

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



CEN22FA119

POWERPLANTS

Group Chair's Factual Report

April 21, 2022

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A. ACCIDENT

Location: Johnson County Executive Airport (OJC), Olathe, Kansas
Date: February 13, 2022
Time: 1020 Central Standard Time (CST)
1620 Coordinated Universal Time (UTC)
Aircraft: Piper PA-46-500TP, Registration N2445F

B. POWERPLANTS GROUP

Group Chair	Matthew Walker National Transportation Safety Board Washington, DC
Group Member	Mitch Mitchell Federal Aviation Administration Washington, DC
Group Member	Jonathon Hirsch Piper Aircraft, Inc. Vero Beach, Florida
Technical Advisor	Jeffery Davis Pratt & Whitney Canada Bridgeport, West Virginia
Technical Advisor	Peter Marshall MT Propellers DeLand, Florida
Technical Advisor	Matthew Zolnierczyk Woodward, Inc. Loves Park, Illinois

C. SUMMARY

On February 13, 2022, at 1020 Central Standard Time, a Piper PA-46-500TP, registration number N2445F, was destroyed in an accident at the Johnson County Executive Airport (OJC), Olathe, Kansas. The pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 flight. The airplane reportedly had recently completed an annual inspection; the pilot was to fly the airplane back to his home base on an instrument flight rules (IFR) flight plan from OJC to Albuquerque International Sunport Airport (ABQ), Albuquerque, New Mexico. Once the airplane taxied to the runway, the OJC controller issued a takeoff clearance. About

one minute later, the pilot transmitted "we gotta come back around, four five foxtrot," and the tower controller immediately cleared the airplane for landing. No further transmissions were received from the accident airplane. Flight track data showed the airplane began the takeoff roll on runway 36 at OJC, accelerated, reaching a peak ground speed of 80 knots about 2,250 feet down the 4,097 foot long runway at the time he became airborne, and reached a peak altitude of approximately 1,175 feet Mean Sea Level (MSL); field elevation at the departure end of runway 36 is 1,096 feet MSL. The airplane then drifted slightly to the right and slowed before turning back toward the left. The airplane's groundspeed continued to decrease throughout the remainder of the data. The airplane impacted the ground on the extended runway centerline about 400 feet past the departure end of runway 36. The final recorded position was about 100 feet southeast of the initial impact point. The airplane came to rest upright with its fuselage oriented in a southeasterly direction. There was a postimpact fire that burned the wings and forward fuselage aft to the rear spar carry-through structure. The fuselage aft of the cabin, including the empennage, was intact. There was a fan shaped burn area on the ground that extended from the aircraft wreckage in a southerly direction.

The engine was shipped to Pratt & Whitney's facility in Bridgeport, West Virginia, where it was examined August 30 and 31, 2022 by members of Pratt & Whitney Canada (P&WC), Piper Aircraft, the FAA, and the NTSB. The engine was twisted from impact damage and covered in soot from the post-impact fire. The propeller and nose landing gear were removed to facilitate the exam, and the propeller was sent to MT Propeller in DeLand, Florida. The engine was then disassembled, working front to aft, from the reduction gearbox, exhaust, and power turbine sections. To facilitate better access to the gas generator section, the engine was then rotated, and the accessory gearbox removed.

The reduction gearbox planet gears turned freely, with rub marks on the outer ring gear and 1st stage carrier. The propeller overspeed governor, propeller governor, and torque limiter were removed and sent to Pratt & Whitney Canada (P&WC) for further analysis. The power turbine was blued from extensive heat and exhibited circumferential rubs on the outer shrouds of all blades, with the knife edges worn off. A 180-degree section of the 1st stage power turbine had rub marks consistent with contact with the 1st stage vane ring. The accessory gearbox would not turn due to the Ng tachometer-generator geartrain having crushed against the casing during impact. The fuel pump, fuel control unit, and fuel/oil heat exchanger were removed from the accessory gearbox (AGB) and submitted with the propeller overspeed governor, propeller governor, and torque limiter to P&WC. The combustion chamber and compressor turbine had metallic debris, and the blades in all stages of the compressor were torn and bent opposite to rotation.

The six components were examined at P&WC's facility in Montreal, Canada on October 17, 2022, with members of PWC and Transport Safety Bureau - Canada

present. All the components were heavily sooted. The heat exchanger had no leaks, and the internal thermal element was tested satisfactorily against the component maintenance manual (CMM). The fuel pump, which had impact damage, had clean inlet and outlet fuel filters, and passed testing in accordance with the CMM. The fuel control unit was sooted and coated in oil. The unit had impact damage making it untestable. Internally, the bellows met the minimum requirements and the plunger moved freely, though there was debris typical of thermally damaged seals. The torque limiter failed to meet the minimums required in the CMM with significant air leaks noted; however, the adjustment screw was confirmed to work properly. The internal seals and gaskets had significant thermal damage, consistent with the noted air leaks. The propeller governor, the speed and reset levers, beta valve, and input shaft were confirmed to operate rotate freely by hand, and the eccentric adjustment screw slot was in-line with the indication mark on the retaining plate. The overspeed governor was sooted and displayed impact damage, and the input shaft was rotated by hand. The propeller governor and overspeed governors were sent to Woodward in Loves Park, Illinois for further examination.

The propeller was examined at MT Propeller in DeLand, Florida on November 1, 2022, with members of MT Propeller, Piper Aircraft, the FAA, and the NTSB present. All five of the composite blades had broken on impact; only two were partially recovered. The propeller was heavily sooted, but, with hydraulics, the blades could still move to both fine and coarse pitch limits. The phenolic blocks in the pitch change mechanisms were found broken, with slight scuff marks and indentations noted for three of the five blades on the forward-facing surface of the aft pitch change plate. Discussions with MT Propeller engineers confirmed two of the three marks could be propeller blade position witness marks within 26-34 degrees range of pitch, which corresponds to a cruise power setting.

The propeller governor and overspeed governor were examined at Woodward, Inc in Loves Park, Illinois on November 29, 2022. The propeller governor had several customized fittings, hardware attachments, and non-Woodward wires and seals. An acceptance test was performed, which showed significant leaks. A different relief valve was slaved to the propeller governor and retested, with improved performance. Once disassembled, the relief valve spring was shorter than standard, common with heat damage, leaving the valve partially open and resulting in the leaks. The overspeed governor had non-Woodward lockwire, seals, and attachment hardware, and the internal gasket was thermally damaged. The reset solenoid was approximately 60-degrees out of normal alignment. During acceptance testing, significant leaks were noted at both the reset and feathering solenoids. X-ray images of the reset solenoid showed the poppet and spring canted inside the housing. X-ray images of the feathering solenoid had no poppet present. Due to the leaks, it was determined both solenoids should be disassembled.

Due to delays in getting the drawings from Eaton Corporation and machine availability at Woodward, the solenoids were x-rayed and disassembled on February 16, and the feathering solenoid housing machined apart on March 21, 2023, by Woodward with the NTSB observing virtually. The solenoids were individually tested and found to leak at the lowest possible pressure settings. The reset solenoid poppet was confirmed to be canted in the housing, and the internal solder missing, likely from thermal damage. The feathering solenoid housing was machined in half and the retaining pins were found sheared from impact. The spring was intact but shortened, likely from excessive heat, and even, circumferential marks in the poppet suggested it had been seated correctly prior to impact.

D. DETAILS OF THE EXAMINATION

1.0 ENGINE INFORMATION

1.1 Engine Description

The accident airplane was equipped with a single Pratt & Whitney Canada (P&WC) PT6A-42A turboprop engine and an MT Propeller 5-bladed, variable pitch propeller. The PT6A-42A is a two-shaft engine, with one shaft for the Gas Generator section, consisting of a combination three-stage axial and single-stage centrifugal compressor, an annular combustion chamber, and single-stage gas producer (GP) turbine that drives the compressor, and the second shaft for a two-stage power turbine (PT)¹ that drives the output shaft through the reduction gearbox (RGB) (Figure 1). The output shaft rotates clockwise when viewed from aft, looking forward (ALF)². The configuration allows the free power turbine (for the remainder of this report will be

¹ The power turbine is a free turbine design where it is not mechanically connected to the compressor.

² All directional references to front and rear, left and right, top and bottom, and clockwise and counterclockwise are made ALF, as is the convention. All numbering is in the circumferential direction, starting with the No. 1 position at the 12:00 o'clock position or immediately clockwise from the 12:00 o'clock position and progressing sequentially clockwise, ALF.

referred to as just the power turbine) and propeller to rotate at constant speed while the fuel control system schedules compressor speed according to the power demand.

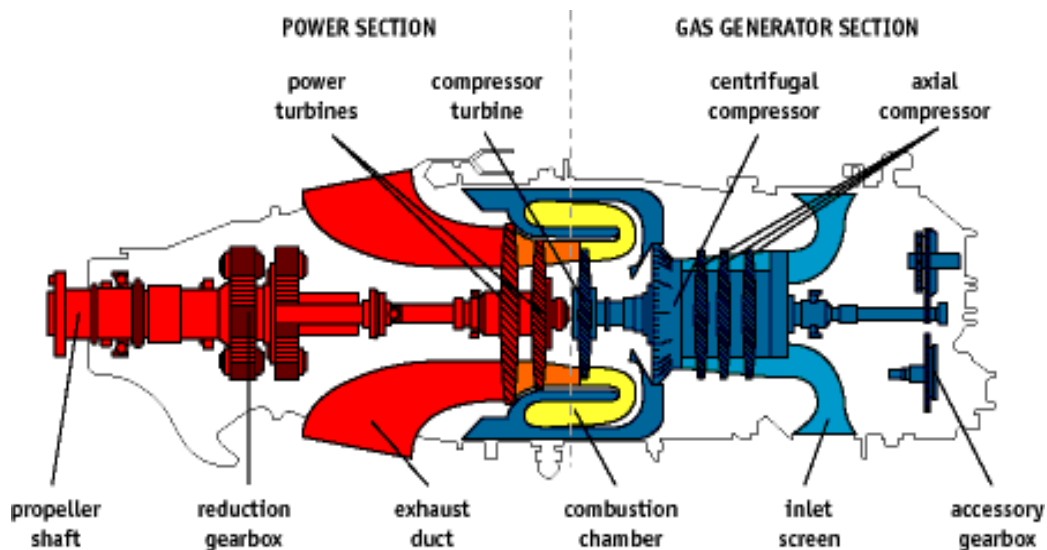


FIGURE 1: CROSS-SECTION DIAGRAM OF A PT6A-42A (COURTESY OF P&WC)

According to the Federal Aviation Administration (FAA) Type Certificate Data Sheet (TCDS) E4EA, revision 30, dated June 16, 2021, the PT6A-42A engine has a maximum continuous horsepower (HP) at sea level of 850, with an equivalent shaft horsepower (ESHP) of 903 and the maximum propeller shaft rotation speed in revolutions per minute (RPM) of 2,000 at maximum continuous power³. For the PA-46-500TP aircraft, TCDS A25SO derates the engine from a maximum continuous and takeoff power limit of 850 HP to 500 HP.

1.2 Engine History

³ 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. For the PT6A-42A, these ratings are accurate up to a compressor inlet air (dry) temperature of 106-degrees F.

According to the engine data plate, the engine serial number (ESN) was RM0518 (Photo 1). According to the engine logbook, on February 11, 2022, an annual engine inspection was performed in accordance with Mead Aircraft Services, Inc. Meridian inspection guide and found to be in airworthy condition. A repaired Honeywell fuel control unit, part number (P/N) 4138014-1, was installed during the annual inspection. The accident engine had accumulated 2,169.6 total hours when it was serviced, prior to the accident flight.



PHOTO 1: ENGINE DATA PLATE

2.0 ENGINE EXAMINATION AND DISASSEMBLY (S/N RM0518)

2.1 General Condition

The accident engine was examined and disassembled at the P&WC facility in Bridgeport, West Virginia on August 30-31, 2022, with persons from the FAA, P&WC, Piper Aircraft, and the National Transportation Safety Board (NTSB) in attendance.



