



NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

December 20, 2021

POWERPLANT GROUP CHAIRMAN'S FACTUAL REPORT

NTSB No: CEN21LA004

A. ACCIDENT

Location: Lake Elmo, Minnesota

Date: October 2, 2020

Time: 15:12 central daylight time (CDT)

Aircraft: Piper PA-46-500TP, registration number N62ZM

B. POWERPLANTS GROUP

Group Chairman: Robert Hunsberger
National Transportation Safety Board
Washington, D.C.

Member: Jonathon Hirsch
Piper Aircraft
Vero Beach, Florida

Technical Advisor (Canada): Karel Currey
Pratt & Whitney Canada
Bridgeport, West Virginia

C. SUMMARY

On October 2, 2020, about 1512 central daylight time (CDT), a Piper PA-46-500TP, N62ZM, equipped with a Pratt & Whitney Canada (PWC) PT6-42A turboprop engine, was substantially damaged when it was involved in an accident near Lake Elmo, Minnesota. The airline transport pilot sustained serious injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* (CFR) Part 91 personal flight. The pilot reported that shortly after takeoff from runway 32 at the Lake Elmo airport (21D) and following landing gear retraction, he noticed a “hiccup” in the engine power and immediately started a turn back towards the airport. During the turn, the pilot reported that all engine power was lost and then he executed a forced landing into a field of standing corn. The airplane impacted the terrain, bounced, and

came to rest upright in the corn about ½ mile northwest of the departure end of runway 32. The airplane sustained substantial damage to the right wing as a result of the impact and post-crash fire.

The PWC PT6-42A turboprop engine teardown examination was completed at the PWC Bridgeport, West Virginia (WV) facility with party members from PWC, Piper Aircraft, and the NTSB from March 9-10, 2021.

D. DETAILS OF THE INVESTIGATION

1.0 Engine Information

1.1 Engine Description

The PWC PT6-42A is a reverse flow turboprop engine featuring a three-stage axial compressor, a single-stage centrifugal compressor, an annular combustion chamber, a single-stage compressor turbine, a two-stage independent power turbine, and a hydromechanical fuel control unit (FCU) (**Figure 1**). According to the Federal Aviation Administration (FAA) type certificate data sheet E4EA, Revision 28, July 17, 2020, the engine has a takeoff dry power rating of 850 shaft horsepower¹. The engine is derated to 500 SHP on the PA-46-500TP airplane. The Ng spool consists of the compressor and compressor turbine. The Nf spool consists of the independent power turbine.

All directional references to front and rear, right and left, top and bottom, and clockwise and counterclockwise are made aft looking forward (ALF).

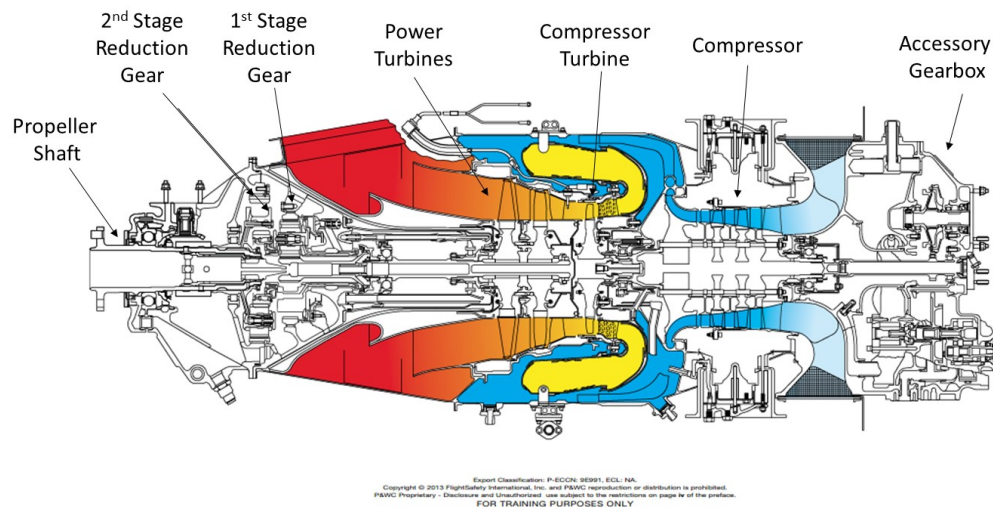


Figure 1- Pratt & Whitney Canada PT6-40 Series Engine

¹ The engine ratings are based on static sea level condition 29.92 in Hg pressure, compressor intake screen installed, no external accessory loads and no air bleed.

