WOODWARD

# INVESTIGATION/8D REPORT

Class 1 Published: 17-SEP-2012 (D8)

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| CUSTOMER<br>HONEYWELL ENGINES & SYSTEMS | | | INVESTIGATION NO<br>1048953 |
| CUSTOMER ORDER<br>NONE | WOODWARD SALES ORDER<br>2985386 | | WOODWARD WORK ORDER<br>8057566 |
| CUSTOMER REJECTION DOCUMENT (CAR,QN,RFA,DMR,ETC.)<br>N/A | WARRANTY DISPOSITION<br>N/A | | PRODUCT DISPOSITION<br>N/A |
| PROGRAM/ENGINE TYPE<br>N/A | | ITEM RECEIVED<br>210739 | ENGINE MFR MODEL RECEIVED<br>N/A |
| PROGRAM CODE<br>83344 SML | SERIAL NUMBER<br>1434485 | ITEM SHIPPED<br>210739 | ENGINE MFR MODEL SHIPPED<br>N/A |
| PARENT ITEM NUMBER<br>210739 | PARENT ITEM SERIAL NUMBER<br>1434485 | FIRST SHIPPED<br>N/A | LAST SHIPPED<br>N/A |
| CUSTOMER SERIAL NUMBER<br>N/A | APPLICATION<br>TPE331 | VESSEL TYPE & VESSEL NUMBER<br>Cessna 441, N48BS | SITE & LOCATION GRID ID<br>N/A |
| TIME/CYCLES SINCE NEW, OVERHAUL, OR REPAIR<br>N/A | | | |
| DATE REPORT OPENED<br>27-AUG-2012 | DATE PART REMOVED<br>N/A | | DATE RECEIVED<br>21-JUN-2012 |

**TEAM MEMBERS (D1)**

Product Engineer: Steven A. Krugler
Customer QA Engineer: Timothy A. Schoonover
Tech Advisor/Reviewer: Terence J. Voskuil
Customer Account Manager: Mark H. Munger
Customer Service Rep: Angelique Stuckey

**PROBLEM DESCRIPTION (D2)**

Reported Problem: UNIT WAS REPORTEDLY INVOLVED IN AN ACCIDENT ON DEC 22, 2011 IN NASHVILLE PA JUST AFTER FINAL APPROACH (Right engine, actuator serial number 1-08665-143)

**INVESTIGATION SUMMARY (D4)**

Confirmation Text: NO REPORTED PROBLEM
Discrepant Item Number: 0201527
Discrepancy: ELECTRICAL PERFORMANCE
Finding: OPEN
Conclusion: The part was returned for investigation. The unit is a combination of a Woodward (Rockford) propeller governor base (210739) and a Woodward HSC cover 100380-7. These two parts combine to make the 897160-9 Honeywell part number. The unit was damaged at the mounting base. The mounting flange was fractured from the main housing. The complete unit could not be tested due to the damage. The cover was removed from the unit and the remaining hardware was disassembled. The components of the 210736 assembly were in acceptable condition. The relief valve was free in the sleeve. The flyweights were intact and free to move. The pump pocket did not show any signs of abnormal wear. All other parts appeared to be in good working order. The cover was mounted on a test rig to run an as-received test. The unit was pressurized and it was determined the unit did not respond to electrical current. The unit was removed from the test stand and measured to the location of the piston. The unit measured .451 in. from the outside hub to the piston. The unit was also measured with the spring seat installed. The measurement from the spring seat to the mounting flange was .185 in. The nominal position of the spring seat to the flange is .192 in. The nominal dimension from the hub to the piston is .460.The stroke measured .055 in. All these values are close to nominal for the stroke and position. The speeder spring was measured for load at length and found to be .8233 which is just outside the production tolerance of .803-.823. The rate tolerance was within limits. The servo valve was inspected for the cause of the open circuit. The wire was cut on the coil side of the header to isolate the open. After the wires were cut both the coil side and the header side had continuity. The hardware was supplied to the material lab to determine if a cause of the open could be identified near the wire cut. No cause of the open was determined. See attached AL report.