PHOTO 2: BOX AS SHIPPED

The engine arrived still secured in the shipping container and the container was opened in the presence of the examination team (Photo 2). The engine was in the container with the 9:00 to 11:00 o'clock position towards the bottom of the crate (left side down) (Photo 3).



PHOTO 3: ENGINE AS UNBOXED

The nose landing gear was still attached to the engine trusses at the left attachment bolt. The right exhaust nozzle was not present; it was reported as removed at the recovery yard. The left exhaust nozzle was crushed against the engine (Photo 4).

There was no evidence of uncontainment. Portions of the airframe engine cowlings were still attached to the engine and engine mounting trusses and had to be cut away. The entire engine was coated with black soot.



PHOTO 4: BOTTOM OF ENGINE

The firewall was bent aft and around the engine. The exhaust duct had visible angular deformation, consistent with torsional loading (Photo 5).



PHOTO 5: EXHAUST DUCT HOUSING TWIST

The engine propeller reversing front linkage was complete, with some bending noted. The rear section of the linkage was fractured adjacent to the cam cluster (also referred to as the cambox) connection at the accessory gearbox, and the cambox was fragmented.

2.2 Propeller

All five propeller blades were broken at the hub (Photo 6). During removal of the propeller hub, the hub could be rotated by hand.

The propeller was removed for shipment to MT Propellers for further disassembly and inspection. See Section 3 for more details.



PHOTO 6: PROPELLER

2.3 Reduction Gearbox

The magnetic chip detector was burned through; the wiring and elements were found loose inside the RGB (Photo 7).



PHOTO 7: RGB CHIP DETECTOR

The propeller overspeed governor (Photo 8; Figure 2 Item 9), propeller governor (Photo 9; Figure 2 Item 7), and torque limiter (Photo 10) were removed for further analysis.



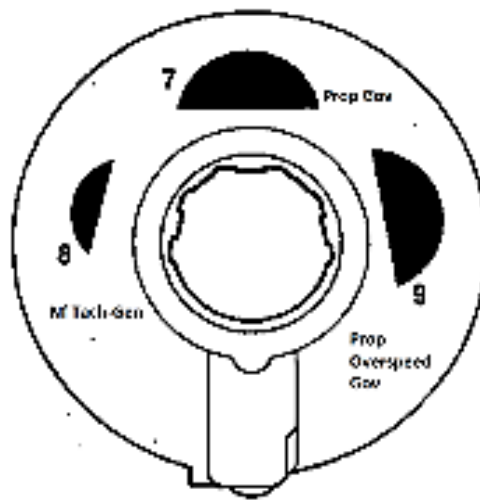
PHOTO 8: PROP OVERSPEED GOVERNOR



PHOTO 9: PROP GOVERNOR



PHOTO 10: TORQUE LIMITER



AS VIEWED FROM FRONT

FIGURE 2: REDUCTION GEARBOX ACCESSORIES (COURTESY OF P&WC)

All five of the RGB 2nd stage planet gears turned freely. There were witness marks on the outer ring gear retaining bolts of the upstream face of the 2nd stage (Photo 11). A corresponding rub mark was on the downstream face of the RGB 1st stage carrier (Photo 12) consistent with impact.



PHOTO 11: CONTACT ON BOLT HEADS

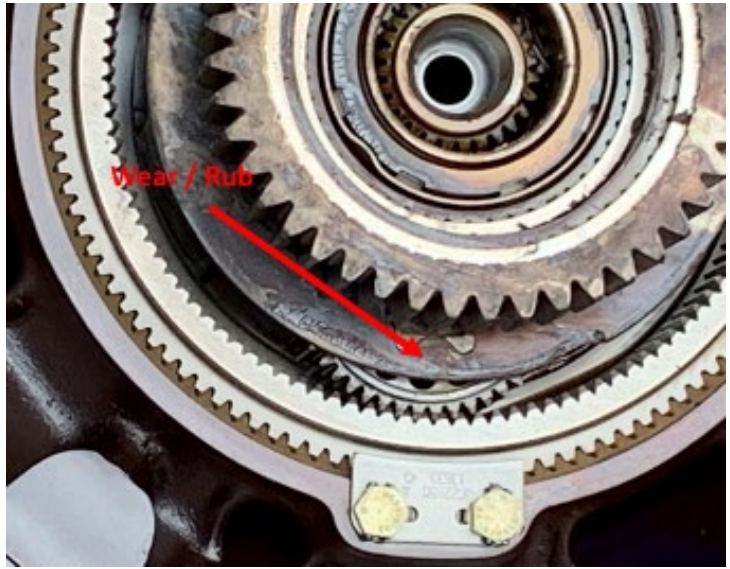


PHOTO 12: 1ST STAGE CARRIER

The No. 5 bearing roller elements appeared smooth, shiny, oil-wetted, and rotated freely; the cage was clean and unremarkable. The RGB 1st stage carrier assembly did not turn. It was capable of rotation only after removal of the 3rd and 4th stage bearing housing.

The propeller shaft was fractured adjacent to the engine RGB 2nd stage carrier, forward of the carrier splines, but was clean and oil-wetted. (Photo 13). The fracture surface appeared consistent with overload.



PHOTO 13: PROPELLER SHAFT

2.4 Exhaust Section

The thermocouples and wire harnesses were all present. The flange between the PT housing and exhaust duct was partially separated, with all the retaining bolts still in-place.

2.5 Power Turbine

The 1st stage PT rotor was intact, and all blades were present and full length. The outer shrouds were intact with a light bluish tint consistent with thermal distress. Circumferential rubbing was seen on all the blade outer shrouds. All the shroud knife edges, which interface with the inner surface of the turbine shroud of the 1st stage vane ring, were worn off (Figure 3). A 180-degree section of the 1st stage PT blades had circumferential rubbing on the inner face and leading edge platforms, consistent with contact from the 1st stage PT vane.

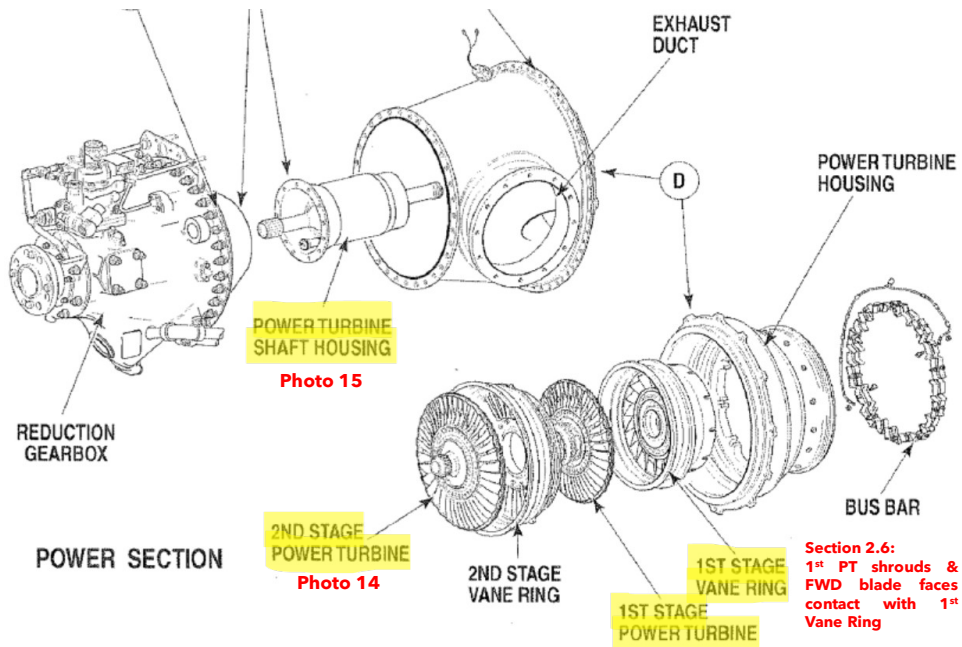


FIGURE 3: POWER SECTION; PT6A PILOT MANUAL (COURTESY OF P&WC)

The 2nd stage PT blades and outer shrouds appeared intact (Photo 14). The downstream (aft) face of the disk, blade roots, and balancing rim exhibited



PHOTO 14: 2ND STAGE PT BLADES, WITH CHARRED AIRFRAME DEBRIS (BOTTOM)

circumferential rubbing with consistent with contact with the No. 3 bearing cover; the No. 3 bearing cover exhibited corresponding contact rub. The 2nd stage PT disk could not be separated from the 2nd stage vane ring.

The aft end of the PT shaft housing was asymmetrically crushed (Photo 15). The No. 3 and No. 4 bearings were clean, lightly oil-wetted, and rotated freely (Photo 16). The No. 4 bearing retention bolts were fractured.



PHOTO 15: PT SHAFT HOUSING

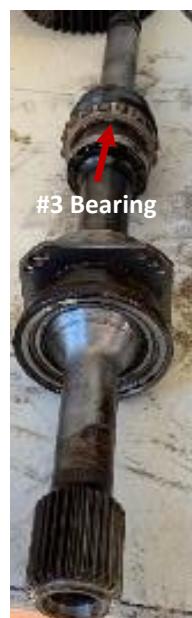


PHOTO 16: NO. 3 BEARING

2.6 Gas Generator Section - Combustion Chamber

The gas generator case, which houses the gas generator section to include the compressor turbine, axial and centrifugal compressors, and attaches to the exhaust duct at the forward end and inlet casing at the aft end (Figure 4), was visibly deformed. There was staining at the 12 o'clock position, consistent with oil leaking from the No. 2 bearing while the engine was inverted.

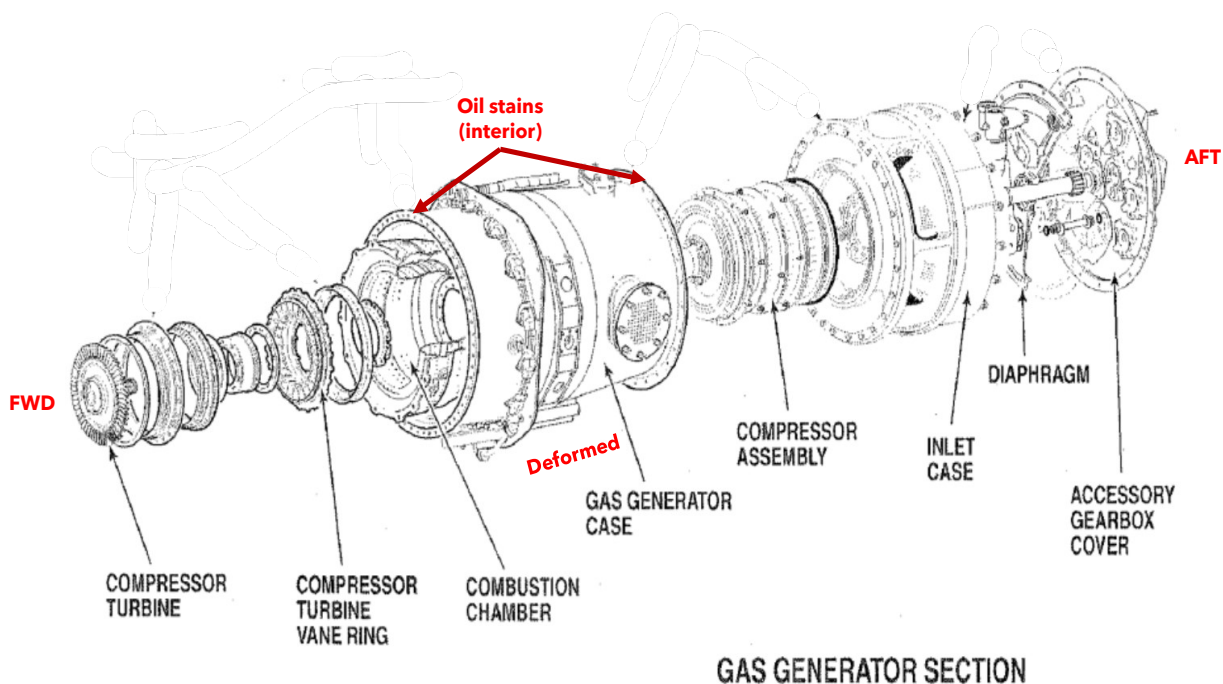


FIGURE 4: GAS GENERATOR SECTION PT6A PILOT MANUAL COURTESY OF P&WC, MODIFIED BY NTSB)

Shiny, metallic debris was noted throughout the axial and centrifugal compressor, as well as the compressor turbine and combustion chamber (Photo 17).



