

FACTUAL NOTES

ACCESSORY INVESTIGATION IN SUPPORT OF ENGINE INVESTIGATION OF Schweizer Grumman AG-CAT model 164B N629EH.

Customer: Thunder Valley AG Aviation
Application: Schweizer Grumman AG-CAT model 164B N629EH
Location: Indiana USA
Event Date: 26 July 2022
Engine Model: PT6A-34AG
Engine Serial No. (ESN): 56841

CRM Case No.: No case
P&WC File No.: 22-150
RFA No.: 22ECN00153
Event Category: CAT 1

1. EVENT SYNOPSIS

As per NTSB notification, the pilot reported a partial loss of engine power during takeoff, and he was forced landing to a corn field about 300 ft from the end of the runway. Pilot sustained minor injuries. The airplane was substantial damaged.

2. INVESTIGATION PARTICIPANTS

The accessories investigation was performed on 4 January 2023 at the Pratt & Whitney Canada (P&WC) Service Investigation Facility in Saint-Hubert, Quebec, Canada. The following individual participated in the investigation as representative of the respective organisation:

3. ACCESSORIES INVESTIGATED

The following accessories were investigated.

Accessories from ESN 56841					
Accessory	P&WC P/N	OEM P/N	OEM	S/N	TSN / TSO
Fuel Control Unit	None	2524440-7-6	Honeywell	A74252	Unk
Fuel pump	3019044 E	025323-101	Hamilton Sundstrand	2677	Unk
Start control unit	3019109 B	25234-3	Triumph	13456	Unk
Propellor governor	None	8210-002-01	Woodward	16809655	Unk
Overspeed governor	None	A210507 W	Woodward	14633050	Unk



FACTUAL INFORMATION

3.1. Fuel System

3.1.1. Fuel Pump:

Note: This unit was not on the engine at initial engine delivery.

External Condition and cleanliness

The fuel pump was received assembled to the FCU. The external surface was covered with a thin film of black deposit. The mounting flange was fractured. The drive coupling was missing. A slave coupling was used to rotate the drive shaft with a socket and screwdriver. The outlet filter, filter bowl housing and inlet strainer were missing. A portion of the airframe drain tube was connected at the fuel pump drain port.

Attachments Security

The inlet screen cover and filter bowl lockwire were missing. The remaining lockwire were at the right locations and in good condition.

Test Results

The fractured mounting flange prevented testing of the fuel pump.

Detailed Disassembly

The fuel pump was split from the FCU. The fuel pump housing cavity on the FCU side showed blue stains and splatters typical of FCU driveshaft bearing washout. The rear cover was removed to access the gear set. There was contamination on the inside diameter of the rear cover carbon seal, driveshaft side. The rear bearing bushings showed presence of black contaminant like the contaminants observed in the inlet cavity where the inlet screen resides. The drive gear bushing showed shinier surface on a portion of the circumference indicating that the gear was rotating when the mounting pad fractured. Light pitting and circular scoring marks were present on the bushings mating face with the gears. The drive gear showed normal wear but the mating face with the carbon seal on the FCU side revealed a rough surface that could be felt with a plastic probe. This condition would impact the sealing integrity and could be a potential source of external leakage. The engine maintenance manual (EMM) 3021242 Rev. 67 allows for 0.55cc/minute at that location. The driven gear showed normal wear. The front bearing bushings showed similar condition as the rear ones. Both packings, one per bushing, were in good condition. The main housing gear pockets showed presence of the same black deposit. There were no signs of cavitation, and the gear wipes marks were normal. There was contamination on the inside diameter of the front carbon seal, FCU side, and the mating face with the drive gear face showed light circular scratches. The fuel filter bypass valve and the regulator valve were both unremarkable.



3.1.2. Fuel Control Unit (FCU):

Note: This unit was not on the engine at initial engine delivery.

External Condition and cleanliness

There was black granular deposit on the external surface. The FCU was attached to the fuel pump. While rotating the fuel pump drive shaft, the FCU drive shaft and governing weights were monitored via the flow body housing bleed holes. The drive shaft rotation was confirmed indicating proper engagement of the FCU drive coupling. The throttle shaft was bent aft and upward preventing rotation on the entire range. Closer examination showed that the flow body bushing supporting the throttle shaft was partially pulled out from its location. The part power trim was in the stowed position (running). The acceleration adjustment cup indexing mark was in line with the datum mark on the bypass valve housing.