1.2 Engine History

According to the engine logbook, ESN PCE-RM0091 was the original engine delivered with the airplane in July 2001. The engine was removed for repairs and then reinstalled on two occasions, most recently on July 29, 2015. The engine had accumulated 2,871.7 hours time since new (TSN) and 1,119 cycles since new (CSN). The engine had not been overhauled.

On October 1, 2020, Malibu Aerospace in Blaine, Minnesota performed the following maintenance on the engine:

- Borescope inspection (BSI) of the engine hot section through a fuel nozzle port.
- Engine idle was adjusted to 65% N1 on the FCU.

2.0 ESN PCE-RM0091 TEARDOWN EXAMINATION

The engine was secured in a shipping container when the team arrived at PWC- Bridgeport, WV (**Photo 1**) and was removed and placed in a work stand for examination and disassembly (**Photos 2, 3, and 4**). The engine appeared to be in good condition with no evidence of radial uncontainment or undercowl fire. All external engine lines were intact and secure. The inlet screen was deformed radially inward toward the engine centerline and corn stalk/earthen debris was collected in the screen around the engine circumference. (**Photo 5**). The Ng spool was rotated through a pad on the accessory gearbox (AGB) and spun smoothly. When the Ng spool was rotated, a light rubbing noise was audible from the compressor module. The Nf spool spun smoothly when the prop shaft was manually rotated by hand. The magnetic chip detector (MCD) plugs were removed from the AGB and reduction gearbox (RGB) and there was no debris accumulation on either plug (**Photo 6**). The engine oil filter was removed from the AGB, and no debris was visible in the filter pleats.