PHOTO 17: DEBRIS IN THE GAS PATH

2.7 Gas Generator Section - Compressor

With the AGB removed, the 1st stage axial compressor rotor blades and stator vanes could be seen. The 1st stage compressor blade airfoils were dented, torn, and bent opposite the direction of rotation (Photo 18). The 1st stage stators were all full-length and intact. There was evidence of tip rub and some impact damage present on all blades. There was no visible damage to the centrifugal impeller when viewed through a compressor bleed valve port on the gas generator case. The compressor was not disassembled further.



PHOTO 18: 1ST STAGE COMPRESSOR DAMAGE

The compressor turbine was difficult to rotate by manually turning the blades. After removal of the AGB, tip rub was observed on all blades, with rubbing on the fir trees, disk bore, and balance weights. Rubbing was also noted on the downstream (AFT) (Photo 19) and upstream (Front) (Photo 20) blade platforms.

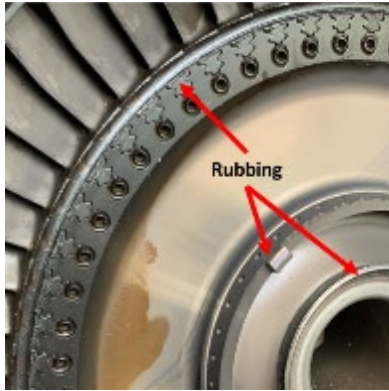


PHOTO 19: DOWNSTREAM (AFT) FACE, COMPRESSOR TURBINE



PHOTO 20: UPSTREAM (FRONT) FACE, COMPRESSOR

2.8 Accessory Gearbox

The AGB was intact. It was attached to the aft end of the engine solely by the external lines / tubes. All accessories for the AGB were present and intact. All the P3 (compressor discharge pressure) and P_y (P3 after going through the FCU (Figure 5, Item 2), but before the propeller governor) line connections were intact, tight, and safety wired. The coupling shaft and center transfer tube between the inlet case and accessory gearbox were not present.

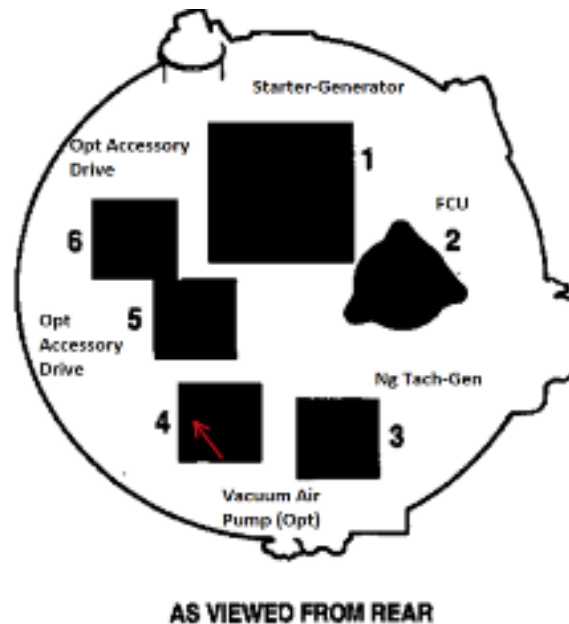


FIGURE 5: ACCESSORY GEARBOX (COURTESY OF P&WC)

The external oil scavenge pumps were fractured but securely attached, and the external scavenge oil tubes (No. 3 and 4 bearings and the reduction gearbox) were bent and crushed.

The AGB was seized when attempting to rotate by the tachometer-generator drive. The Ng tachometer-generator gears were found pressed forward into the roller bearings, preventing rotation of the geartrain.

The oil filter was present, clean, and lightly oil-wetted. The housing was lightly oil-wetted, clean; the O-rings were partially burned away/consumed. The housing was deformed, and the filter was difficult to remove.

The chip detector was fractured from the accessory gearbox housing and exposed but was retained by the airframe wiring harness.

The pressure oil pump had debris inside consistent with the housing material. The displacement gears, whole and intact, had cut into the pump housing wall (Photo 21).



PHOTO 21: OIL PUMP

The oil tank was not intact; fragments of the tank were found in the shipping container. The starter-generator (Figure 5, Item 1) shaft was fractured (Photo 22).



PHOTO 22: STARTER-GENERATOR

The fuel-oil heat exchanger (Photo 23) and fuel pump and fuel control unit (FCU) (Photo 24) were removed from the accessory gearbox housing for further disassembly.



PHOTO 23: HEAT EXCHANGER



PHOTO 24: FUEL PUMP AND FUEL CONTROL UNIT

3.0 PROPELLER EXAMINATION (S/N 180532)

The propeller was examined at MT Propellers in DeLand, FL on November 1, 2022, with MT Propeller, the FAA, Piper Aircraft Inc, and the NTSB.

3.1 Propeller Description

Per the markings on the hub of the propeller, this propeller was model type MTV-27-1-E-C-F-R(P), S/N180532. The MT-Propeller (Figure 6), model MTV-27-1-E-C-F-R(P) installed on the accident airplane (Photo 25), is a hydraulic, constant speed, five-bladed propeller with feathering and reversing features. The hub material is aluminum alloy. The blade materials include laminated wood composite structure, composite fiber cover, and metal leading edge sheaths for erosion protection. The model number describes as follows:

- MT: manufacturer
- V: Variable pitch propeller
- 1: consecutive number of series
- E: Propeller flange ARP 880
- C: Counterweights mounted for pitch change toward high pitch/feathering
- F: Feathering system installed
- R(P): Reverse system for Pratt & Whitney PT6A

The propeller blades are wood-composite: high compressed wood in the root and lightweight wood in the remainder. Epoxy fiberglass covers the surface, painted with acrylic lacquer. The outer portion is protected against erosion by a bonded on

stainless steel erosion sheath, approximately 50 cm long on the outer portion, while the inner portion is protected by a bonded-on electrical de-ice boot.

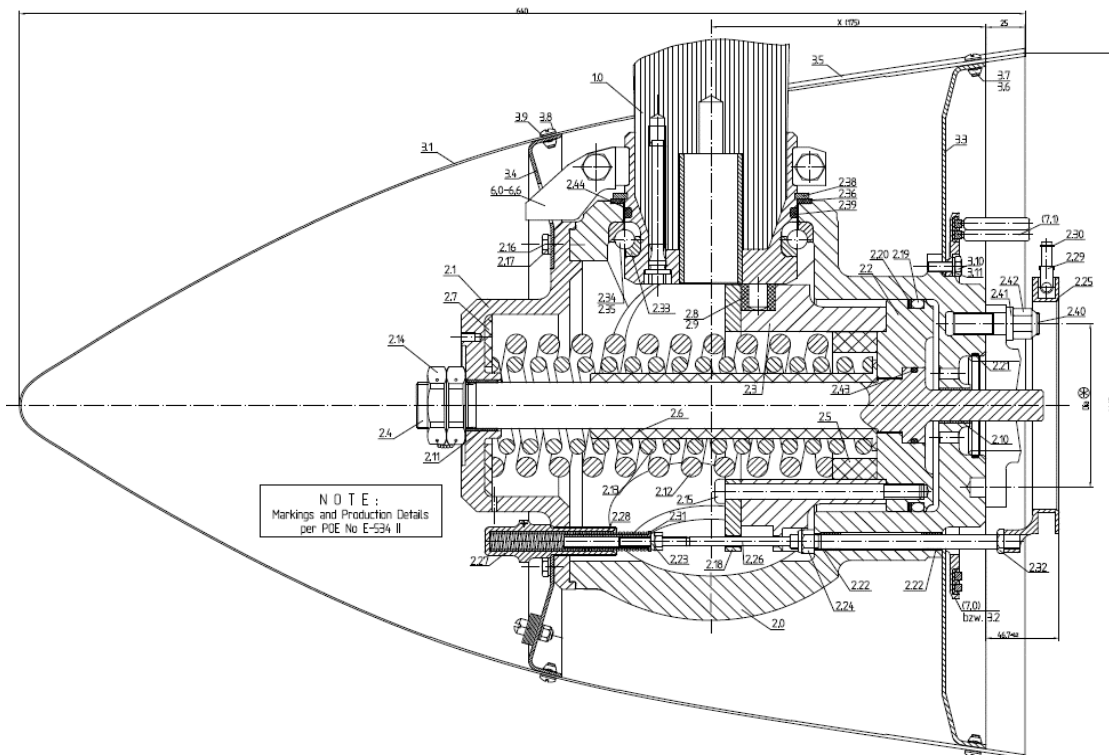


FIGURE 6: MTV-27 PROPELLER; FIGURE PROVIDED BY MT PROPELLERS

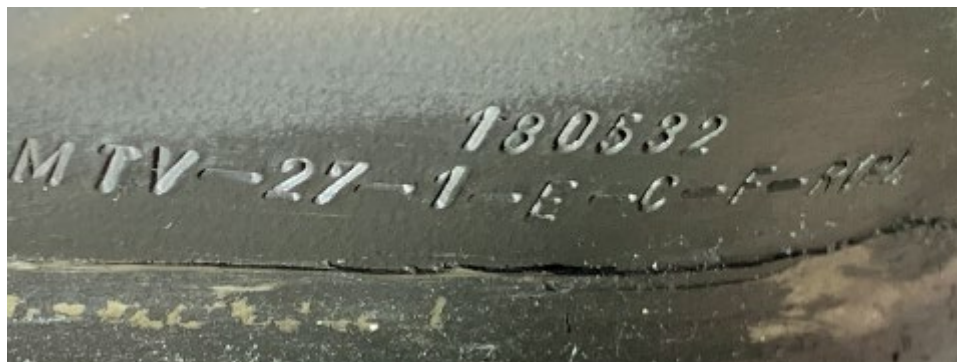


PHOTO 25: MODEL AND SERIAL NUMBER

3.2 Propeller History / Maintenance Logs

According to the maintenance records submitted by the operator, on August 3, 2021, the propeller was newly installed per FAA Supplemental Type Certificate SA03446NY. This supplemental type certificate replaced the original 4-bladed Hartzell propeller with a 5-bladed MT propeller. The propeller had accumulated 77.6 total hours at the time of the accident.

3.3 General Condition

All the propeller blades were broken at the roots; only two airfoils were partially recovered on-scene. Both recovered blades were fractured, exposing the inner wood core (Photo 26).



PHOTO 26: TWO RECOVERED PROPELLER BLADES

The propeller was entirely sooted from the post-impact fire (Photo 27). The roots of all five propeller blades were present in the propeller hub and burnt/thermally distressed/fire damaged.



PHOTO 27: BURNED PROP HUB

The aluminum frame, part of the spinner bulkhead, around the propeller blades was melted and deformed, while the steel blade retaining clamps and blade counter-weights were heavily sooted (Photo 28). The spinner was not present; it was removed at P&WC West Virginia facility to facilitate separation of the propeller. All three beta rods were present but removed at P&WC to allow for separation and transport of the propeller. All required safety wire was in-place and intact on the hub retaining bolts.