Attachments Security

The lockwire and seals were at the right location and in good condition. The ground idle speed adjustment lockwire was of a bigger size compared to the other ones and note performed adequately, indicating that the ground idle speed was adjusted. This is a permissible field adjustment.

Test Results

The bent throttle shaft and the supporting bushing being out of position prevented the FCU testing.

Detailed Disassembly

The FCU was split from the pump. The nylon coupling was in place and in good condition. The nylon coupling showed, on the FCU driveshaft side, presence of a white material having the appearance of RTV. It is believed that this material was used to maintain the coupling in position because the force used to remove it from the driveshaft was a little bit more than usual, usually no resistance. The EMM does not call for this type of material to be used while fitting the coupling on the FCU driveshaft. The FCU driveshaft was rotated by hand and the typical resistance was observed. There was blue dye and splatters from the driveshaft bearings present on the driveshaft bearing retaining plate. The Ng stop adjustment screw was measured within the component maintenance manual (CMM) limits. The Data plate information shows that the unit was overhauled by Kansas Aviation of Independence on the 17th of July 2020. Removing the throttle lever from the throttle shaft revealed that the flow body housing bushing supporting the throttle shaft was cracked at two locations, 180 degrees apart. Using a cutting wheel, the throttle shaft was sectioned flush to the housing, including a section of the bushing. The throttle shaft was easily removed. The flow body housing was split from the drive body housing exposing both cavities and the governing system. There was a film of liquid on both mating flanges. There was a ring of blue dye on the flow body housing internal wall, which was lining up with the driveshaft cap bearing, indicating that some of the cap bearing grease was washed out. The flow body housing cavity also showed presence of dark deposit. The air passages going to the bellows chamber looked clean.



The air passages in the drive body, supplying the Py and Px pressure to the flow body were also clean. There was light deposit on the governor system components. There was presence of a liquid like oil at the interface of the cap bearing assembly cap and the governor lever bearing. The governor lever assembly was removed and disassembled. All components were unremarkable except for the presence of a fluid on most of the components. The Py bleed face and orifice was clean. The air inlet adaptor was removed revealing presence of a wet substance at the mating flange with the drive body. The wetness and greasy appearance were also present in the P3 and Py ports. The Py orifice hole was not clean. Some fluid was visible in the air passage. The Py orifice was removed and secured in a sealed plastic bag. The P3 and Py ports also revealed presence of black granular deposit. The Py orifice and the air inlet adaptor were sent to the P&WC chemical laboratory to determine the nature of the contaminants. The bypass valve cover was removed. A large debris with vegetation appearance was observed in between both packings. The debris and the housing were sent for chemical analysis. The bypass sleeve was also sent to the P&WC chemical laboratory to determine the nature of the contaminants, black granular debris, and a wet orange color deposit. The bypass valve diaphragm was in good condition. The manufacturing date was 2Q17 (2nd quarter of 2017) and the identification was partially transferred to the bypass valve housing. The metering valve was unremarkable. The ratio arm cover from the bellows side was also sent to the chemical laboratory to analyse the grease deposit observe in its internal cavity. The driveshaft assembly components were unremarkable except for the presence of a fluid on most of the components. The bellows was removed and found covered with a grease residue. Per the CMM, there should be no protective coating added to the bellows convolutions. The evacuated bellows dimension "A" was measured to 1.027 inch. The correcting factor for the atmospheric pressure of 29.93 in. hg. is + .0038". The dimension "A" written on the governor bellows end plate was 1.0221. So, $1.0221 + 0.0038 = 1.0259$ which is the corrected value. To determine if the dimension "A" was within the CMM requirement we must subtract from the measured dimension, 1.027 the corrected value of 1.0259. The resultant, 0.0011 was within the CMM requirements. The governor bellows was successfully tested since no leakage was detected. The torsion shaft assembly was removed and found in good condition. It was also successfully tested. There was no leak through the braze joint.

Chemical Analysis

The Air inlet adaptor, Py orifice, bypass valve housing, bypass sleeve, and ratio arm cover from the bellows side were sent to the P&WC chemical laboratory on the GDA request number 23020887. The analysis showed for the air inlet adaptor presence of environmental contaminants mixed with ester-based engine oil and the Fourier transform infrared spectroscopy (FTIR) pattern similar to LCPMC 79133 known in the industry as LPS3, a specialized soft-film spray coating designed to prevent rust and corrosion on steel, aluminum and other metals. The Py orifice showed presence of engine oil that could not be identified to a specific type. The bypass valve housing showed presence of wood, other environmental debris, and copper/zinc elements. The bypass sleeve revealed presence of iron oxide other environmental particles, and copper/zinc elements. The copper/zinc elements observed from the bypass valve housing and sleeve are from the toll used during disassembly. The ratio arm cover showed a greasy residue composed of an ester based compound and aliphatic hydrocarbons that could not be identified to a specific compound.



