

ERA22FA086

POWERPLANTS

Group Chair's Factual Report - Attachment # 2

Woodward Propeller Governor, Serial Number, 1440642, Investigation Report and
Test Run Sheet

June 27, 2023

CUSTOMER HONEYWELL ENGINES & SYSTEMS		INVESTIGATION NO 1181230	
CUSTOMER ORDER Crash Investigation	WOODWARD SALES ORDER 3821490	WOODWARD WORK ORDER C106547	
CUSTOMER REJECTION DOCUMENT (CAR, QN, RFA, DMR, ETC.) N/A	WARRANTY DISPOSITION N/A	PRODUCT STATUS N/A	
PROGRAM/ENGINE TYPE GARRETT SMALL PROP GOVERNOR		ITEM RECEIVED 8210-260	ENGINE MFR MODEL RECEIVED N/A
PROGRAM CODE 83344 SML	SERIAL NUMBER 1440642	ITEM SHIPPED 8210-260	ENGINE MFR MODEL SHIPPED 893615-13
PARENT ITEM NUMBER 8210-260	PARENT ITEM SERIAL NUMBER 1440642	FIRST SHIPPED 28-SEP-1977	LAST SHIPPED 28-SEP-1977
CUSTOMER SERIAL NUMBER N/A	APPLICATION N/A	VESSEL TYPE & VESSEL NUMBER N/A	SITE & LOCATION GRID ID N/A
TIME/CYCLES SINCE NEW, OVERHAUL, OR REPAIR N/A			
DATE REPORT OPENED 01-SEP-2022		DATE PART REMOVED N/A	DATE RECEIVED 23-AUG-2022

TEAM MEMBERS (D1)

Product Engineer: NATHAN BOGDONAS
 Customer QA Engineer: Jean Taylor
 Tech Advisor/Reviewer: David M. Kettle
 Customer Account Manager: Charles J. Johnson
 Customer Service Rep: SHANNON L. COTE
 Product Integrity Coordinator: James D. Rosplock

REASON FOR INVESTIGATION (D2)

Reported Issue: Event Description: On December 10, 2021, about 2330 eastern standard time, a Swearingen SA-226AT, N54GP, was destroyed when it was involved in an accident near Bedford, New Hampshire. The commercial pilot was fatally injured. The airplane was operated as a Title 14 Code of Federal Regulations Part 135 on demand cargo flight. According to preliminary information from the Federal Aviation Administration, the airplane was on the instrument landing system approach to runway 6 at Manchester Boston Regional Airport (MHT), Manchester, New Hampshire. During the approach, the pilot reported an engine failure at 2330:42 but did not specify which engine. Radio and radar contact were lost at 2330:51, when the airplane was about 1/4 mile from the runway. The wreckage was located on a river sand jetty, oriented north, and a post-crash fire consumed the cockpit, cabin, and both wings. No debris path was observed. A crater about 6 ft long, 3 ft wide, and 2 ft deep was observed at the beginning of the sand jetty. The left aileron was recovered in the water near the crater. The empennage was located just beyond the crater. The empennage remained intact, with the elevator and rudder attached and undamaged except for the right elevator tip. The right wingtip was located near the empennage and an outboard left-wing section was located 60 ft left of the main wreckage. Three landing gear were located near the main wreckage and the radome was located at the end of the sand jetty, in water. Elevator control continuity was confirmed from the elevator to the cockpit area. Rudder control continuity was confirmed from the rudder to the cabin area. No aileron cables were identified. The left engine was located in the main wreckage. The left propeller had separated and was partially embedded in mud to the left of the left engine. All three blades remained attached to the hub and did not exhibit rotational damage. The right engine was located forward and left of the main wreckage. The right

INVESTIGATION SUMMARY (D4)

Confirmation Text: DID NOT CONFIRM REASON FOR INVESTIGATION/RETURN

Discrepant Item Number: NA

Discrepancy: No Discrepancy Found

Finding: No Findings

Conclusion:

The unit was received and an as received visual inspection was performed on the unit. Immediately present during the inspection was the charred appearance of the unit. The appearance was consistent with a unit involved in a fire see Figure 1. The magnetic pick-up coil wires were severed see Figure 2. The baseplate had evidence of heat damage and a missing baseplate packing see Figure 3. Lastly the lockwire was non-Woodward, indicating the original had been removed after leaving the Woodward Facility. Even with the findings during the visual inspection it was determined that an as received test could be completed on the unit.