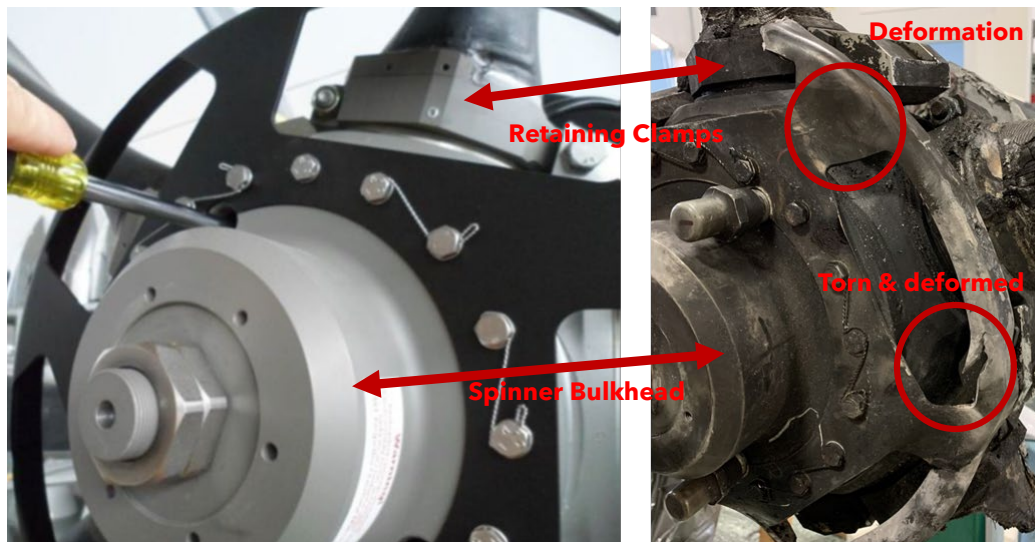


PHOTO 28: EXEMPLAR HUB (LEFT) AND ACCIDENT HUB (RIGHT)

3.4 Propeller Blades

All the propeller blade roots were burned and sooted. Fractures orientation for all the propeller blades was perpendicular to the grain of the underlying wood. All propeller blades were fractured just outboard of their retaining clamps and counterweights; propeller blade No.5 blade had slightly more airfoil/root material present than the others. The propeller blade numbers are stamped into the propeller hub (Photo 29) and internally on the pitch change plates to ensure balancing is consistent.

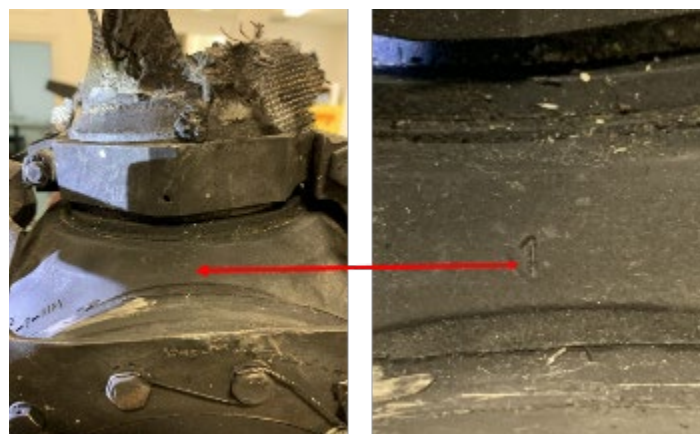


PHOTO 29: BLADE NUMBERING

3.5 Propeller Hub - Exterior

The exterior was heavily sooted. The aluminum components were all melted, consistent with being exposed to the post-impact fire. Snap rings were all present, keeping the blade roots locked in and level. Shiny, clean scuff marks were noted on the hub behind three of the five counterweights, as the counterweights may have shifted at some point after the post-crash fire (Photo 30).



PHOTO 30: SHINY SCUFF MARKS BEHIND THE COUNTERWEIGHTS

3.6 Hub - Interior / Springs & Pitch Change Mechanism

The feathering and retaining springs were whole, intact, and still under compression (Photo 31). The servo piston was whole, intact, and otherwise undamaged. The retaining rings at the forward and aft end of both springs were intact and otherwise unremarkable.

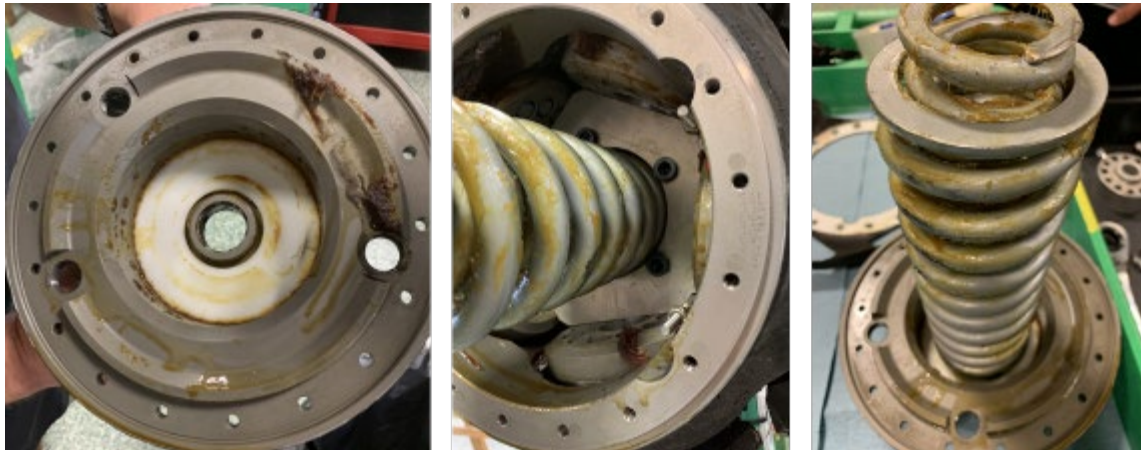


PHOTO 31: FEATHERING SPRING, RETURN SPRING, AND RETAINING RINGS

Black pitch change and white pitch guide phenolic blocks are positioned between the blade root and the pitch change plates, which are centered around the piston. The pitch change of the blades is obtained via a pin in the blade root, where

the axial movement of the servo piston turns the blades through the pitch change blocks. The movement of the servo piston moves two retaining plates which hold the front and back of the black and white blocks for each blade. The phenolic pitch change blocks (black) for propeller blades Nos. 2 and 5 were intact; however, the pitch change blocks for propeller blades Nos. 1, 3, and 4 were fractured (Photo 32).

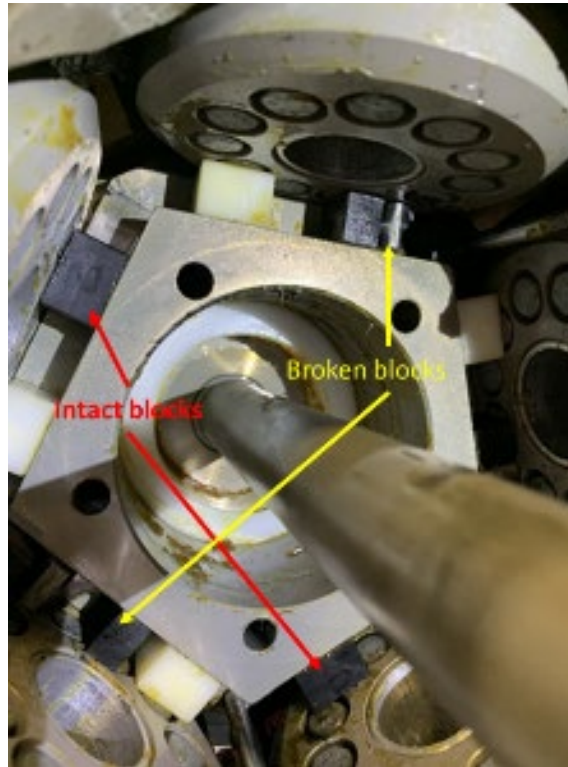


PHOTO 32: AFT PITCH CHANGE PLATE WITH BROKEN PHENOLIC BLOCKS.

Small indentations and scuff marks were noted on the forward face of the aft pitch change plate (Photo 33). The marks all measured 5.8 -7 centimeters (cm) (2.28 - 2.75 inches) from the installation alignment hole for the blade pins (Photo 34).

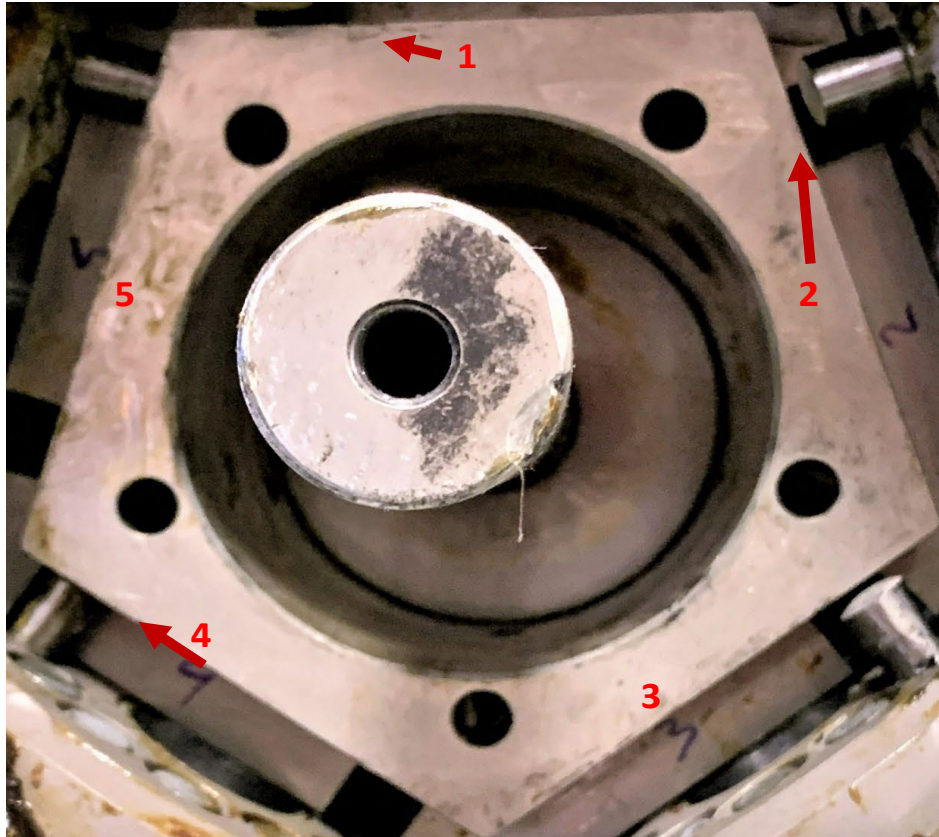


PHOTO 34: FORWARD FACE OF THE AFT PITCH CHANGE PLATE

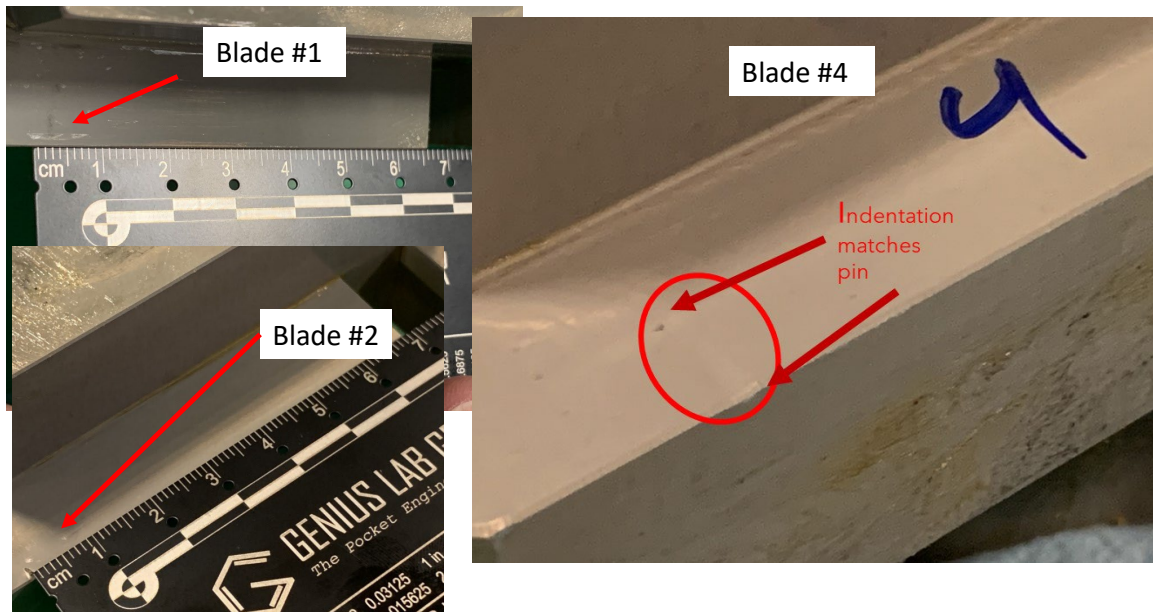


PHOTO 33: INDENTATION AND SCUFF MARKS ON THE PITCH CHANGE PLATE

3.7 Correlating the Pitch Change Markings

The indentations and scuff marks to the pitch-change plate were compared to path of travel of the pin within the phenolic blocks (Figure 7). Two of the measurements, those greater than 6cm, were outside the normal length of travel for the pins. The mark at 5.8 cm (2.28 inches) on propeller blade No. 4, corresponds to 3.79 cm (1.49 inches) from the center of rotation. This would equate to a pitch angle of approximately 26-34 degrees; according to MT Propeller, this falls in the cruise