Conclusions: There was no evidence of operation issues (except for the open circuit of the servovalve) which would have caused the unit not to operate at a reduced speed setting. The servovalve is limited in authority to operate between 3478 and 4044 RPM which corresponds to 92.6 to 108 percent speed of the propeller. With the open circuit it is expected the unit would have scheduled the propeller speed close to the 0 current setting of 3782 RPM or 100.75 percent. No other anomalies were observed.

**ROOT CAUSE (D4)**

Investigation Type: Product Return

Origin of Cause: OTHER
General Cause: PRODUCT ISSUE
Cause: Other
Sub Cause: Other
Root Cause: The cause of the open circuit in the servovalve was not determined.

**CORRECTIVE ACTION PLAN (D5)**

Corrective Action: Since the cause of the open was not determined, no corrective action was taken. No other problem was identified.

**CORRECTIVE ACTION IMPLEMENTATION (D6)**

Corrective Action Status: NO ACTION

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**MATERIALS LABORATORY** Date: 31 August 2012
**INVESTIGATION REPORT** Report No. : AL 6934

**PART OR MATERIAL:** P/N 100380-7, Propeller Governor Servoactuator

**WORK REQUIRED:** Determine the cause of the continuity loss.

| Steve Krugler | Joe Zanter | Eileen Clevenger |
|---|---|---|
| Requested by | Authorized by | Assigned to |

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**Background:**
From Issue #55729, "Look to determine cause of continuity loss of servo valve. unit had an open circuit, we cut wires next to header to determine location of open and when cut coil and both leads had continuity. Try to identify original open."

**Conclusions:**
No reason for the loss of continuity was found.

**Observations:**
The Servoactuator, as-received had already been partially disassembled. The cover had been removed and the lead wires from the coil to the connector and from the connector to the external lead wires had already been cut (see figure 1). The coil, the connector wires, and the external lead wires were all checked and found to have continuity. Next all the lead wires and connections were carefully examined for damage other than what had occurred when the wires were sliced. All were as expected, with the lead wires showing clear indications of having been sliced (see figure 2 for a representative example), except for the green lead wire attached to the coil. Two if the wires were broken off well below the rest of the wires in the bundle (see figure 3).
The servo valve was further disassembled and the coil removed. The coil was placed into the scanning electron microscope (SEM), so the green lead wire could be examined in more detail. The majority of the wires in the bundle show signs of having been cut (see figure 4), as shown by the angled surface and the smearing of the silver plating over the surface. But two of the wires from the bundle were separated at a level below the rest (as was shown in figure 3). When those were examined in the SEM, they had a more "cone" shaped fracture (see figure 5). This is more typical of a tensile overload and may indicate that the two wires from the bundle had separated before the rest of the wires were cut.
Finally the connector was placed in the SEM and the solder joints at the cut examined. As with the lead wires, it appears that the wires were separated just above the solder joints by a cutting action (see figure 6),

**Discussion:**
After testing the various lead wires of the servoactuator and finding all had continuity and then examining the wires, where they had been cut, no reason for an open circuit was found. Only one set of lead wires, the green wire from the coil showed any abnormalities. Those consisted of two of the wires, fractured below the rest of the bundle. But while this may have resulted in increased resistance in the lead wire, it should not have registered as an open circuit.

