

Communication Summary

12/18/2014 and 1/5/2015

Information From: Inspector Steven Levine, BDL FSDO



Summary & Factual Information:

Inspector Levine indicated that party members met at Triumph Engine Control Systems to investigate an Electronic Engine Control that was installed on the engine installed in N373RL involved in an incident on 11/24/2014. The Electronic Control Unit (ECU) EMC-35R (Triumph part number 1152202A5-24) serial number JG8ALK0486, had already been received into Triumph's Repair Station (SF3R839L) under customer purchase order 27456, sales order number 523710. There was no chain of custody from the field to Triumph. The team went out to the electronics shop to see the ECU. Visual observation revealed no physical damage, both tamper seals were in tack. Nick Zannetos, a Triumph technician from the Repair Station, was assigned to do all work during the investigation. The following is a summary of Inspector Levine's findings from the examination:

Sales Order Number: 523710
Work Order Number: 809499
Part Number: 115220-2A5-24
Serial Number: JG8ALK0486

Started check and test on the morning of December 17, 2014 with the following steps:

- 1) Extracted fault history
- 2) Performed bonding check (PASSED)
- 3) Performed pressure test (FAILED)
 - a. Pressure measurements were consistently 0.5 psi below the input pressure (0.1 psi below the lower test limit)
- 4) Performed incoming Acceptance Test Procedure (ATP) (PASSED)
- 5) Performed 5 minute vibration test (PASSED)
- 6) Replaced seals in test equipment and performed pressure test again (FAILED)
 - a. Pressure measurements were consistently 0.5 psi below the input pressure (0.1 psi below the lower test limit)
- 7) Performed a check of the primary channel 5V power supply (FAILED)
 - a. Power supply voltage measurement was 4.93V (0.12V below the lower limit for the check)
- 8) Performed three cycle Environmental Stress Screen (ESS) (FAILED)
 - a. Test of an open circuit condition on the WFMV input failed during the high temperature portion of the ESS. The measured value was slightly out of tolerance.

Completed check and test on the afternoon of December 18, 2014.

Regarding the pressure test failure, this is a test of the ambient pressure sensor in the ECU. The 0.5 psi deviation from the nominal value equates to a delta altitude of approximately 1000 ft. So if the ECU 'thinks' that it is 1000 ft higher in altitude than it actually is, it will operate with a slightly lower acceleration schedule. So it will take slightly longer to go from one engine power setting to a higher setting. Also, the maximum fuel flow limit would be about 5% lower than it normally would be for that altitude. Since the ECU failed the pressure test, the sensor has been recalibrated. The pressure test was

performed again after the sensor calibration and the ECU passed. The ESS also checks the pressure sensor measurements and there were no issues during the ESS related to the pressure measurements.

Regarding the 5V power supply check, power supplies that are below the lower limit are susceptible to intermittent resets of the primary channel. A reset of the primary channel would result in the reversionary channel taking control and a primary hard fault being declared.

Regarding the ESS failure, this is a test of an open circuit condition at the WFMV (metering valve fuel flow position) input to the ECU. This failure is attributable to moisture infiltration into the ECU flex circuit. Since the ECU is not a hermetically sealed box, the flex circuit material will absorb moisture over time resulting in small amounts of current leakage in the circuit and the failure observed during ESS. The normal production process is to bake the unit to remove the moisture. This bake out process has always resolved the particular ESS failure on previous units.

I can attest that the above summary is correct to the best of my knowledge:

Edward F. Malinowski
National Transportation Safety Board
Air Safety Investigator