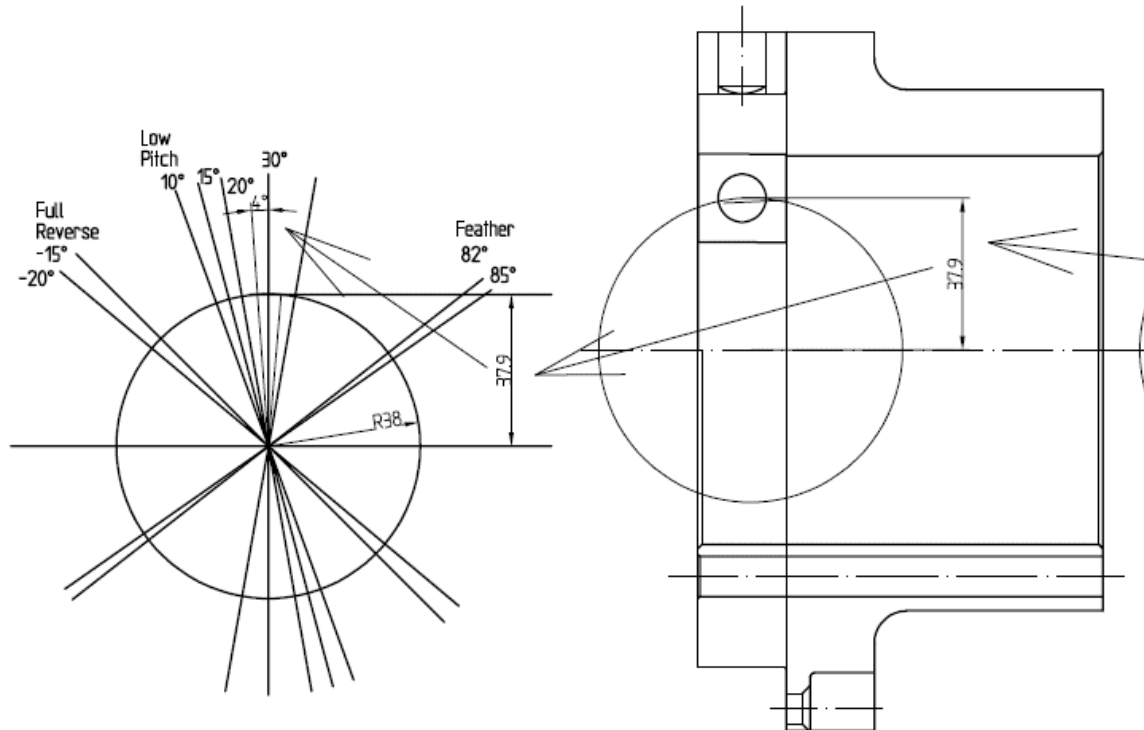


FIGURE 7: BLADE PITCH ROTATION; (COURTESY OF MT PROPELLERS, MODIFIED BY NTSB power setting range.

4.0 SPECIFIC COMPONENT EXAMINATIONS

The overspeed governor, propeller governor, fuel control unit and fuel pump, torque limiter, and fuel/oil heat exchanger were submitted to P&WC's Accessories Investigation Team in Montreal, Canada for disassembly and further inspection. Inspection and testing were completed on October 17, 2022, with representatives of P&WC and Transportation Safety Board - Canada present. Below is a summary from their field notes. Table 1 provides the lists of components tested and pertinent information about each. The overspeed governor and propeller governor were further tested at Woodward in Loves Park, Illinois on November 29, 2022, with representatives of Woodward, the FAA, and the NTSB present.

Accessories from ESN RM0518					
Accessory	P&WC P/N	OEM P/N	OEM	S/N	TSN / TSO
FCU	Data plate missing	Data plate missing	Honeywell	Data plate missing	Unk
Fuel pump	3033808	399701-5	Eaton	011287	Unk
Torque Limiter	Data plate not legible	Data plate not legible	Honeywell	Data plate not legible	Unk
Oil to fuel heat exchanger.	3124177-0	10994A	Meggitt	WA61477	Unk
Propellor governor		8210-007-01	Woodward	17736806	Unk
Overspeed governor	Airframe part	210638	Woodward	17853481	Unk

TABLE 1: TESTED COMPONENTS (COURTESY OF P&WC)

4.1 Fuel/Oil Heat Exchanger

This heat exchanger was an airframe supplied component (Photo 35). The unit was covered with a black and oily deposit. The fuel outlet tube was present; the fuel inlet fitting was severed. The oil outlet and inlet ports were present and clean. One mounting support was fractured and missing. The lockwires were present and in the right locations. There were light fretting marks on the transfer valve outside diameter.



PHOTO 35: FUEL/OIL HEAT EXCHANGER (PHOTO COURTESY OF P&WC)

To facilitate testing, the fuel outlet port was blanked, and the fuel inlet test fitting was installed to allow the fuel section to be pressurization with air. The unit was submerged in water, ensuring the oil inlet and outlet ports were underwater. Air pressure was applied to the fuel side for roughly two minutes with no air bubbles visible from either oil port. The thermal element movement (travel) was tested in accordance with the Meggitt CMM 73-10-20 preassembly check. The thermal element movement was measured to 0.135 inches, meeting the CMM requirements.

The thermal element cap could not be removed using a screwdriver as is the standard procedure; pliers were used to completely remove the cap. The thermal element and the spring were intact.

4.2 Fuel Pump

The fuel pump S/N 011287 matched the original pump shipped with the engine (Photo 36). The housing was covered with black deposits. The outlet fuel fitting was partially pulled out of the housing. The input shaft was rotated by hand in step movements. The fuel inlet port appeared clean. Lockwires were in the appropriate locations except for the fuel filter bowl, which was missing the lockwire. Prior to testing the fuel pump, the outlet fuel filter bowl was removed revealing a clean outlet fuel filter with no visible debris between the pleats. The fuel inlet screen was removed and was found clean as well.



PHOTO 36: FUEL PUMP; COURTESY OF P&WC

The fuel outlet fitting was removed and revealed that a portion of the first four threads were stripped, and the housing sealing face was dented. To test the unit, the first four threads were machined off and the housing sealing face was refaced. A slave fitting with a slightly longer than design threaded section was used during unit testing. The fuel pump was satisfactorily tested in accordance with the Eaton CMM 73-10-05.

4.3 Fuel Control Unit

The FCU housing was sooted (Photo 37, right). The metal components showed surface corrosion. The inlet fitting and throttle shaft were bent aft. The condition lever bracket was fractured. The minimum pressurizing valve housing was missing, along with the identification data plate. The manual override lever was bent aft and would not rotate full-travel by hand. The cut-off lever was bent inward. The acceleration adjustment cup was dented and perforated. The power trim was in the stowed position. The nylon coupling, where the fuel pump was removed, was in place and in good condition. The FCU drive shaft was rotated by hand with normal resistance. The acceleration adjustment lockwire, high-pressure relief valve lockwire, and high-pressure relief valve seal were damaged. Due to the impact damage, it was not possible to test the unit.

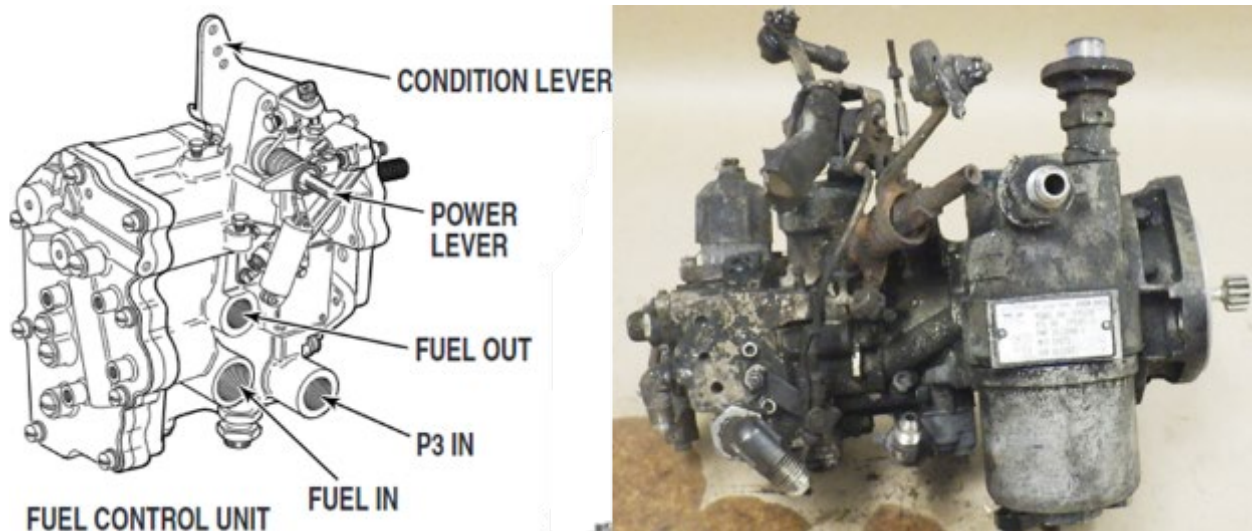


PHOTO 37: FCU DIAGRAM (PT6 OPERATOR'S MANUAL COURTESY OF P&WC) (LEFT) AND SUBJECT FCU(RIGHT)

In the fuel cut-off assembly, the cut-off lever rotated freely, and the valve plunger was properly installed and moved freely in the sleeve. The bent fuel inlet fitting was easily removed, giving access to the fuel inlet filter which was clean except for a small blue, rubbery chaff determined to originate from the damaged fuel inlet fitting. The bent throttle shaft was cut off, and the remaining portion was forcibly

punched out from the flow body housing. The drive body was removed from the flow body revealing a cracked governor cam at the interface with the throttle shaft. The cracked governor cam was caused during the forcible removal of the throttle shaft. The governor cam face which contacts the cam lever assembly bearing appeared in good condition. The governor lever assembly side play was within the CMM requirements.

Small particles were present in the Px (P3 after going through a restrictor, involved in controlling the compressor bleed valve) and Py air passages to the bellows cavity (Photo 38). Contaminants were observed on the cap bearing assembly, the governor weights, in the drive and flow bodies housing cavities. There was no spool gap, failing the CMM requirement. A thin film of a greyish residue was present on the Py pad and the Py bleed mating faces. There were no visible signs of wear. The Px pad showed a dimple at the contact point with the fluted pin head. The air inlet adaptor P3 and Py ports showed presence of small particles. The Pa (ambient pressure) bleed, Py orifice and Py bleed were clean. There was a thin, darkish deposit on the fluted pin valve hat (adaptor side). The removed bellows showed contaminant on the governor side, consistent with excess rust inhibitor protection applied on the flow body housing bellows bore during assembly.