Figure 1 Prop Governor



Figure 2 Severed Magnetic Pickup Coil Wire



Figure 3 Missing Baseplate Packing

Prior to testing a new packing was installed into the baseplate since the original packing was missing. During testing the unit was started up slowly to check for any audible signs of internal damage to the unit. There were no signs of apparent damage to any of the highly rotated components on startup. The relief valve pressure was out of limits low on startup and for the duration of the test. A full test was completed even with the reduced unit pressure the following test points were out of limits.

"Total Leak Check" test high at 5.0 qpm (Limits 0.5 qpm max)
"Relief Valve Check" was low at 240 psig (Limits 465 +/-20 psig)
"Pump Capacity Check" was low at 3.7 qpm (Limits 9.0 qpm minimum)
"Maximum RPM" was low at 3607 rpm (Limits 3754 +/-10 rpm)
"Minimum RPM" was high at 3360 rpm (Limits 2815 +/-10 rpm)
"Arm Travel Max to Min" was low at 15 degrees (Limits 60 +/- 5 degrees)
"Pressure Gain" was high at 48 (Limits 30 +/- 10 rpm)
"Magnetic Pickup Voltage" was low at 0.2 v (Limits 4.5 +/- 0.2 v)

Test points like min rpm, max rpm, arm travel, and magnetic coil voltage are typically adjusted in the field and the presence of non-Woodward lockwire indicate an adjustment was performed in the field to these settings. The pressure gain test is not a typical field adjustment and was out of limits high by 8 rpm. An out of tolerance such as this is not considered significant for a product of this age.

Test points total leak check, relief valve check, and pump capacity checks are also not typical field adjustments. In order to troubleshoot these three test points the relief valve was swapped with a house relief valve. The swap would not have disturbed anything else on the unit as this is an isolated system. Additionally, the relief valve assembly was not disturbed during the swap. After the swap the unit was retested and found that total leak check and relief valve points were within limits confirming that the relief valve was the cause of those test points checking out of limits on the original run. While the pump capacity test point did not come all the way back into limits after the swap it improved from 3.7 qpm to 7.1 qpm. The adjustments to the max rpm setting can explain the remaining gap between the 7.1 qpm observed and 9 qpm minimum requirement. Since the speed was adjusted lower the pilot valve was slightly open allowing internal leakage while this test was run.

The cause of all the out of tolerance test points was understood. Therefore, no further testing was necessary. The unit was disassembled to investigate the cause of the shift in the relief valve performance. Upon disassembly of the relief valve, it was discovered that the relief valve spring (P/N 192370) was shorter than expected. The free length of the spring on new units is approximately 1.760" while the relief valve spring checked 1.560". After the discovery additional dimensions on the spring were checked to confirm that correct spring was used. Dimensions inspected included the number of coils, wire size, inner diameter, and outer diameter all of which were conforming to the spring drawing specification. The relief valve spring is compressed to approximately 1.500" when installed into the unit, therefore its probable that the spring took a set at the working height due to excessive heat from the post-crash fire. Therefore, when it was tested, the spring had a lower preload on it allowing the relief valve to open easier than usual causing the out-tolerance test points observed during testing. See Figures 4-6 for relief valve photos.



Figure 4 Assembled Relief Valve



Figure 5 Relief Valve Piston



Figure 6 Relief Valve Spring

There were no additional findings during disassembly. In summary, all the out tolerances observed at test were consistent with normal field adjustments, age related wear, and the post-crash fire. There was no evidence of a pre-existing condition that would have precluded normal governor operation.