3.1.3. Start Flow Control Unit (SFCU):

Note: Unable to determine if this unit was on the engine at initial engine delivery since it is not recorded in the production tracking system.

External Condition and cleanliness

There was light black granular deposit on the external surface. The control lever was moving freely over the entire range. The section of the lever contacting the maximum stop was worn showing the maximum stop screw imprint. There was a blue fitting, airframe component, connected to the dump port.

Attachments Security

The lockwire were present, at the right locations and in good condition.

Test Results

The unit was prepared for test per the Lucas CMM 73-10-02 Rev. 05. Upon installation on the test rig, it was observed that the control lever had a slight sideways movement. The unit was partially tested only. The pressure required to open the transfer valve was 10,5 psig above the CMM requirement and remained opened. The unit was removed for the test rig to proceed with the disassembly.

Detailed Disassembly and Results

The transfer valve was removed and disassembled revealing a seized plunger. Pulling on the plunger to remove it from the sleeve required a lot of force. The plunger showed score marks and there was contamination in the sleeve bore. The transfer valve components except the housing were sent to the P&WC chemical laboratory for analysis. The minimum pressurizing valve was disassembled exposing orange colored debris. The bypass port was not obstructed but there was contamination in the housing bypass cavity. The minimum pressurizing valve components and the debris collected from the housing were sent to the P&WC chemical laboratory for analysis. The remaining of the start control unit components were in good condition.

Chemical Analysis

The transfer valve and minimum pressurizing valve components were sent to the P&WC chemical laboratory on the GDA request number 23020887 to determine the nature of the contaminants. The orange-yellow particles collected from the transfer valve components comprise iron oxide, silicon dioxide and other environmental elements. From the minimum pressurizing valve components, a very fine brownish particles on the spring, mainly composed of copper mixed with iron chromium lead and bronze. The orange-brown particles collected from the sleeve were rich in aluminium, copper, iron mixed with oxygen and other environmental contaminants. There was fibrous material rich in carbon oxygen and traces of sulfur.



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3.2. Oil System

3.2.1. Propeller Governor (CSU):

Note: Unable to determine if this unit was on the engine at initial engine delivery since it is not recorded in the production tracking system.

There was light black deposit on the external surface. The oil ports were clean. The drive shaft was rotating by hand freely, and the pilot valve was moving in the drive shaft. The speed adjustment and the reset levers were both moving freely over their entire range. The beta valve could be pushed in, requiring more force on the first actuation than subsequent actuations.

Attachments Security

The lockwire and torque seal paint were at the right locations and in good conditions.

Test Results

The unit was shipped to Woodward for testing. This is a summary from the Woodward report 1185063.

The control lever angle was significantly out of limits, however the lever angle is often adjusted in the field for engine rigging and did not have an impact on unit performance. Although there were a few test points out limits the unit showed full functionality. Due to these findings, there was no evidence of a pre-existing condition that would have precluded normal governor operation.

3.2.2. Overspeed Governor (OSG):

Note: Unable to determine if this unit was on the engine at initial engine installation since this is an airframe component.

External Condition and cleanliness

There was dirty oil deposit on some section of the external surface. The solenoid connector and contacts were in good condition. The oil ports were clean. There was light black granular deposit on the drive shaft and in its vicinity. The drive shaft was rotating by hand and the pilot valve was moving axially.

Attachments Security

The cover screws were lockwired. There was a seal present between two of those screws. Torque seal paint was present on the speed adjustment set screw.



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Test Results

The unit was shipped to Woodward for testing. Following is a summary from the Woodward report 1185066.

The as received test showed all test points were within limits except the "Maximum Speed" was higher than high limits by .23%. The shift in the test data along with non-Woodward lockwire and torque sealant suggest typical field adjustments were made to this unit. Although the max speed test point was out limits, the unit showed full functionality. Due to these findings, there was no evidence of a pre-existing condition that would have precluded normal governor operation.

4. ADDITIONAL ACTIVITIES / FURTHER ANALYSIS

A final report will be provided later.

5. SUMMARY

There were no indications of any pre-impact mechanical anomalies to any of the accessories that would have precluded normal engine operation.

6. CLOSING

These factual notes are based on accessories examination conducted on 4 January 2023 and may be altered or corrected in the final investigation report on the basis of further information.