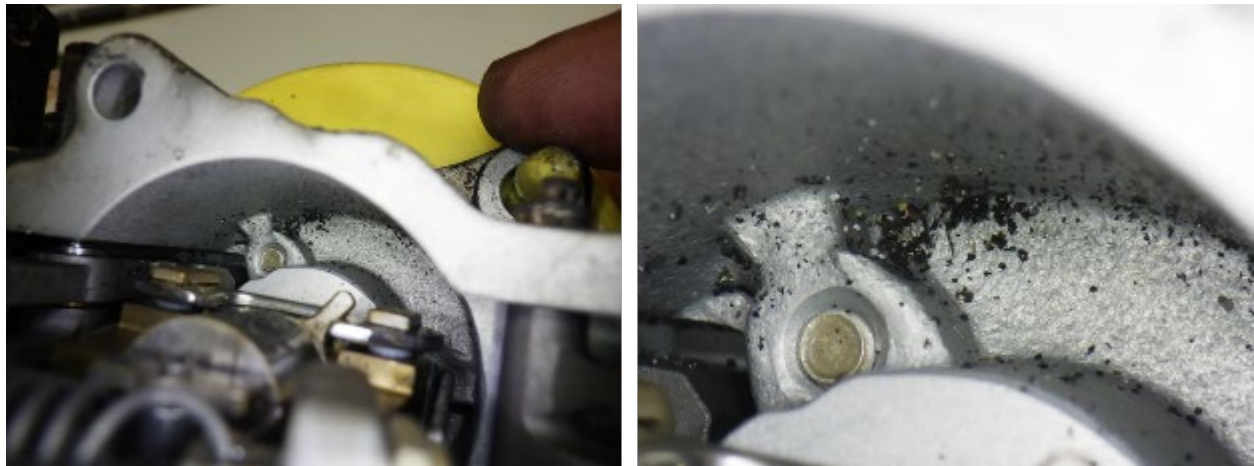


PHOTO 38: P3 & PY AIR INLETS (COURTESY OF P&WC)

The governor bellows, which changes fuel flow relative to compressor and ambient air pressure, was satisfactorily leak tested and found to be above the minimum acceptable value per the CMM limits. The torsion shaft assembly was satisfactorily pressure tested. The bypass valve components and metering valve were in good condition. The plunger moved freely in the sleeve.

4.4 Torque Limiter

The P&WC records showed the original unit installed was P/N 3055738-01 (Honeywell P/N 4138012-2) S/N C79505. The identification data plate was illegible (Photo 39). The housing was partially sooted. There was oil coking or burnt packing on the mounting ring and in the inlet port. Surface corrosion was present on the metal parts. The Py fitting appeared clean. The lockwires were in place at the proper location. The seals were present and in the proper locations.



PHOTO 39: TORQUE LIMITER (COURTESY OF P&WC)

Prior to testing the unit, the mounting ring and the inlet port were cleaned of residue. The unit was tested in accordance with Honeywell CMM 73-20-09. The torque pressure setting and leakage/gain checks were below the CMM requirements and external air leakage was noticeable. Functionality of the pivot and spring assembly was confirmed by changing the adjustment screw position and witnessing changes in the oil pressure.

Disassembly of the unit showed all preformed packings were either very brittle and cracked or reduced to powder, which could explain the external leakage and the deviation to the specifications observed during testing (Photo 40). The remaining components were in good condition.



PHOTO 40: BRITTLE PACKINGS (COURTESY OF P&WC)

4.5 Propeller Governor

According to the original Honeywell build records, the propeller governor, also referred to as the Constant Speed Unit (CSU), was original to the initial engine delivery (Photo 41, right). Initial examination of the propeller governor at P&WC revealed the housing was sooted. There were granular deposits on the cover. The speed and reset levers were rotated through their full travel by hand and returned to

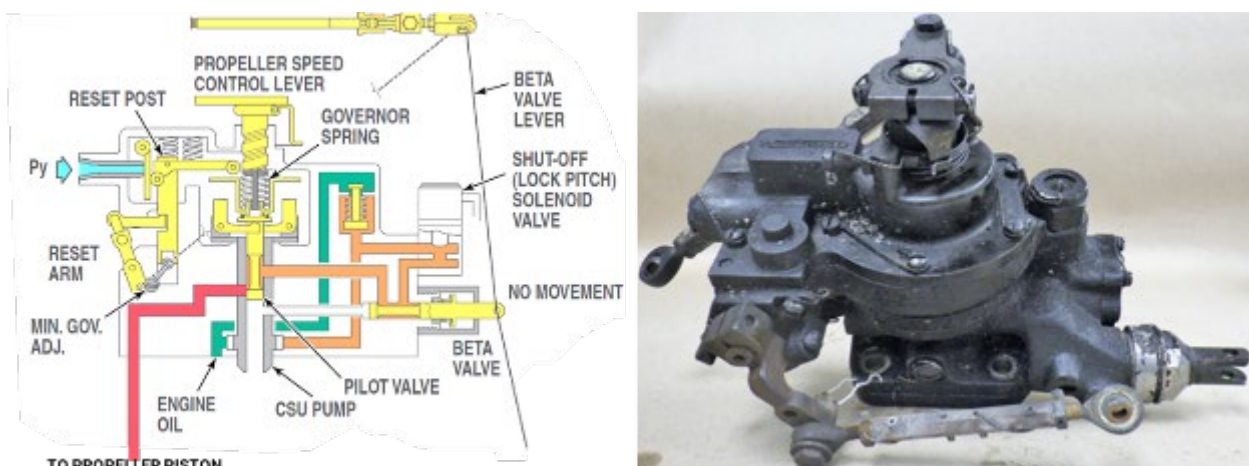


PHOTO 41: PROPELLER GOVERNOR DIAGRAMPT6 OPERATOR'S MANUAL (COURTESY OF P&WC) LEFT; SUBJECT PROPELLER GOVERNOR RIGHT

their respective maximum stop by spring tension. The beta valve moved with no restrictions. The input shaft rotated freely by hand. The eccentric adjustment screw slot was in-line with the indication mark on the retaining plate as it should be. The lockwires were at the right locations and in good condition.

The Py fitting was not properly seated on the housing (it had been loosened at P&WC West Virginia to facilitate removal), exposing a burnt O-ring. The O-ring was not installed correctly; it was installed between 2 cover bolts instead of going from one cover bolt to the pressure relief valve adjustment cap plug.

After completion of the initial external examination at P&WC, the propeller governor was shipped to Woodward for additional testing and disassembly (Photo 42). It was confirmed as an older unit, originally shipped from Woodward on October 18, 2011, and it did not have the standard Woodward lockwire seals.



PHOTO 42: PROPELLER GOVERNOR (COURTESY OF WOODWARD)

There were several customized fittings and hardware attachments, as well as several foreign wires and seals all indicative that the CSU had been serviced at some time by someone other than Woodward. The visual condition was deemed "pretty bad but testable" according to the Woodward mechanics (Photo 43). The repair date on the assembly was confirmed to be July 8, 2021.



PHOTO 43: PROPELLER GOVERNOR, UNPACKED AT WOODWARD
(COURTESY OF WOODWARD)

The CSU was installed on a test stand (Photo 44). On initial testing, the pump output flow and relief valve pressure were both below normal operating range. With a slaved, new relief valve (not for this CSU), both values increased.



PHOTO 44: CSU ON THE WOODWARD TEST BENCH
(COURTESY OF WOODWARD)

The relief valve was disassembled to better define the low pressure seen on the test stand. The relief valve spring length was measured at 1.565 inches, which most closely corresponds to the installed, loaded length of 1.47-1.57 inches. The anticipated value was 1.74-1.78 inches, suggesting the valve was partially open. According to Woodward, this is a known issue when the relief valve springs are exposed to extreme heat, such as during a fire (Photo 45).

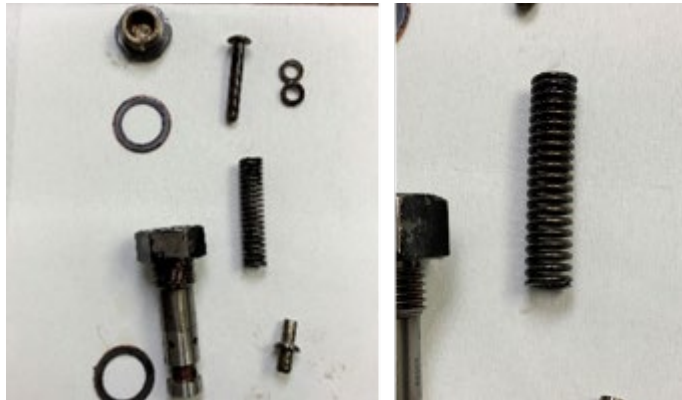


PHOTO 45: CSU RELIEF VALVE DISASSEMBLED (COURTESY OF WOODWARD)

4.6 Overspeed Governor

The overspeed governor is an airframe-supplied part; therefore, it is unknown if it was an original installation. Upon initial examination at P&WC, it was heavily sooted (Photo 46). The airframe harness connector was melted on the feathering solenoid connector. The reset solenoid airframe harness connector was present but was unable to be removed by hand. The solenoid body was rotating by hand, but the movement was limited to few degrees. There was an impact damage next to the speed adjustment screw. The input shaft was rotating by hand. The reset and feather solenoids lockwire going to the connectors were broken. A lockwire from the cover retaining bolts was broken and a section was missing.



PHOTO 46: OVERSPEED GOVERNOR (COURTESY OF P&WC)

To test the governor, a speed reset solenoid was energized to open it resulting in oil pressure pushing against the piston, canceling the spring effect. With less spring tension on the flyweights, the overspeed governor can be tested at speeds lower than maximum (Figure 8). This reset solenoid had customer hardware that could not be removed; therefore, the reset function was not tested at P&WC.

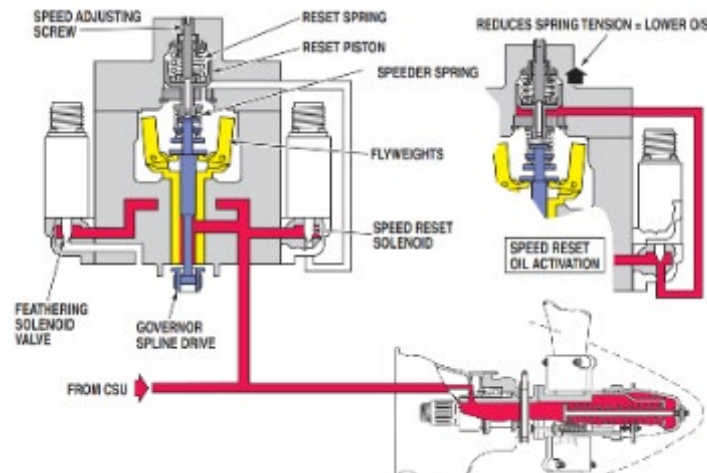


FIGURE 8: ENGINE OVERSPEED GOVERNOR PT6 PILOT FAMILIARIZATION HANDBOOK (COURTESY OF P&WC)

After completion of the initial external examination and testing at P&WC, the propeller governor was shipped to Woodward for additional testing and disassembly. The overspeed governor was oily and sooted, with the ports uncovered (Photos 47 and 48). There were non-Woodward lockwire, seals, and attachment hardware including torque seals.



PHOTO 47: OVERSPEED GOVERNOR, OUT OF THE BOX (COURTESY OF WOODWARD)



PHOTO 48: OVERSPEED GOVERNOR, UNPACKAGED (COURTESY OF WOODWARD)

With the electrical connection for the feathering solenoid removed, debris was seen inside the housing, likely the remains of the gasket, a room temperature vulcanized (RTV) silicone, inside the fitting (Photo 49).



PHOTO 49: FEATHERING SOLENOID REMOVED FROM GOVERNOR (COURTESY OF WOODWARD).

The propeller governor incorporates a feather and a reset solenoid. The governor uses a set of flyweights connected to a control valve, controlled by a bevel gear on the propeller shaft. The flyweights act counter to a speeder spring and a reset spring. When the propeller reaches a specified RPM limit, the flyweights lift the control valve and bleed off oil to the RGB sump, increasing blade angle, which adds demand to the engine and slows the propeller. In order to test the governor at slower speeds, such as pre-takeoff checks, the reset solenoid is used to increase oil pressure and reduce the spring tension against the flyweights, allowing the pilot to increase throttle and test the governor at less than the takeoff power setting. The feathering solenoid serves to adjust the blade angle to a high pitch, or feather, with a reduction in oil pressure.