Author: _____

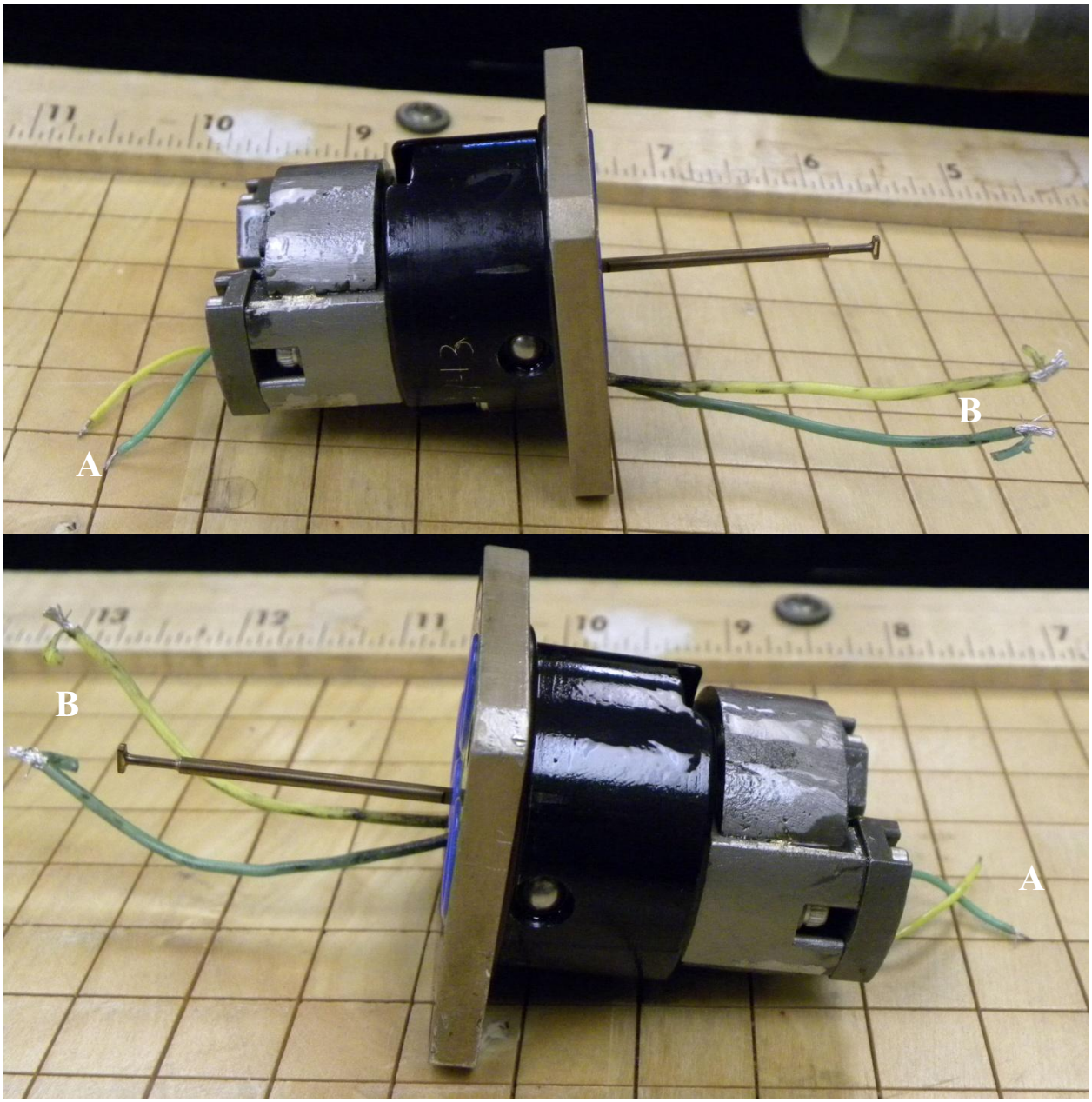


**Figure 1. The partially disassembled servoactuator, P/N 100380-7, as-received. The wires labeled A are the lead wires from the coil, while the wires labeled B are from the connector.**