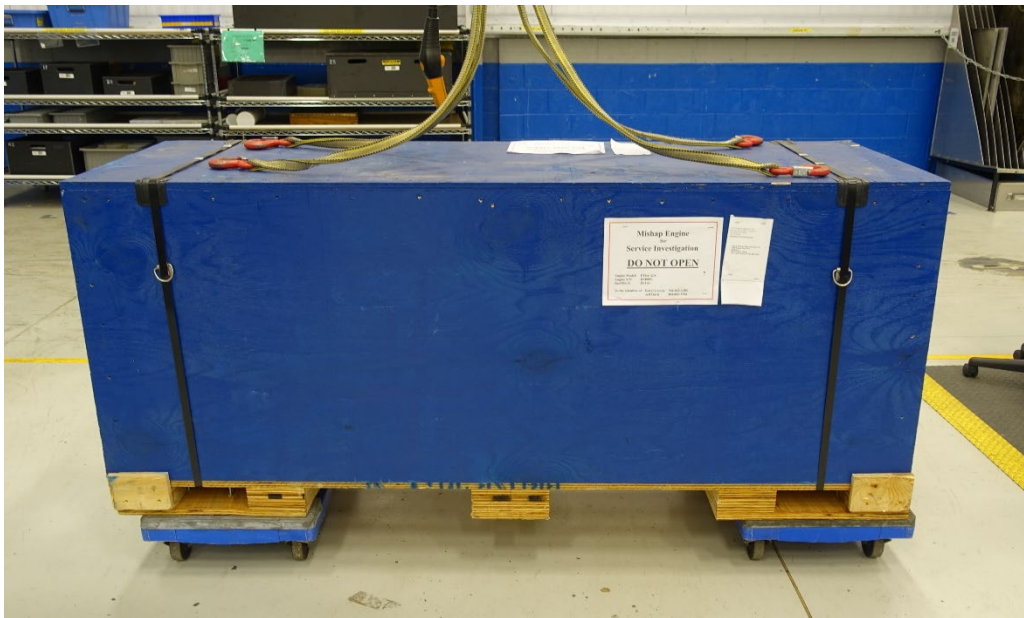


Photo 1- Engine Shipping Container, as Received at PWC-Bridgeport, WV

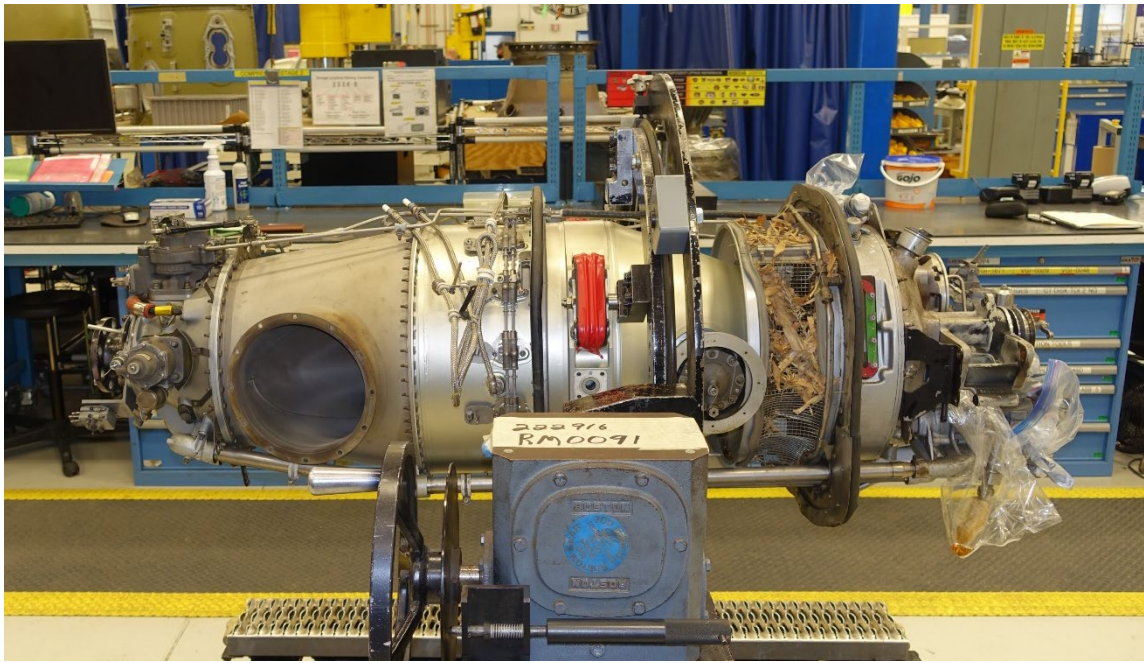


Photo 2- Left Side of Engine, as Received

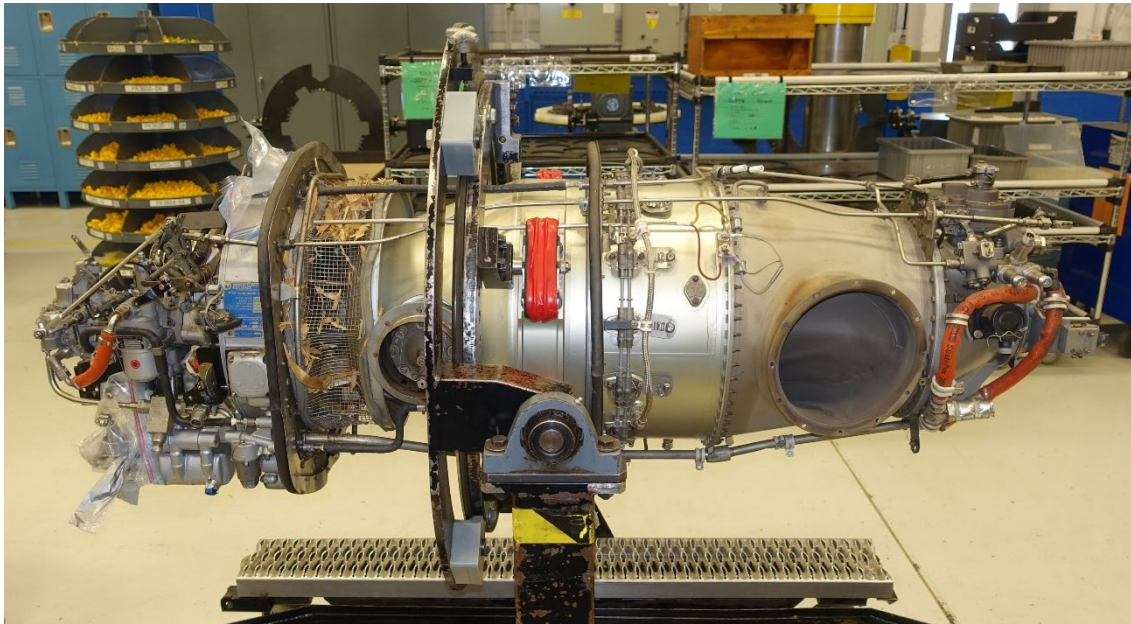


Photo 3- Right Side of Engine, as Received