The feathering solenoid on the overspeed governor was approximately 60-degrees out of position and would not fit the test stand (Photos 50 and 51). The event feather solenoid was removed, and a feathering solenoid of the same part number was installed for testing (Photo 52).

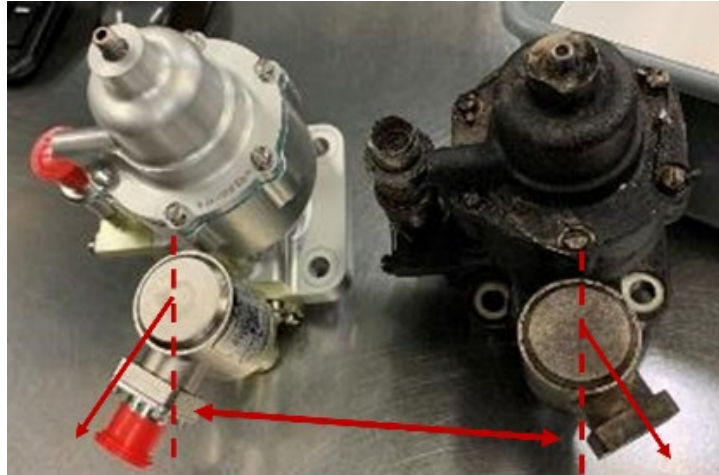


PHOTO 52: EXEMPLAR GOVERNOR WITH STANDARD FEATHERING SOLENOID (LEFT), WITH THE ACCIDENT UNIT (RIGHT) (COURTESY OF WOODWARD).

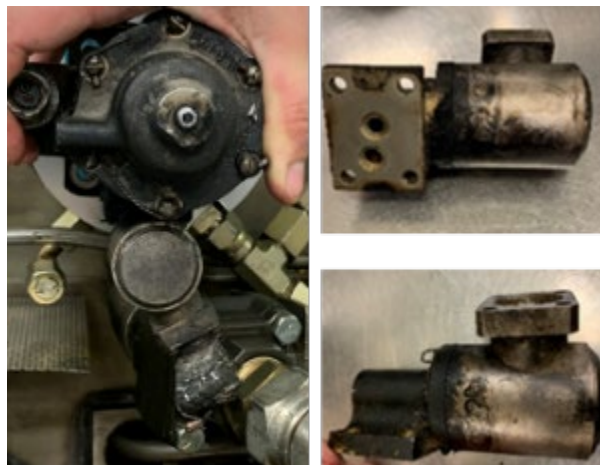


PHOTO 51: FEATHERING SOLENOID DID NOT FIT THE TEST STAND (COURTESY OF WOODWARD).

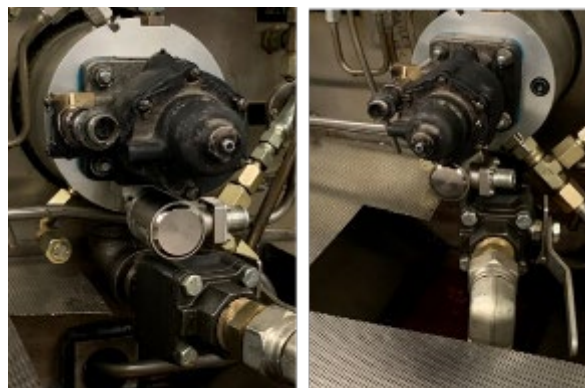


PHOTO 50: ALTERNATE FEATHERING SOLENOID INSTALLED FOR TESTING (COURTESY OF WOODWARD)

During testing of the overspeed governor, a leak was observed at the reset solenoid (Photo 53). The governor reacted to an overspeed condition at a significantly lower RPM than normal. On a second test run, with the solenoid energized (open), a significant leak was noted at the reset solenoid. The reset solenoid was removed, and the test re-run with a shop supplied serviceable solenoid. With a shop supplied solenoid installed, the governor and reset function performed closer to test specification, possibly suggesting the accident reset solenoid was partially open.

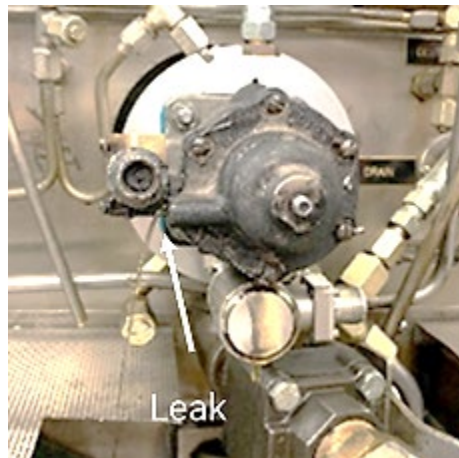


PHOTO 53: RESET SOLENOID LEAKING DURING INITIAL TESTING
(COURTESY OF WOODWARD).

Both the feathering and reset solenoids were x-rayed and leak tested at the Woodward facilities (Photo 54). The reset solenoid (Woodward P/N 1310-105) poppet and spring were offset at an angle within the housing (Photo 55). The reset solenoid leaked at lowest possible pressure setting (Photo 56), with valve de-energized (closed). A small differential pressure was noted, suggesting the poppet was only partially displaced.

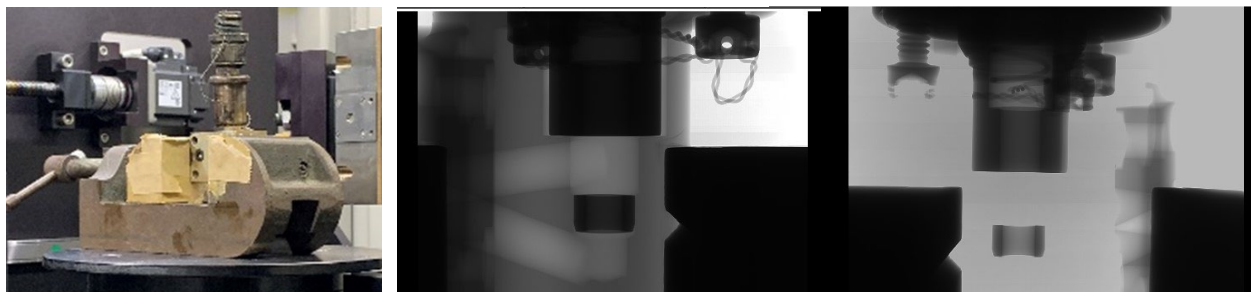


PHOTO 54: X-RAY SET-UP (LEFT); IMAGES OF FEATHERING SOLENOID (CENTER, LEFT; COURTESY OF WOODWARD)

Solenoid
damage:
top is bent,
not aligned
with
poppet
(bottom)

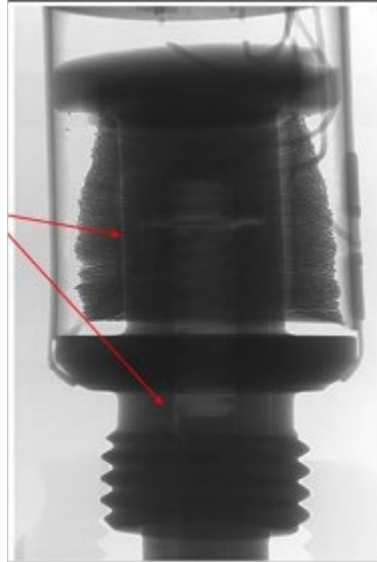


PHOTO 55: RESET SOLENOID X-RAY (COURTESY OF WOODWARD; MODIFIED BY NTSB)

The feathering solenoid (Woodward P/N 1310-118) also leaked at lowest possible pressure setting, registering no differential pressure (Photo 56). The poppet, or plunger, was not visible in the x-rayed image as it is made of a Kel-F plastic. According to Woodward, the observed leak was most likely due to the plastic poppet having melted during the post-impact fire.

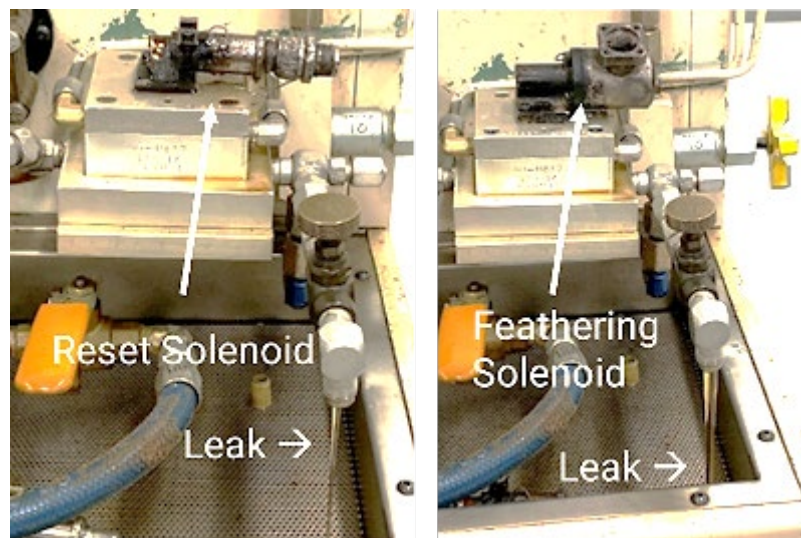


PHOTO 56: LEAK TEST OF THE OVERSPEED GOVERNOR RESET AND FEATHERING SOLENOIDS (COURTESY OF WOODWARD)

After the feathering and reset solenoids were tested, they were disassembled. Disassembly was delayed until technical drawings were received from Eaton Corporation, the manufacturer of the solenoids. Due to scheduling issues, they were disassembled separately: the reset solenoid was reviewed and disassembled at the

Woodward facility in Loves Park, Illinois on February 16, 2023; the feathering solenoid housing had to be machined and was completed on March 21, 2023, with members of Woodward present while the NTSB observed virtually / online.

The reset solenoid was x-rayed a second time to confirm the offset of the poppet. The x-ray also did not show internal solder; Woodward suggested that this was possibly due to melting in the post-impact fire (Photo 57).

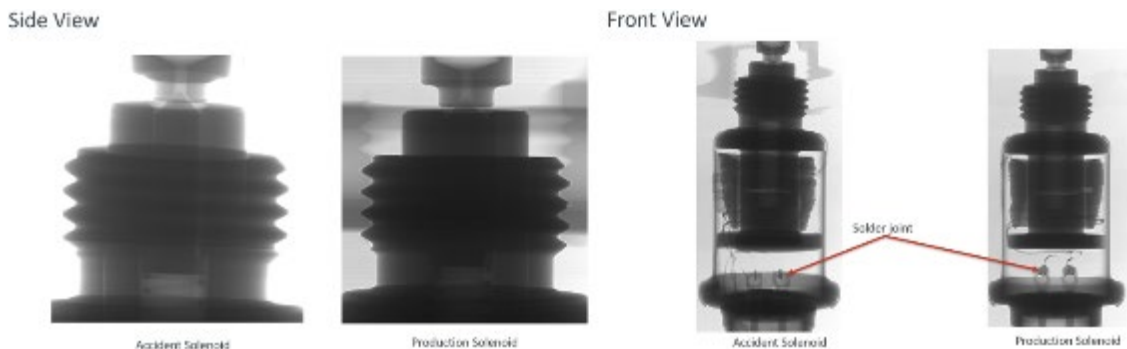


PHOTO 57: MISHAP SOLENOID NEXT TO A PRODUCTION SOLENOID (COURTESY OF WOODWARD)

To disassemble the feathering solenoid, the lockwire was removed and the solenoid was separated from the housing (Photo 58). A small amount of oil was present on the top of the solenoid. The plunger and spring separated with the body. The O-ring was charred and burned. Heat distortion to the packing was clearly evident, and, in removing the spring and plunger, the poppet, which is made of KEL-F plastic, was not present.



PHOTO 58: FEATHERING SOLENOID HOUSING (COURTESY OF WOODWARD)

It was noted that the nameplate, which is an adhesive sticker, was missing from the housing. The alignment pins, pressed in radially to align and hold the solenoid to the body, were confirmed to be installed correctly 180-degrees out from each other and were sheared internally. All potting was missing inside the connector, and the housing held dried and crumbly deposits. According to Woodward, the debris was most likely the stycast - a thermally conductive epoxy used to encapsulate components for heat dissipation and thermal shock - and RTV (Photo 59).