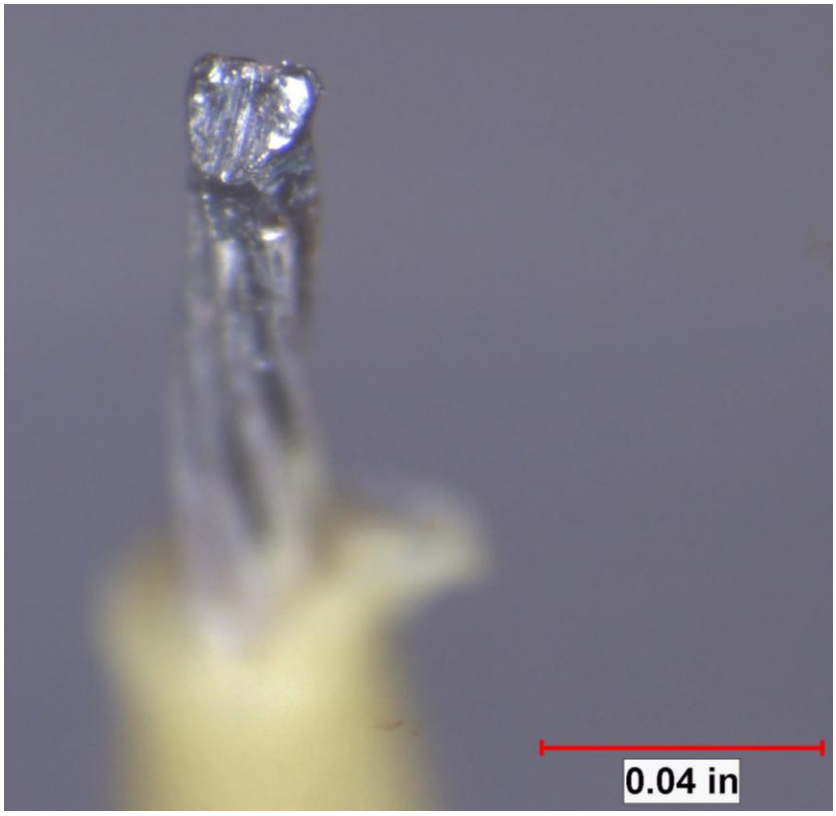


**Figure 2.**

**The yellow lead wire from the coil. This image shows the typical "sliced" structure demonstrated by all of the cut wires of the servoactuator.**

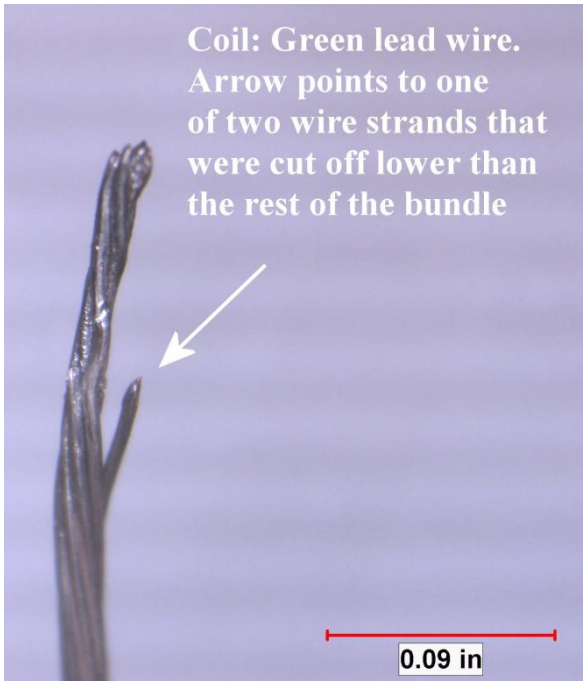


**Figure 3.**

**The green lead wire from the coil. This was the only cut wire that demonstrated any irregularities in the cut surface.**

