

7th November 2018

National Transportation Safety Board
(NTSB)
490 L'Enfant Plaza SW
Washington D.C.
USA

CA037/18/D2S/TEA

To whom it may concern,

In the frame of the investigation on the accident of the EC130T2 helicopter, registered N11VQ, that occurred on January 17th, 2016 in Hawaii, Safran Helicopter Engines (formerly known as Turbomeca) produced the following documents:

- A-2016-001 Kauai HI Onsite Investigation Report V1.pdf
- A-2016-001 Blue Hawaiian Engine Exam.pdf
- N11VQ - Blue Hawaiian Engine Exam Disassembly.pdf
- N11VQ accident_SafranHE investigation complement.pdf
- N11VQ - Ruptured pipe - Additional examinations & Analyses - (update 20Dec.2017).pdf

These documents contain footnotes that place restrictions on the disclosure or use by third parties of the documents or their contents.

On request from NTSB, Safran Helicopter Engines agrees to add the 5 documents here above to NTSB's public docket for this event.

Sincerely




Raphaël SPAGNA

Head of Accidents Investigation Team

INVESTIGATION REPORT	Preliminary <input type="checkbox"/> Final <input checked="" type="checkbox"/>
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Accident **Incident**

Reference	RA 2016-010	Commercial File	N/A
Accident / Incident report	A-2016-001 / WPR16LA55	Preliminary Information report A	N/A

Data				
Date of occurrence	Occurrence place	Operator		
17JAN2016	Kauai, Hawaii, USA	Blue Hawaiian Helicopters		
Aircraft type		S/N	Registration	
EC130T2		8070	N11VQ	
Engine type		S/N	TSN	TSO
Arriel 2D		50708	687.8	N/A
Accessories				
Designation, P/N	S/N	Work performed	TSN	TSO
Engine Data Rec. P/N:9580118410	00965	Download	N/A	N/A
Circumstances reported to TURBOMECA				
<p>The pilot reported that, due to a power loss and the low rotor horn, he performed an autorotation which resulted in a hard landing.</p>				
Conclusion				
<p>Vibration testing conducted on the test bench included both the aircraft starter involved in the accident (P/N 524-031 S/N 5493) and test cell starter (P/N 524-031 S/N 3808).</p> <p>The accident starter resulted in significantly higher vibration and visible oscillation of the fuel injection pipe.</p>				

VALIDATION		APPROVAL	
DATE		DATE	
01MAR2016	D2S/TEA		

SUMMARY

1 HISTORY

1.1 TECHNICAL DOCUMENTATION

Maintenance:

Date	TSN (TSO)	Task	Operated by	Remarks
6Jan2016	627.2	150HR/12MOS Insp.	Blue Hawaiian	Starter not removed

Remarks:

Modular composition:

Modules	S/N	TSN	TSO	CSN	CSO	Remarks
70BMO10020	19710	687.8	N/A	N/A	N/A	
70BMO20010	20781	687.8	N/A	N/A	N/A	
70BMO30070	33044	687.8	N/A	N/A	N/A	
70BMO40020	24781	687.8	N/A	N/A	N/A	
70BMO50010	22779	687.8	N/A	N/A	N/A	
Items	P/N	S/N	Remarks			
HMU	0292862200	2684				

1.2 UPDATED CIRCUMSTANCES (NTSB PRELIMINARY REPORT)

On January 17, 2016, about 1430 Hawaii standard time, an Airbus EC130 T2, N11VQ, landed hard on a beach 2 miles west of Hanalei on the Hawaiian island of Kauai after a reported loss of engine power.

The commercial pilot and 2 passengers sustained minor injuries, and 4 passengers were seriously injured. The helicopter sustained substantial damage to the tailboom and airframe. The helicopter was registered to Nevada Helicopter Leasing LLC, operated by Blue Hawaiian Helicopters under the provisions of 14 Code of Federal Regulations, Part 135, and was conducting an air tour flight at the time of the accident. Visual meteorological conditions prevailed for the flight, and a company visual flight plan had been filed. The local flight originated in Lihue at 1406.