PHOTO 59: DEPOSITS IN THE HOUSING (LEFT) AND EXPOSED SPRING IN THE SLEEVE(COURTESY OF WOODWARD)

The solder connections inside the solenoid were missing. The pins for the electrical wires were recessed into the body which, according to Woodward, is consistent with pulling on the wire harness. The plastic insert on the connectors, which serves as a locking mechanism for the wiring, was melted.

The spring length was measured to be 1.079 inches; the reference length is 1.090 inches (Photo 60). A resistance check was not possible due to the recessed pins. The magnet wire was in good shape, though the tape covering was missing, consistent with being exposed to the post-impact fire. With the feathering body separated, the spring and poppet seat were removed. The seat appeared in good condition other than heat damage.



PHOTO 60: SLEEVE AND SPRING (COURTESY OF WOODWARD)

The feather solenoid body was machined to split the housing from the body. Upon examination, the pin which engages the housing to the body of the solenoid was found sheared, consistent with the approximately 60-degree offset initially observed of the solenoid on the governor.

The reset solenoid was loose against the body when removed from the shipping bag (Photo 61). The sleeve was bent inside the housing to the extent it

could not be removed by hand, the poppet was exposed, and the plunger was sticking out of the threads. The sleeve should have been free to simply drop out, as it is not a press fit or adhered in any way.



PHOTO 61: FEATHERING SOLENOID HOUSING & BODY (COURTESY OF WOODWARD)

The electrical continuity check of the terminal pins registered 293,000 ohms, with the expected value being 100-150 ohms. Coil-to-casing continuity checks registered 0.2 Ohms and 17,220 Ohms respectively, suggesting a ground or short to the case housing.

Based upon the initial resistance checks, no further electrical testing was attempted. A mix of soft, sludge-like and some hardened, crumbly material was found in the seal - likely the 2 different sealant materials (stycast potting and RTV) (Photo 62).



PHOTO 62: BURNT MATERIAL ON HOUSING, WITH THREADS & POPPET EXPOSED (COURTESY OF WOODWARD)

Using a vise, the sleeve was separated from the body, and the plunger and spring dropped out (Photo 63). The spring's reference setting was 0.680 inches; the pre-length reference measurement was 0.6085 inches. The spring has two test points: with 0.25 pounds applied the length of the spring should be 0.560 +/-0.010 inches; and with 0.3 pounds applied the length of the spring should be 0.535 inches. The accident spring measured 0.494 inches in length when at 0.25 pounds was applied and 0.4677 inches in length when 0.3 pounds was applied.

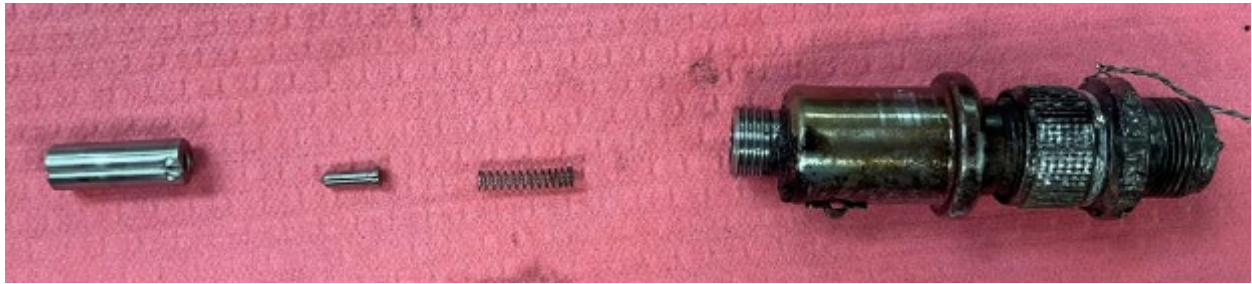


PHOTO 63: SLEEVE, POPPET, SPRING, AND SOLENOID (COURTESY OF WOODWARD)

Several high magnification photos of the poppet revealed impressions evenly spaced circumferentially, consistent with the poppet recessed evenly and to the correct depth at the time of accident (Photo 64).

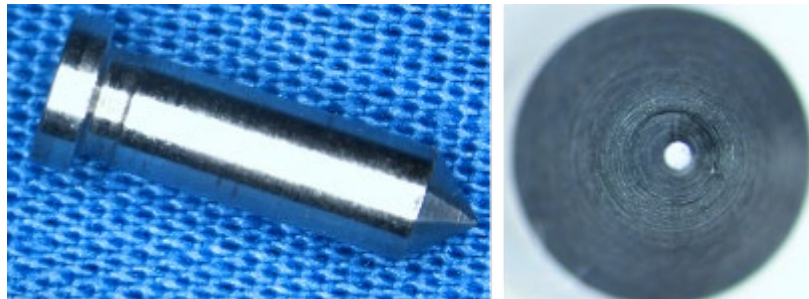


PHOTO 64: POPPET & HI-MAG VIEW OF INTERIOR (COURTESY BY WOODWARD)

E. ATTACHMENTS

1. Propeller Governor (CSU) test data
2. Engine Overspeed Governor test data

Submitted by:
Matthew Walker
Powerplant Engineer

AS RECEIVED

WOODWARD GOVERNOR COMPANY
Rockford, Illinois

TSP-1527
Page 10 Rev. N1

TEST RECORD FOR TURBOPROP GOVERNOR WITH PNEUMATIC OVERSPEED LIMITER

(W.G. Co. P/N 8210-006, Pratt & Whitney P/N CPW (3032018)

(W.G. Co. P/N 8210-007, Pratt & Whitney P/N CPW (3032019)

** See below for additional applicable models.

1. Relief Valve Pressure at 3000 RPM 170 (385+/-10 PSI) 345 with House PRV
 2. Supply Pressure 40 (40+/-5 PSI Mobil Jet II)
 3. Speed Setting: Max. RPM 3840 3840+/-5 RPM 192 control lever angle
 4. Speed setting lever travel from 3000 to 3810 RPM 51 (56+/-3 deg.) 139 to 190
 5. Feather Stop 75 (75+/-1 deg.) travel at 115 deg.
 6. Feather 150 PSI at 123 deg. lever angle (degrees under item 5 +8 deg.)
 7. Pneumatic Control Valve:
Overspeed setting 7 (5 PSI Delta P at 4210 RPM)
31 (21 PSI Delta P min. at 4530 RPM)
1 (6 in. of water max. 3640 RPM)
- Underspeed reset setting-
Test Point Only N/A (10 PSI min. at 3620 with eccentric at lowest point)
- Then calibrate to 8 (4 PSI Delta P at 3620)
3 (12 in. of water max. 3420 RPM)
- Leakage at feather stop 1 (6 in. of water max. 1800 RPM)
8. Pump Capacity 2.3 qts./min. (5.5 min. at 150+/-5 PSI & 3000+/-10 RPM) 6.6 with House PRV
 9. Internal Leakage 7 qts./min. (2.5 qts./min. max.)
(3.0 qts./min. max. overhaul)
 10. Control arm set at 192 193+/-2.5 deg..
 11. Beta Pilot Valve travel from null: In 132 .140+/-0.010
Out 033 .040+/-0.010
 - *12. Solenoid Valve Check N/A Serial Number N/A
 13. Check for external leaks Leaks at control lever
 14. Torque check (on test stand, prior to removing)
Speed adj. lever screw (33-38 lb.in.) N/A
Speed setting stop assy. screw (33-38 lb.in.) N/A
(See Section III.A for proper torques and torquing sequence.)
Air bleed link screw (18-22 lb.in.) N/A
 15. 8210-007-01 W.G. Co. Assy. No. _____ W.G. Co. Serial No. _____
Matt Jeffers Technician 11/29/2022 Date
Sales Order No. _____

RETAIN ONE COPY FOR PERMANENT RECORD.

*This section for 8210-006 only.

** (W.G. Co. P/N 8210-006-01, Pratt & Whitney P/N CPW3074157-01)
(W.G. Co. P/N 8210-007-01, Pratt & Whitney P/N CPW3074158-01)

TSP-1527 page 10

WOODWARD GOVERNOR COMPANY
Rockford, Illinois
CAGE 66503

AS RECEIVED

TSP-847
Page 9 of 10
Rev. AC

TEST RECORD FOR TURBO-PROP OVERSPEED GOVERNORS (See WGC and Customer Chart for applicable governors)

1. Max. Speed (Section 2.2.1) (Test Schematic valve positions 2 open, 1,3,4, 5,6 closed)
 - a. Set point RPM at flow (*) at 150 +/- 10 PSI inlet. (Application information column on applicable drawing) 4047 = 29 QPM
*RECORD RPM (3361) = 9.2 QPM
2. Reset, Min. Speed. (Section 2.2.2) (Test Schematic valve positions 2 open, 1,3,4,5,6 closed)
 - a. Energize reset solenoid valve with 18 +/- 1 VDC, increase or decrease speed to obtain flow (*) at 150 +/- 10 PSI inlet pressure.
*RECORD RPM N/A untestable
3. Internal leakage. (Section 2.2.3) (Test Schematic valve positions 2 open, 1,3,4,5,6 closed)
 - a. Set RPM to that specified. (Application information column on applicable drawing). With inlet pressure at 60 +/- 5 PSI, internal leak should be no more than (*).
2.33 QPM max
*RECORD FLOW (10.1) QPM
4. Feather Solenoid Check. (Section 2.2.4) (Test Schematic valve positions 2,4,5,6 open, 1,3, closed)
 - a. With stand speed at zero, energize feather solenoid with 22 +/- 1 VDC, increase or decrease inlet pressure to obtain the Delta P specified in Section 2.2.4. Flow should be as specified in Section 2.2.4.
RECORD FLOW N/A untestable
 - b. Feather leak check. (Section 2.2.4.3) (Test Schematic valve positions 2,4,5, open, 1,3,6 closed)
Reduce voltage to .750 + 0-.1 with no undershoot. If flow is more than 2 QPM reject valve.
RECORD FLOW N/A untestable
5. Magnetic Pick-up Voltage. (Section 2.2.5) (Test Schematic valve positions 2, open, 1,3,4,5,6 closed)
 - a. Set stand speed to 3200 +/- 10 RPM, magnetic Pick-up output voltage should be (*).
*RECORD VOLTAGE N/A
 - b. Magnetic pick-up indicated RPM. Set stand speed to 3200 +/- 10 RPM. Indicated RPM should be as specified in Section 2.2.5.1.2.
RECORD RPM N/A
6. External Unfeather Adapter. (Section 2.2.6.1 & 2.2.6.2)
(Test Schematic valve positions 1,3 open, 2,4, 5,6 closed)
 - a. Supply oil to the external connection at 200 +/- 10 PSI. Flow must be 4 QPM Min.
RECORD FLOW N/A
 - b. Unfeather Adapter leak check. (Test Schematic valve positions 2 open, 1,3,4,5,6 closed)
With oil inlet pressure at 150 +/- 10 PSI. Leakage past the check valve shall not exceed 1 ounce per minute, Max.
RECORD LEAKAGE N/A

* with House reset solenoid
 Max speed = 3825 rpm at 9.2 QPM
 reset speed = ~~3818~~ 3740 rpm at 8.2 QPM
 Internal leakage = 3818 rpm at 7.2 QPM

WOODWARD GOVERNOR COMPANY
Rockford, Illinois
CAGE 66503

AS RECEIVED

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7. External Leakage Check. (Section 2.2.7) (Test Schematic valve positions 2, open, 1,3,4,5,6 closed)

NONE ALLOWED Leaks from reset
solenoid
and
cover to body

8. Torque Check. (Section 2.3)

9. Woodward I/N 210638 S/N 17853481

Reset Solenoid P/N _____ S/N _____

Feather solenoid P/N _____ S/N _____

Technician's name and date Matt Jeffers 11/29/20.2

Sales Order No. 3838486

RETAIN ONE COPY FOR PERMANENT RECORD

(*) As specified on the applicable assy drawing.