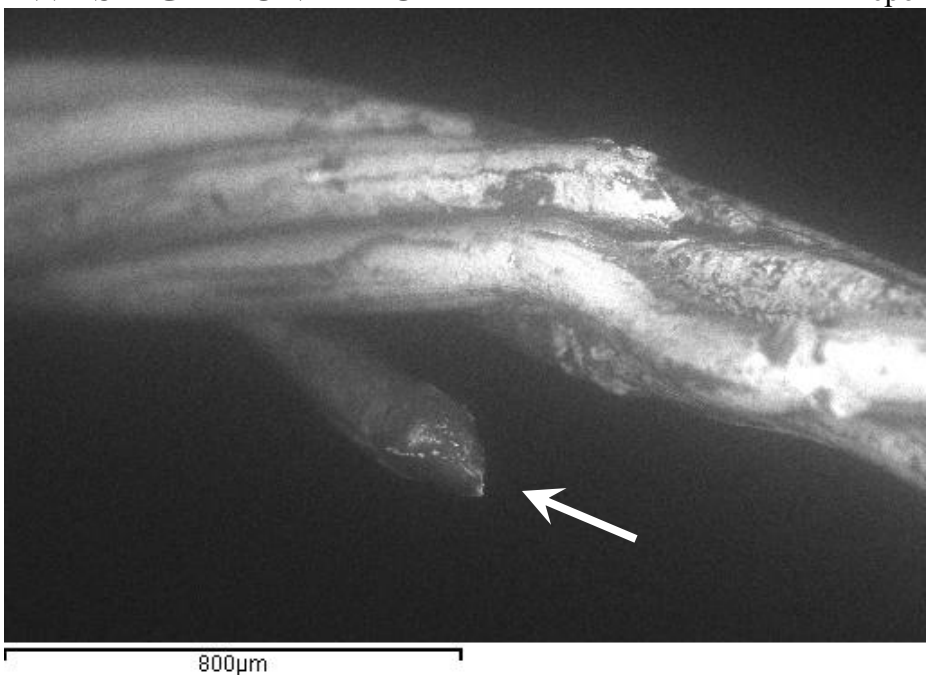


**Figure 4. SEM image of the wire (arrow) from the green coil that was not cut at the same place as the rest of the wires. The cone shape to the fracture, indicates it likely failed due to overload.**

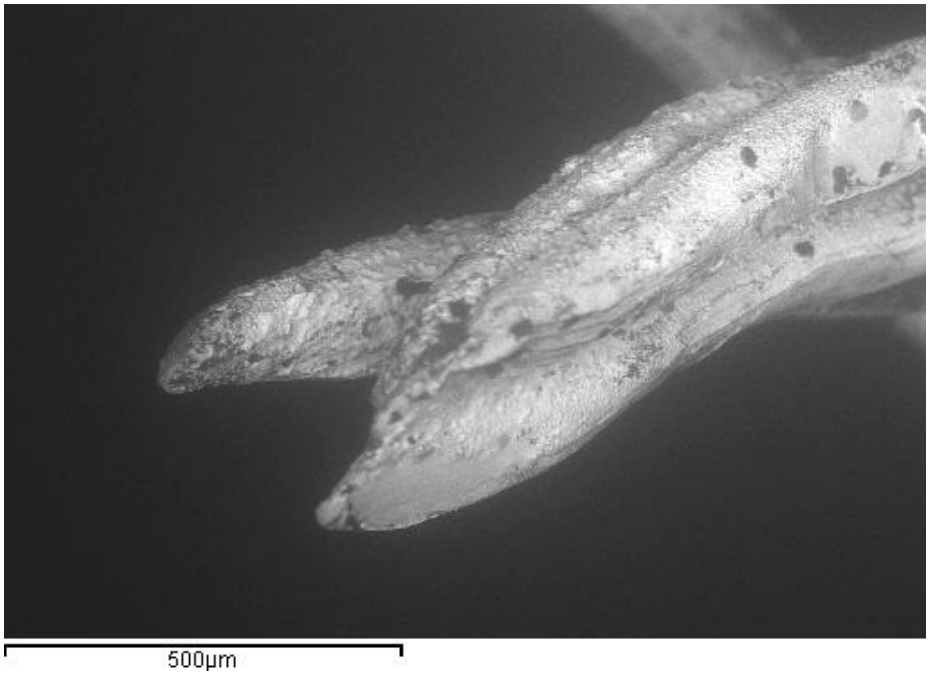


**Figure 5. The other wires from the green coil leadwire. They're fracture surfaces are smooth and inclined at an angle, typical of a cut and/or slice.**