ROOT CAUSE (D4)

Origin of Cause: FIELD / END CUSTOMER (OWNER)

General Cause: No Problem Found

Cause: No Problem Found or Identified

CORRECTIVE ACTION PLAN (D5)

General Corrective Action: No Action without Additional Customer Input

Specific Corrective Action: No Direct Action, Continue to Monitor

CORRECTIVE ACTION IMPLEMENTATION (D6)

Corrective Action Status: NO ACTION

WOODWARD GOVERNOR COMPANY
Rockford, Illinois
CAGE 66503
VENDOR CODE 23245

AS RECEIVED

TSP-325
Page 9 of 15
Rev. AH

CONSTANT SPEED PROP GOVERNOR - TEST REPORT
Use with Governors 210560 (869120-1), 210563 (893615-3) (See Below)

OIL INLET TEMP. 140 ± 5 DEG. F. OIL INLET PRESSURE 95 ± 10 PSIG

S/N 1440442

P/N 8210-260

PT.	TSP PARAGRAPH NUMBER	SPEED (RPM)		OIL PRESSURE (PSIG)		OIL FLOW (GTS./MIN)		
		REQUIRED	ACTUAL	REQUIRED	ACTUAL	REQUIRED	ACTUAL	
1	C1	CHECK VALVE PRESS. CHECK	0	0	15 Max.	8	START FLOW	START FLOW
2	C2	TOTAL LEAK CHECK	0	0	200 $\pm$ 10	200	.5 MAX.	5.0
3	C3	RELIEF VALVE CHECK a.	3500 $\pm$ 15	3500	465 $\pm$ 20	240	0	0
4	C4	PUMP CASE PRESSURE b.	3500 $\pm$ 15	3500	525 PSI MAX.	250		
5	C4	PUMP CAPACITY CHECK	3500 $\pm$ 15	3500	150 $\pm$ 5	150	9.0 MINIMUM	3.7 7.1
6	C5	EXTERNAL LEAK	3500 $\pm$ 15	3500	RELIEF VALVE	-----	0	NONE
7	C6	OVERSPEED SETTING	3942 $\pm$ 10	N/A	150 $\pm$ 5	N/A		
8	C7	MAXIMUM RPM	3754 $\pm$ 10	3607	150 $\pm$ 5	150		
9	C8	MINIMUM RPM	2815 $\pm$ 10	3360	150 $\pm$ 5	150	USE	
10	C9	ARM TRAVEL - MAX. TO MIN.	55 DEG.-65 DEG.	*	-----	-----	BLEED	
11	C10	INCREASE SPEED TO OBTAIN		3589	200 $\pm$ 5	200	ORIFICE	
12	C10	INCREASE SPEED TO OBTAIN		3637	50 $\pm$ 5	50		
13	C10	PRESSURE GAIN = PT12-PT11 20-40 RPM		48				
14	C11	DECREASE SPEED TO OBTAIN		3587	200 $\pm$ 5 PSI	200		
15	C11	SPEED HYSTERESIS = PT11-PT 14 -15 TO +40 RPM		2				
16	C12	INTERNAL LEAK	AS REQUIRED	3411	150 $\pm$ 5	150	NEW 1.40 MAX. O'HAUL 1.7 MAX.	N/A .8
17	C13	MAGNETIC PICKUP VOLTAGE	3700 $\pm$ 10	3700	Adjust pickup to 4.5V $\pm$.2 peak-to-peak			.2
18	C13	PICKUP INDICATED RPM	925 $\pm$ 3*	925				
19	C16	ELECTRICAL SPEED CHANGE	50 $\pm$ 5	N/A	28 VDC APPLIED TO COIL			

Use with Governors:

210736 (869120-6,-7,-8,-9) 8210-260 (893615-13)

210738 (893615-7,-12) 8210-100 (893615-17)

210743 (897382-1) 8210-266 (893615-18)

REMARKS: If governor is shipped without a lever, test with P/N 210039

*Applied to 210743 prior to "D" change only.
Indicated pickup RPM (62)

TECHNICIAN	SIGNATURE	DATE
	Matt Jeffers	08/23/2022
GARRETT PURCHASE ORDER # <u>N/A</u>		
W.G. SALES ORDER # <u>3821490</u>		

* Max screw at 98 degrees
Min screw at 83 degrees
15

TSP-325
Page 9 of 15
Rev. AH

P/N _____

	SIGNATURE	DATE
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GARRETT PURCHASE ORDER # _____		
W.G. SALES ORDER # _____		

TSP-325
Page 9 of 15
Rev. AH

P/N _____

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Relief valve
At 3500 rpm = 450 psi