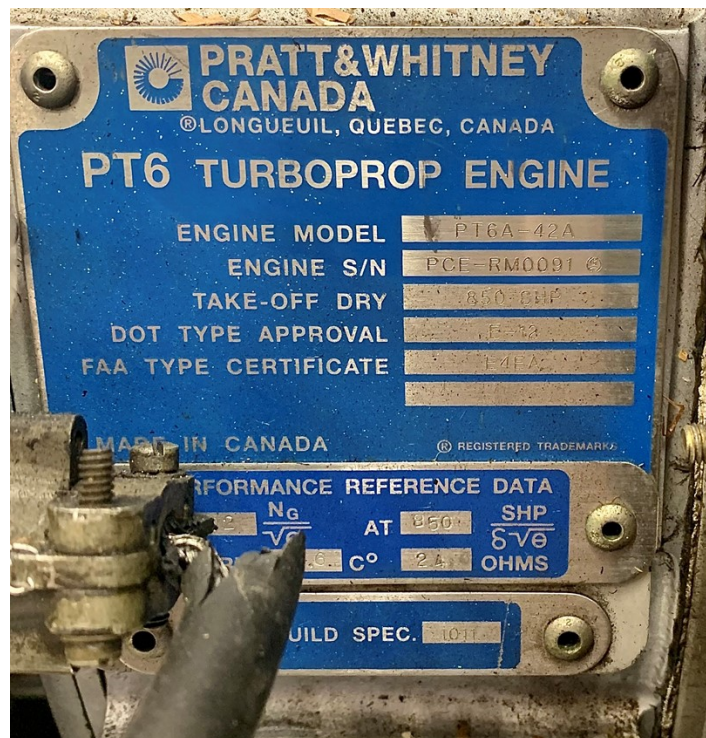


Photo 4- Engine Data Plate



Photo 5- Corn Stalk Material Collected on the Inlet Screen



Photo 6- RGB and AGB Chip Detector Plugs

2.1 Power Turbine

The 1st and 2nd stage power turbine rotors and nozzles were both in good condition and unremarkable (**Photos 7 and 8**).