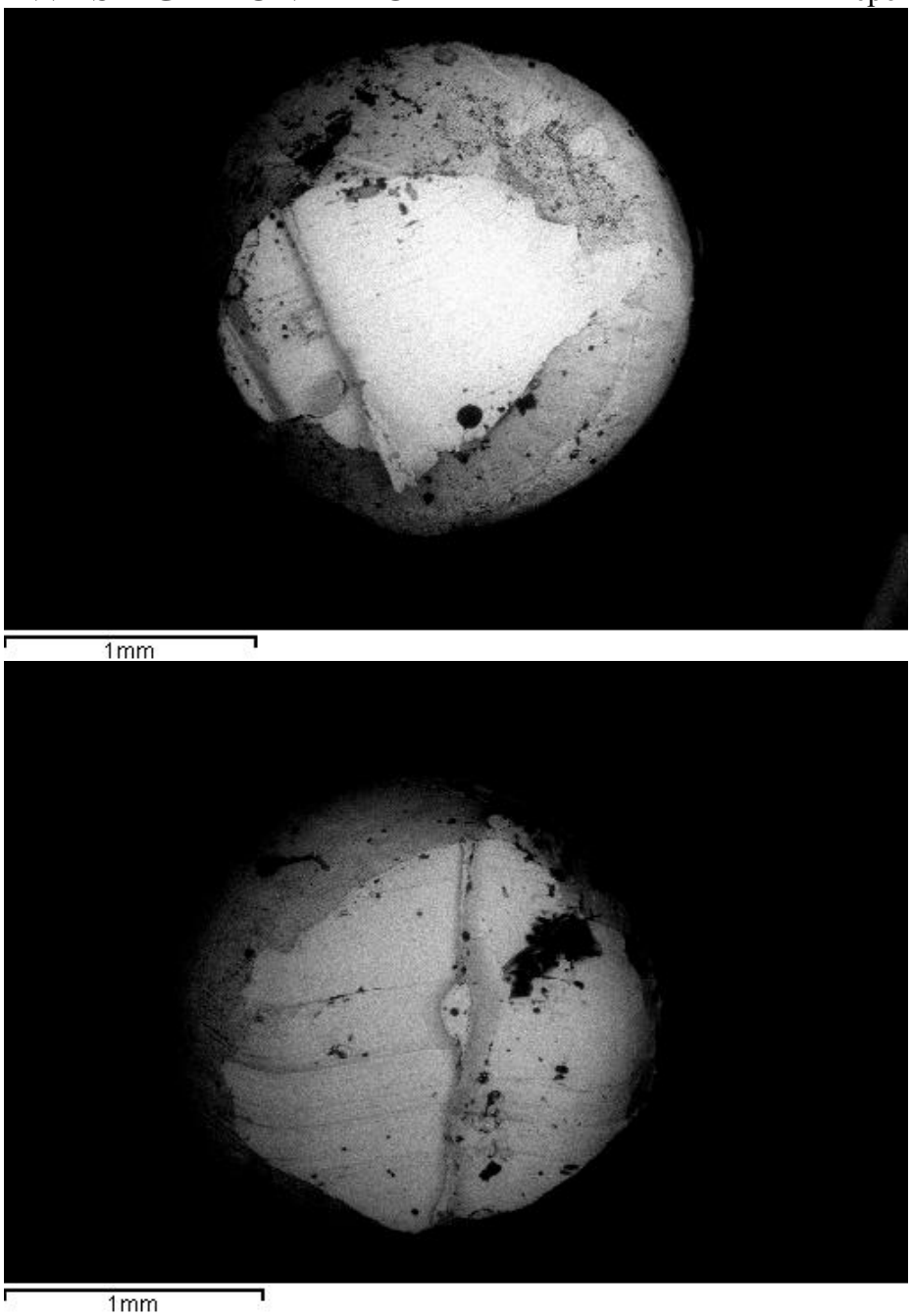


**Figure 6. The two connectors from the servoactuator housing. As the SEM images show, both show signs that the wires were disconnected from them by a deliberate cut.**

