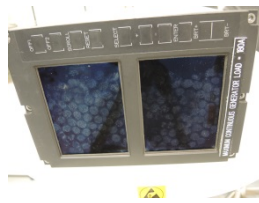


Technical document

VEMD, DECU and Harness examination

Document ID: **BEA_n-ae140118_tec01**
Date of occurrence: 18/01/2014
Place of occurrence: Houlton (United States)
Aircraft type: AS 350 B3
Registration number: **N578AE**
Equipments examined:

VEMD Thales P/N : B19030SA02 S/N : 1634	DECU Thales P/N : 70BMB01020 S/N : 366	Harness
		

Note: These avionics computers are not flight data recorders as installed on some aircraft. The data are only recorded for maintenance purposes.

The DECU is a dual channel digital control unit performing fuel regulation, engine parameters management and failure recording. On each channel (or module), an internal 32 kB EEPROM stores dated failure blocks.

The VEMD is a multifunction screen installed on the instrument panel and designed to manage essential and non-essential vehicle and engine data. The VEMD is a dual channel system. In each channel (or module), an internal 32 kBytes EEPROM stores failure information and data.

The relevant VEMD data for accident investigations are:

- Flight reports,
- Failure messages with associated dated parameters,
- Over-limit reports (not dated).

Work performed:

• **VEMD**

The VEMD was powered up and read-out on the helicopter. Afterwards it was sent to the BEA.

The VEMD was in good condition. The two main internal boards were visually inspected under magnification. Both boards were in good condition. The computer was powered up on the Airbus Helicopters bench in accordance with the BEA/Airbus Helicopters procedure. All the data recorded by the VEMD were directly displayed on its screens and were photographed.

- **DECU**

The computer was successfully read out on the USA Turbomeca test bench. Data showed that a stepper motor failure was recorded. In that case, the fuel control system would trigger a “GOV” red warning. That warning was reported by the pilot.

The computer was sent to the BEA for additional functional testing.

The functional tests consisted in:

- board inspection at BEA,
- tests on specific test rig at Turbomeca facilities,
- ATP tests at Thales facilities (DECU manufacturer).

- **Harness between the DECU, the stepper motor and the resolver**

The harness was visually inspected at BEA. Severe fire damage was observed. It was tested on the Turbomeca bench in accordance with the Turbomeca procedure.

Results:

- **VEMD**

The data relative to the last recorded flight were associated to the flight numbered 2791 which lasted 1 h 10 min. 16 failures and several over-limits were recorded during this flight.

Note: Computation of VEMD flight duration begins when NG is above 10% or when NR is above 70 RPM and ends when NG is below 10% and NR is below 70 RPM.

Failures

The 16 failures were categorized into 3 groups:

- The two first failures (no identification label) occurred at the beginning of the flight and were not correlated to the event.
- The following 8 failures were recorded during the flight. They are summarized in the following table with their associated recorded parameters:

Time	Description	NG (%)	TRQ (%)	T4 (°C)	NF (RPM)
1 h 08 min 26 s	AUTO F MTR	89.4	63.3	653	385
1 h 08 min 56 s	INVAL NF-A	102.6	84	896	511
1 h 08 min 56 s	NF B	102.6	84	896	511
1 h 08 min 56 s	NF A	102.8	84	899	511
1 h 09 min 26 s	INVALID TRQ A	102.8	80.4	934	511
1 h 09 min 27 s	TRQ FADEC	102.6	46.4	934	511
1 h 09 min 49 s	OUT OF RNG EOP L	89.4	63.3	653	385
1 h 09 min 49 s	OUT OF RNG EOP R	89.4	63.3	653	385

The AUTO F MTR failure is a “stepper motor or resolver failure” and is associated the triggering of a “RED GOV” signal.

Note:

- *NF is the free turbine rotation speed (N2), computed in rotor rotation speed.*
- *NG is the gas generator rotor rotation speed.*
- *T4 is the temperature measured at the exit of the gas generator chamber.*

The last six failures (FAN FAILED L, FAN FAILED R, 2 BRIGHTNESS FAILED L, 2 BRIGHTNESS FAILED R) occurred at 1 h 49 min 49 s. They were probably recorded when the VEMD was powered up on the helicopter while the flight report had not been completed yet. They were identified as VEMD internal failures.

Over limits

Eight over-limits were recorded and cannot be dated:

- T4 MED over-limit that lasted 19 seconds. That indicates that the T4 MED temperature threshold would have reached values above 865°C during the starting phase or values between 915°C and 941°C during the flight phase.
- T4 HI over-limit that lasted 8 seconds and reached values above 941 °C.
- NG TRA over-limit that lasted 40 seconds and reached a value of 104 %.
- NF TRA over-limit that lasted 25 seconds and reached a value of 510 RPM.
- 4 NR over limits which maximum value reached 496 RPM.

• DECU

Board inspection at BEA

The DECU was in good condition. The two main internal boards were visually inspected under magnification at BEA. Both boards were in good condition.

Tests on specific test rig

They were performed on the Turbomeca test bench in Bordes.

The DECU's stepper motor function was checked at different temperatures on a specific test rig at Turbomeca facilities. The following tests were performed:

- At room temperature (+ 20 °C / + 68 °F).
- At - 40 °C (- 104 °F).
- At + 50 °C (+ 122 °F).

An additional test was performed on a forced vibration table at room temperature (+ 20 °C / + 68 °F for 15 minutes.

No fault was found during all the tests. The stepper motor failure could not be repeated on the specific test rig.