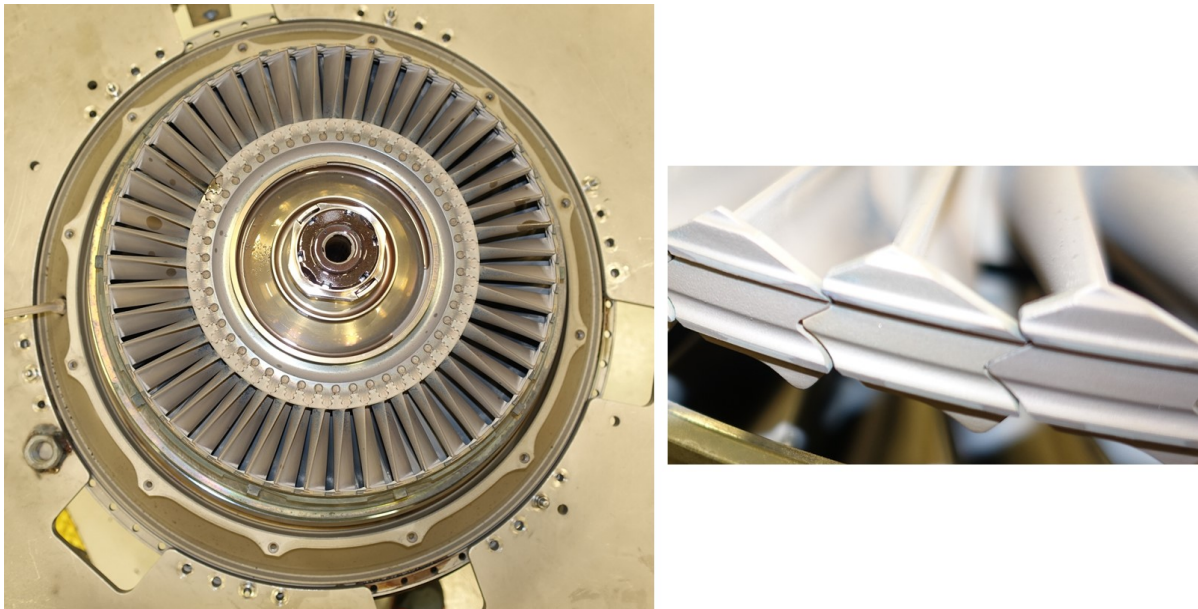


Photo 7- (L) 1st Stage Power Turbine Rotor Disk and (R) Blade Tip Platforms



Photo 8- 2nd Stage Power Turbine Nozzle

2.2 Compressor Turbine

The compressor turbine (CT) rotor disk and nozzle were in good condition. The CT rotor blades had light superficial impact damage along the leading edge (**Photo 9**).

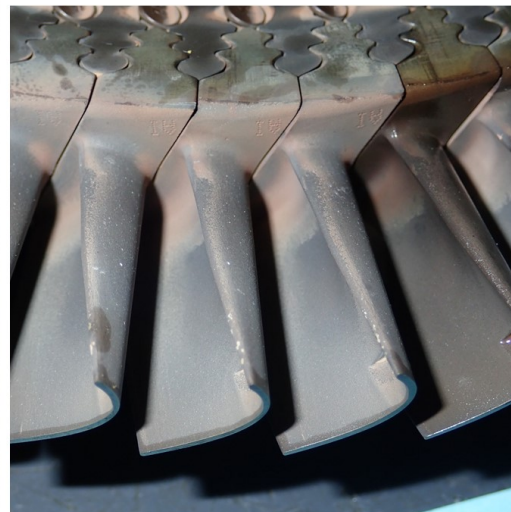


Photo 9- (L) Compressor Turbine Rotor Disk, (R) Compressor Turbine Blade Leading Edge

2.3 Combustor and Fuel Nozzles

The combustor assembly was intact and did not exhibit indications of thermal damage, fuel nozzle streaking, or uneven wear (**Photo 10**). The fuel nozzles were individually removed and visually examined with no anomalies noted.

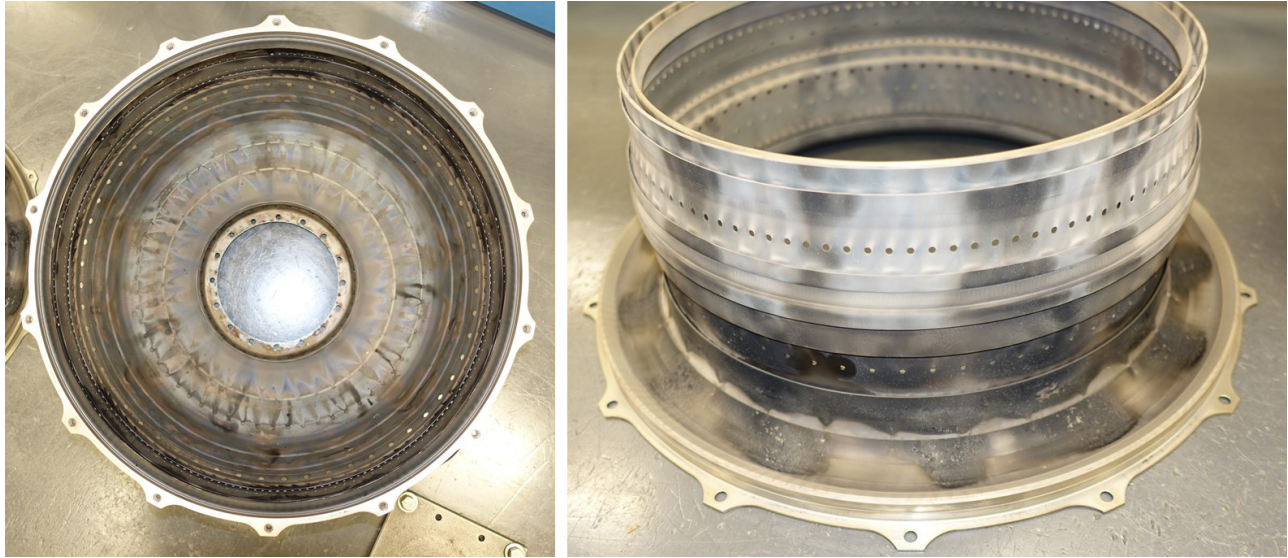


Photo 10- Combustion Liner

2.4 Compressor

Loose corn stalk debris was visible through the compressor, from the 1st stage axial rotor to the centrifugal impeller (**Photos 11 and 12**). A dark sticky residue was adhered to interior stator case surfaces, stator vanes, and compressor rotor blades. The residue was most concentrated on the stator case along the 1st stage compressor rotor blade tip path. The stator case had a light rub coincident with the 1st stage blade path between the 5 and 7 o'clock positions (**Photo 13**). The No. 1 and No. 2 bearings were oil wetted and in good condition. The compressor bleed valves were removed and functionally tested. Both bleed valve pistons actuated smoothly and there was no evidence of damage that would have prevented normal operation.