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# INVESTIGATION/8D REPORT

Class 1 Published: PRELIMINARY

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|---|---|---|---|
| CUSTOMER<br>HONEYWELL ENGINES & SYSTEMS | | | INVESTIGATION NO<br>1048954 |
| CUSTOMER ORDER<br>NONE | WOODWARD SALES ORDER<br>2985381 | | WOODWARD WORK ORDER<br>8057557 |
| CUSTOMER REJECTION DOCUMENT (CAR,QN,RFA,DMR,ETC.)<br>N/A | WARRANTY DISPOSITION<br>N/A | | PRODUCT DISPOSITION<br>N/A |
| PROGRAM/ENGINE TYPE<br>N/A | | ITEM RECEIVED<br>210739 | ENGINE MFR MODEL RECEIVED<br>N/A |
| PROGRAM CODE<br>83344 SML | SERIAL NUMBER<br>1443345 | ITEM SHIPPED<br>210739 | ENGINE MFR MODEL SHIPPED<br>N/A |
| PARENT ITEM NUMBER<br>210739 | PARENT ITEM SERIAL NUMBER<br>1443345 | FIRST SHIPPED<br>N/A | LAST SHIPPED<br>N/A |
| CUSTOMER SERIAL NUMBER<br>P691C | APPLICATION<br>TPE331 | VESSEL TYPE & VESSEL NUMBER<br>Cessna 441, N48BS | SITE & LOCATION GRID ID<br>N/A |
| TIME/CYCLES SINCE NEW, OVERHAUL, OR REPAIR<br>N/A | | | |
| DATE REPORT OPENED<br>27-AUG-2012 | DATE PART REMOVED<br>N/A | | DATE RECEIVED<br>21-JUN-2012 |

**TEAM MEMBERS (D1)**

Product Engineer: Steven A. Krugler
Customer QA Engineer: Timothy A. Schoonover
Tech Advisor/Reviewer: Terence J. Voskuil
Customer Account Manager: Mark H. Munger
Customer Service Rep: Angelique Stuckey

**PROBLEM DESCRIPTION (D2)**

Reported Problem: UNIT WAS REPORTEDLY INVOLVED IN AN ACCIDENT ON DEC. 22, 2011 IN NASHVILLE PA JUST AFTER FINAL APPROACH (Left Engine, actuator serial number 1-08265-374)

**INVESTIGATION SUMMARY (D4)**

Conclusion: The part was returned for investigation. The unit is a combination of a Woodward (Rockford) propeller governor base (210739) and a Woodward HSC cover 100380-7. Because of this, the unit was run with an 897711-4 model specification instead of the 897160-9 specification. This difference only affects the speed setting of a few of the test points. The data was transferred to a Honeywell test sheet for the 897160-9.

There were 4 points out of test limits. These include test point 3.4.1a which was 3725 rpm where the limits were 3728 to 3780. Test point 3.4.2 was run at 3745 rpm vs. 3500 rpm. This test point is checking internal leakage and the difference in speed would not have affected the output. Test point 3.4.6 was checked at 375 rpm instead of 400 rpm. Since the output was above the .7 volts peak to peak at the lower speed the voltage would have been also been above the minimum voltage at the higher speed. Test point 3.4.6 checks the maximum voltage at high speed. This point was checked at 4317 rpm instead of 3904 rpm. Since the voltage was below the maximum at the higher speed, it would be below the maximum at the speed required by the test specification.

Testing showed the unit operated within test specification except for the test point 3.4.1a which was within 3 rpm of the test specification limits.

**ROOT CAUSE (D4)**

Investigation Type: Product Return
General Cause: No Problem Found
Cause: No Problem Found or Identified
Root Cause: Unit operated properly when functionally tested

**CORRECTIVE ACTION PLAN (D5)**

Corrective Action: No corrective action required

**CORRECTIVE ACTION IMPLEMENTATION (D6)**

Corrective Action Status: CLOSED