ATP tests

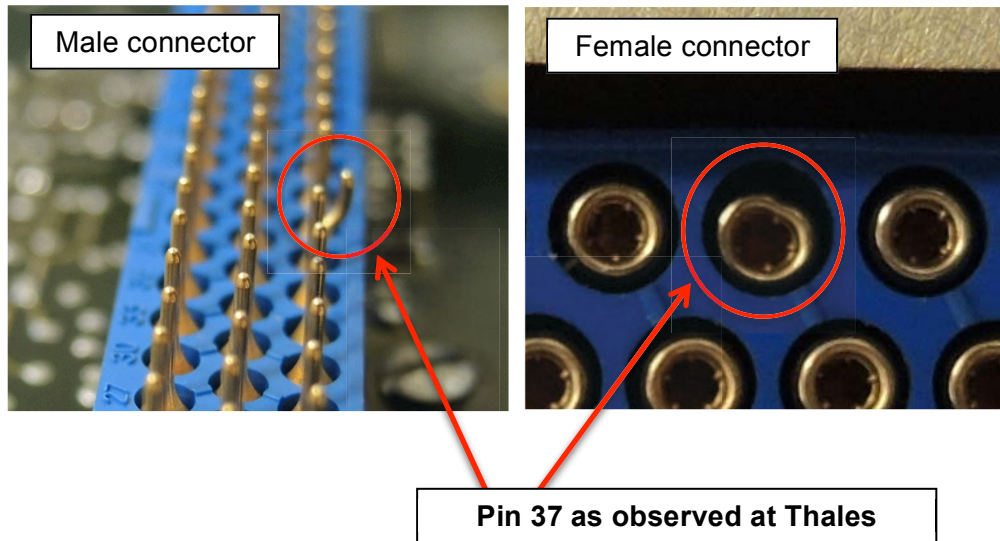
The ATP tests performed were conducted at Thales facilities in Chatellerault. The DECU was found compliant with all the manufacturer specifications.

Supplemental information related to pin 37 of the DECU

An internal visual inspection of the DECU was performed by Thales after the ATP tests. It showed that the pin 37 of J11 male connector was bent as a “bayonet”.

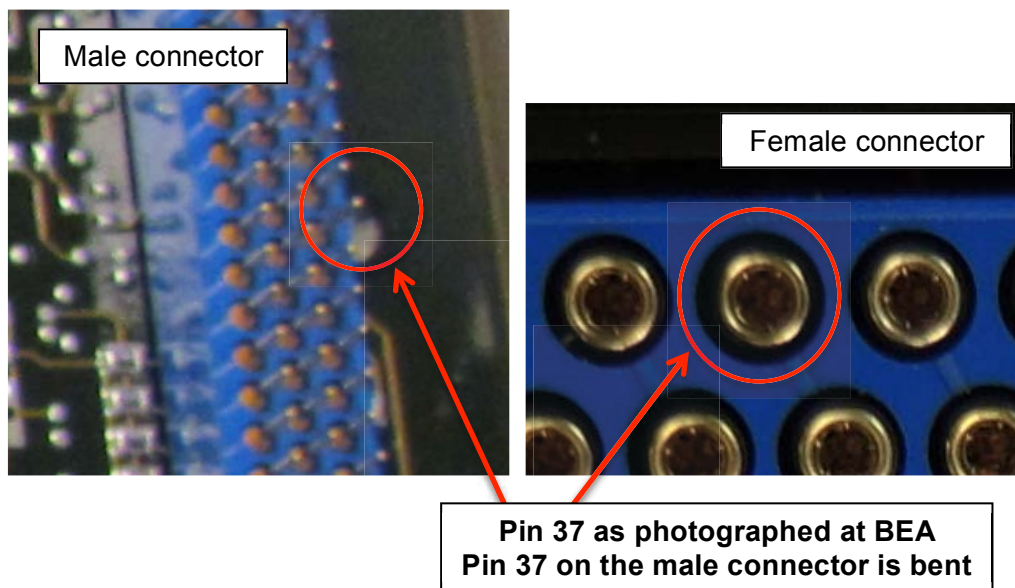
The pin 37 of J11 connector is connected to the red light which indicates a red GOV signal.

Picture taken during the visual inspection performed at Thales on 06/23/2014



Pictures taken during visual inspection at BEA on 03/28/2014

During the boards inspection at the BEA, some photos of these connectors were taken. The condition of the pin 37 had not been initially observed. A review of the pictures was done by BEA after the visual inspection at Thales.



The pins 37 of the male and female connector were found more damaged during the visual inspection at Thales than it was during the visual inspection performed at BEA. That indicates that the fact that the pin 37 of J11 male connector was bent as a "bayonet" directly resulted from the reassembly performed at BEA after the visual inspection.

According to the manufacturers (Turbomeca and Thales), pin 37 was initially correctly installed and that all the damages probably resulted from the BEA visual inspection.

- **Harness**

The electrical connection between the DECU, the stepper motor and the resolver of this harness was tested using the Turbomeca repair shop's test rig. No fault was found.

The tests were also manually performed without any fault (the cables was bent and twisted manually).

Conclusion:

The event flight was identified in the recorded data on the DECU and VEMD computers. A failure related to the step motor resolver was recorded by both computers. That failure is associated to a red GOV signal triggering which was reported by the pilot after the event.

Based on the VEMD, DECU and Harness examination, the root cause of this failure could not be determined and/or repeated.

The reports issued by Turbomeca (T14-CRA0144A-2 (N578AE).pdf), Thales (ASW-14-002154 -ir 00 DECU SN 366 Expertise Report.pdf) and Eurocopter (AS_350_B2_SN_3_16_-_VEMD_Reading_et_Analysis_Report.pdf) will be provided to the Investigator-in-Charge.