The pilot reported that he was about 1/4 mile off shore northwest of Honopu Sea Arch at 1,300 feet mean sea level (msl) when he heard the low rotor rpm aural warning horn. He immediately entered an autorotation and turned towards the beach. He transmitted over the radio that he had an engine failure. As he approached the shoreline he made a right turn to the south and landed hard on the beach. He applied the rotor brake to slow the rotor, and at that time he noted that the engine was not running. The passengers began to exit and he pulled the engine fuel cutoff.

Updated on Jan 21 2016 5:39PM

1.3 RESULTS OF FIELD INVESTIGATION (ACCIDENT)

- The helicopter had been recovered to a secure hangar previous to the examination.
- All fuel, oil, and air connections between airframe and engine were properly connected, tight, and saftied.
- The only visible damage to the engine were small dents in the linking tube at the rear mount consistent with a hard landing in a vertical direction.
- The gas generator and free turbine both turned easily by hand.
- Proper freewheel operation was confirmed. Continuity was confirmed from the free turbine to the main rotor. Continuity was also confirmed from the gas generator to the starter gear of the accessory gearbox.
- The fuel injection line between the adjusted valve and injection union could be moved away from the b-nut indicating a break of the line underneath the b-nut. The b-nut was removed using a calibrated torque wrench.
- The break-away torque of the b-nut was 126.4 in lbs indicating the nut had been properly torqued. A break of the line was discovered approximately 1/2 - 1 mm from the flare. The line was removed and sent to the NTSB lab for metallurgical analysis.
- The starter generator was removed revealing a large amount of black greasy liquid. The operator indicated that this was unusual to what they normally see.
- The engine and starter were removed and shipped to Turbomeca USA for examination on the test cell. The VEMD, DECU, and EDR were also removed for examination at the same time as the engine. A separate report will be issued for these examinations.

2 REVIEW OF INVESTIGATION

Description of equipment	P/N S/N	Date of review	Work performed	In the presence of
Arriel 2D	02902020030	4,5FEB2016	Test Cell run	NTSB

2.1 ENGINE EXAMINATION

2.1.1 Findings on arrival

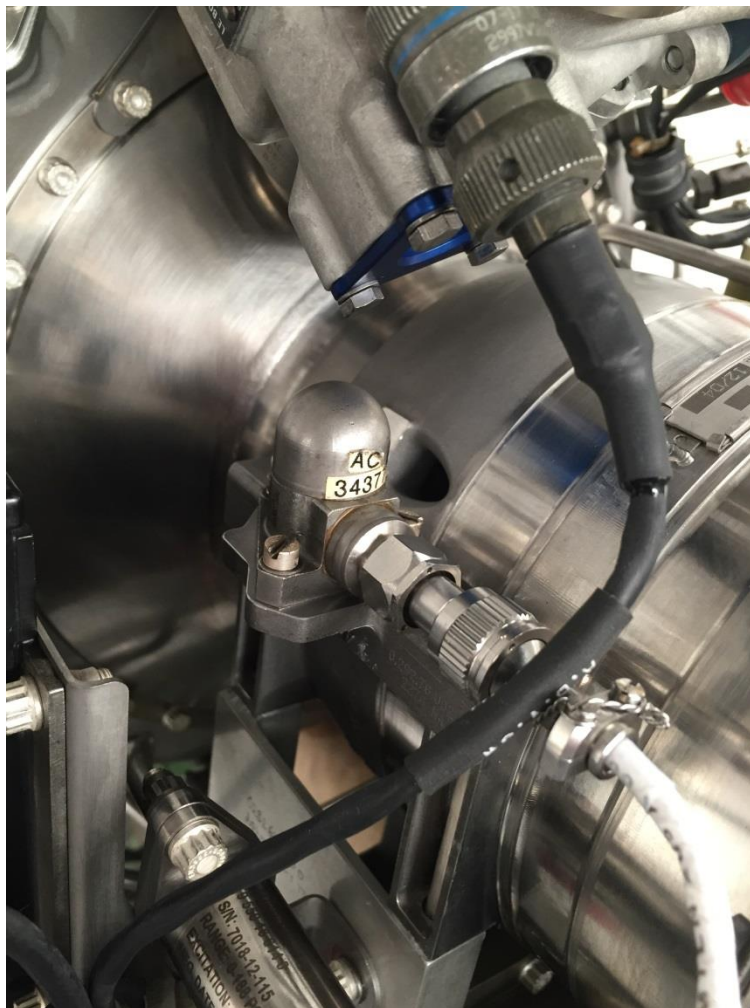
The engine was removed from the crate. A new fuel injection pipe was installed p/n 0292737310. The engine was boroscoped and the results were normal. The accident starter was removed to obtain a sample of the black greasy liquid on the starter pad and then reinstalled. The engine was then installed on the test bench.