Photo 11- Compressor 1st Stage Rotor



Photo 12- Centrifugal Compressor Exducer Debris Accumulation



Photo 13- Axial Compressor Stator Case Debris Buildup and Rub Marks

2.5 Reduction Gearbox

The RGB sun, ring, and planet gears were intact and rotated smoothly. The torque sensing system hardware was unremarkable.

2.6 Fuel Control Unit and Turboprop Governor

The air pressure sense lines were disconnected from the FCU and turboprop governor. The ferrule and/or braze joints on each line were pressure leak checked with air at 20 pounds per square inch (psi) in a water bath or by spraying the tube and connections with soap solution with no leaks detected (**Photo 14**). The fuel filter was removed and was in good condition with no debris accumulation.

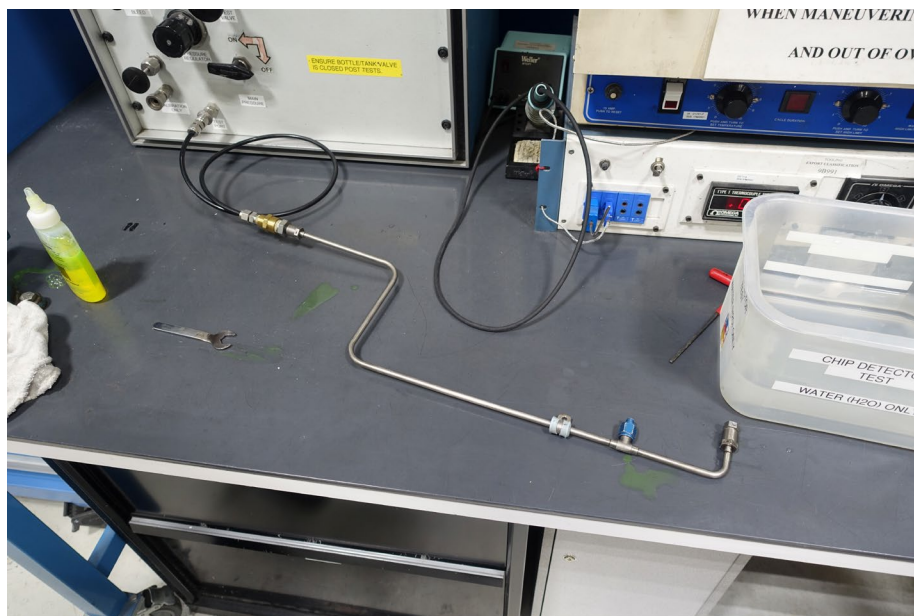


Photo 14- Turboprop Governor Py, Air Pressure Sense Line Leak Check

3.0 COMPONENT EXAMS

The fuel pump, FCU, flow divider valve, and fuel oil heat exchanger were shipped to Pratt & Whitney Canada in Montreal, Quebec, Canada for examination, testing, and/or disassembly in the presence of a Transportation Safety Board of Canada representative. The turboprop governor was shipped to Woodward in Loves Park, Illinois for examination and testing under the supervision of the NTSB. The PWC accessories report is available in the investigation docket as “Powerplants- Attachment 1- PWC Accessories Accident Report.”

3.1 Fuel Pump

The fuel pump, part number (P/N) 3033808, serial number (S/N) 5606, was manufactured by Eaton Aerospace. The fuel pump housing was lightly soiled. The fuel pump driveshaft rotated with normal resistance. There was no debris or obstructions observed on the outlet filter, inlet-screen, or inlet

screen cavity. The fuel pump was installed on the test stand and a leak was observed originating at the fuel outlet nipple. A visual examination of the fuel pump outlet nipple revealed damage and it was replaced with a spare. The fuel pump was tested in accordance with Eaton overhaul manual 73-10-12 revision 2². The fuel pump performance met specification and no anomalies were noted during the test.



