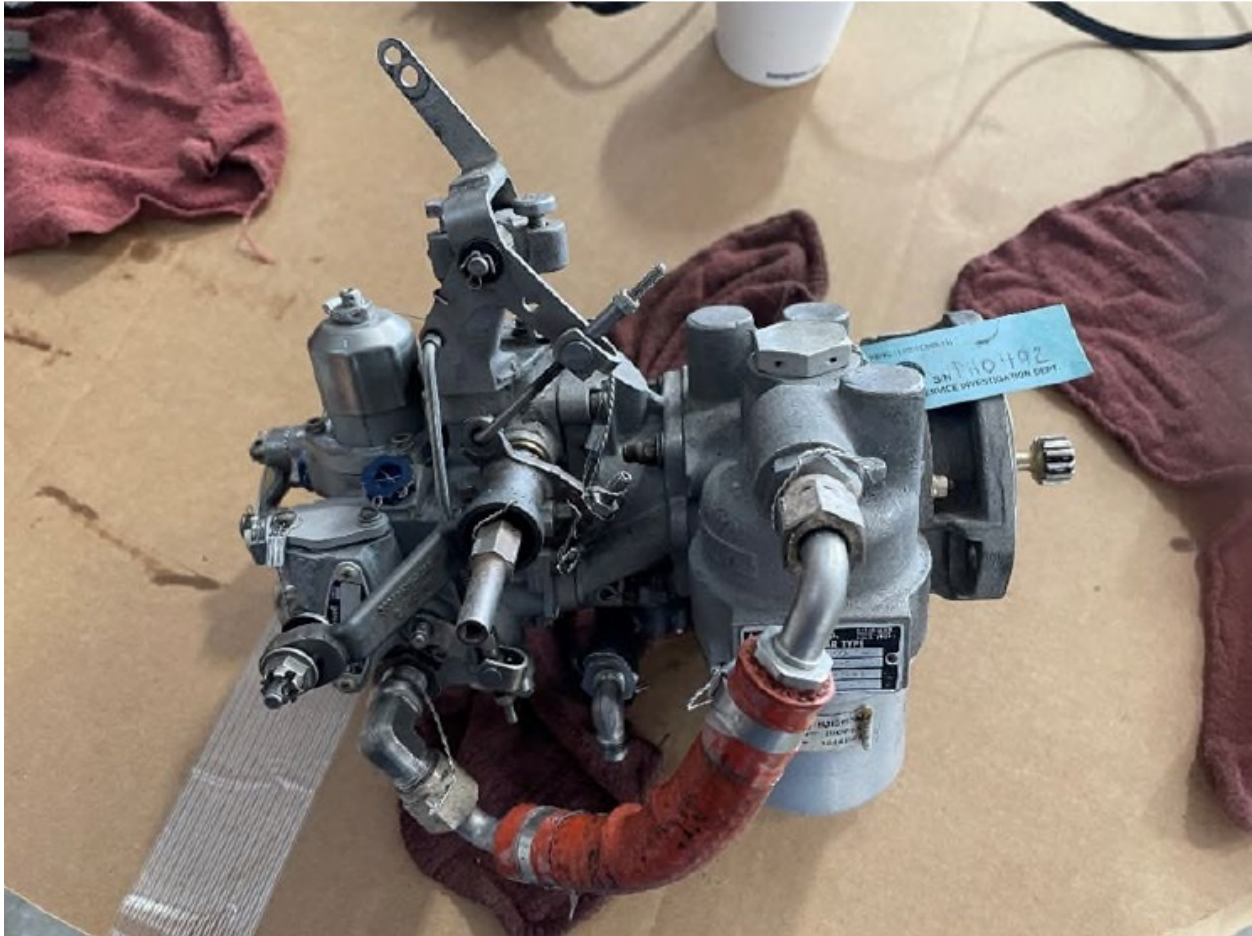


Figure 33 - Fuel Pump and FCU Removed

Control Unit (FCU): The FCU (white arrow, Figure 32) showed no damages and was removed attached to the fuel pump. The fuel pump with the FCU was sent to P&WC Accessories Investigation for further analysis (Figure 33).

Flow Divider Valve (FDV): The FDV was not removed for the purpose of this investigation.

Fuel Nozzles: The fuel nozzles were not removed for the purpose of this investigation.

Air System

Compressor Bleed Valve (BOV): The BOV was not accessed for the purpose of this investigation.

Oil System

Propeller Governor (CSU): The CSU (black arrow, Figure 11), which showed no distress was removed. The CSU rest lever and propeller control lever could be moved by hand. The CSU drive shaft could be rotated freely by hand. The gasket screen showed no presence of any debris. The CSU and sent by the NTSB to Woodward for further analysis.

Overspeed Governor (OSG): The OSG was observed in place on the RGB.

SUMMARY

The engine displayed contact signatures to its power turbine blades and vane ring characteristic of the engine developing some degree of power at the time of impact. There were no indications of any pre-impact mechanical anomalies to any of the engine components that would have precluded normal engine operation.

2.0 Propeller Examination

Model: HC-B3TN-3D / T10282N+4

Assembly S/N: BUA33394 (DOM 5/4/2015)

Blades S/Ns:

#1 - L60580

#2 - L60587

#3 - L60591

The propeller examined is a 106.5" diameter, Steel Hub Turbine Series, 3-blade, feathering, reversing, pressure to decrease pitch. Oil pressure from the propeller governor is used to move the blades to the low pitch (blade angle) direction. A spring and counterweights move the blades to the high pitch/feather direction in the absence of governor oil pressure. The blades are of aluminum construction. The hub and clamps are made of steel alloy.

Propeller logbook excerpts provided by the FAA ASI indicated the propeller was last inspected during a 100-hour inspection on 11/14/2022. A work order indicated the propeller beta plunger was adjusted on 5/30/2023. A decal on the propeller piston indicated it was serviced with Aeroshell 6 grease and there were no decals indicating where it was overhauled.

The propeller was presented for examination (Figure 34). The propeller remained mounted to the engine prop shaft flange with all eight bolts secure and lock-wired. The spinner dome was undamaged.



Figure 34 -Propeller as-presented

All three blades presented in the feathered position with no indication of slipping in the clamps. There was no evidence of an external oil leak. All three link arms remained attached at the piston link pin and clamp link screw. The beta system was exercised with a beta puller; it actuated smoothly and returned to the home position

without hesitation. The propeller was removed to facilitate further examination of the engine.

All three blades were bent aft, bent opposite rotation and twisted towards low pitch in the tip region (outboard 16-18" of the blade). All three blades exhibited varying degrees of leading edge gouging and bending. Chordwise/rotational scoring and abrasion was isolated to the camber side of the blade (Figure 35).



Figure 35: Tip damage on Blade #2, typical on all three blades

No attempt was made to actuate the propeller with air pressure. There was no other remarkable damage and no further disassembly was deemed necessary.

There were no visible discrepancies noted that would prevent or degrade normal propeller operation prior to impact. All visible damage was consistent with high impact forces while rotating at low power and low blade angle (not feathered).

Signatures that indicate rotation at low power are:

1. Chordwise/rotational scoring isolated to the camber side.
2. Aft bends, bending opposite rotation, twisting towards low pitch isolated to the tip region.

3. All three link arms were attached at both ends with no remarkable damage.
4. No indications of blades slipping in the clamps.

Submitted by:

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