Photo 15- Fuel Pump, as Received (Photos Courtesy of PWC)

² As noted in the maintenance section of the report, a flight idle adjustment was performed the day before the accident flight. There was no report of a fuel leak during adjustment or the subsequent ground runs.

3.2 Fuel Control Unit

The FCU, P/N 3052899-02, S/N C77121, was manufactured by Honeywell. The FCU exterior was lightly soiled. The driveshaft with normal resistance and the throttle lever moved freely over the full range. The fuel control was tested in accordance with Honeywell component maintenance manual (CMM) 73-20-35 Revision 1. Multiple test points were outside of test specification limits but were within normal range for a service run unit. The FCU was partially disassembled and there were no internal anomalies identified that would have affected normal operation.



Photo 16- Fuel Control Unit, as Received (Photo Courtesy of PWC)



Photo 17- Fuel Control Unit, Partially Disassembled (Photo Courtesy of PWC)

3.3 Flow Divider Valve

The flow divider valve, P/N 3019906, S/N 20599, was manufactured by Triumph Aerospace. The flow divider valve appeared to be in good condition and was bench tested in accordance with Triumph overhaul manual 73-10-01 revision 7. The valve test performance was satisfactory.

3.4 Fuel Oil Heat Exchanger

The fuel oil heat exchanger (FOHE), P/N 3124177-01, S/N WA6250, was manufactured by Meggitt. A pressure leak check was performed by capping the fuel outlet port and applying a low pressure air sources to the fuel inlet port while the part was submerged in a water bath. No leakage (air bubbles) was observed during the check. The FOHE thermal element was removed and tested in accordance with Meggitt component maintenance manual 73-10-20 and was confirmed to function properly.

3.5 Turboprop Governor

The turboprop governor, P/N 3074158-01, S/N 1516404, was manufactured by Woodward. The governor was bench tested in accordance with test specification procedure (TSP)-1527, revision 1. The maximum speed and control arm location test points were slightly above maximum limit. According to Woodward engineering, the readings were consistent with customer field adjustment and would not have affected performance during the accident flight.

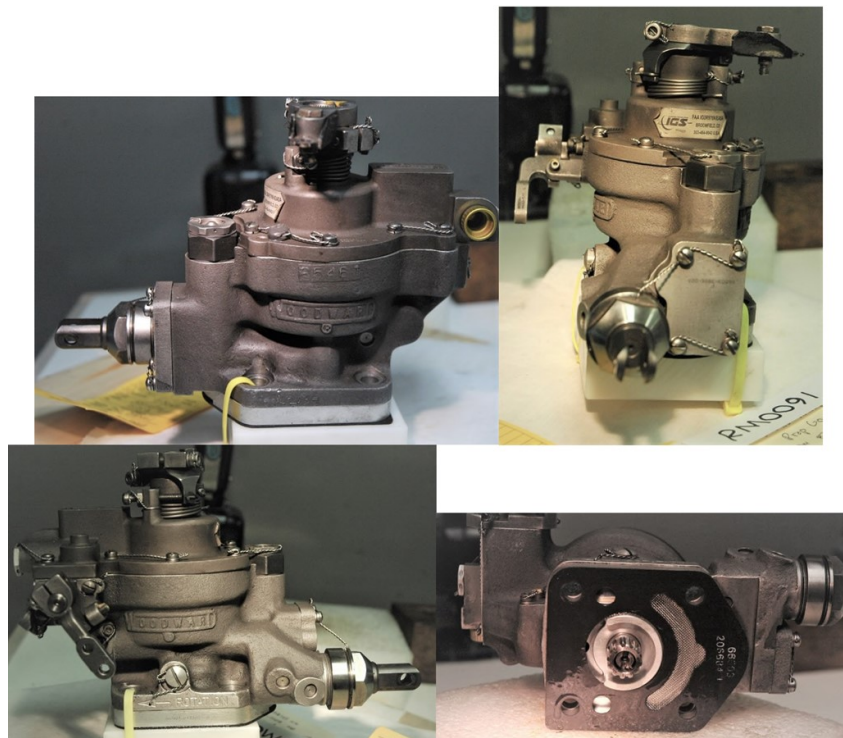


Photo 18- Turboprop Governor, as Received at Woodward

Robert Hunsberger
Aerospace Engineer
Powerplants