2.1.2 Engine testing

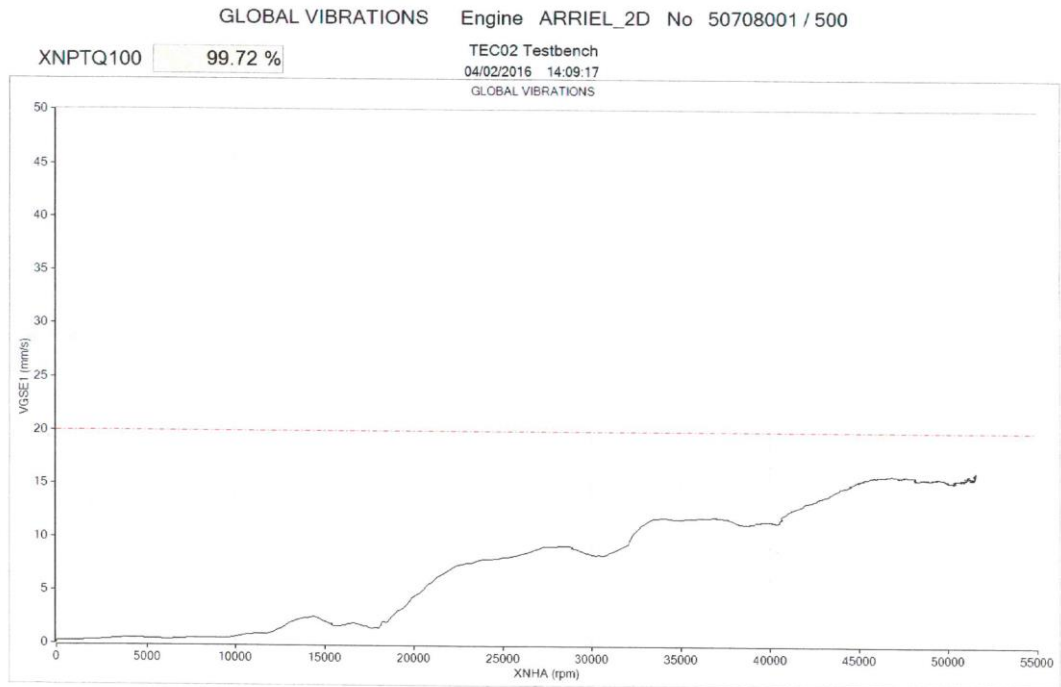
For the purpose of this report the accident starter s/n 5493 will be referred to as accident starter and the test bench starter s/n 3808 will be referred to as shuttle starter.

OEM Vibration Test:

The vibration sensor used in the test bench (CA135) was mounted on the front mounting pad as shown in picture. The engine was first started using the accident starter. An unusual noise and vibration was immediately identified by the test cell operator however the test bench vibration levels were within limits of the TM maintenance manual (15, 6 mm/s measured for a maximum value of 20 mm/s). At both ground idle and flight idle the fuel injection pipe could be observed oscillating for and aft. All preliminary tests were performed (leak check, oil pressure, vib limit etc.). A vibration check was performed from 0 – 99.72% Ng. The engine was shut down and the shuttle starter was installed. A vib check was performed from 0 – 98.36% Ng. The engine was shut down again to complete the prescribed vibration test in accordance with the OEM test manual, by performing the bevel gear vibration check. The shuttle starter remained installed for this test. The test requires 3 checks, each between 4000 and 7000 rpm of the gas generator with a limit of 20g. The results were 1.21g, 1.31g, and 1.17g.

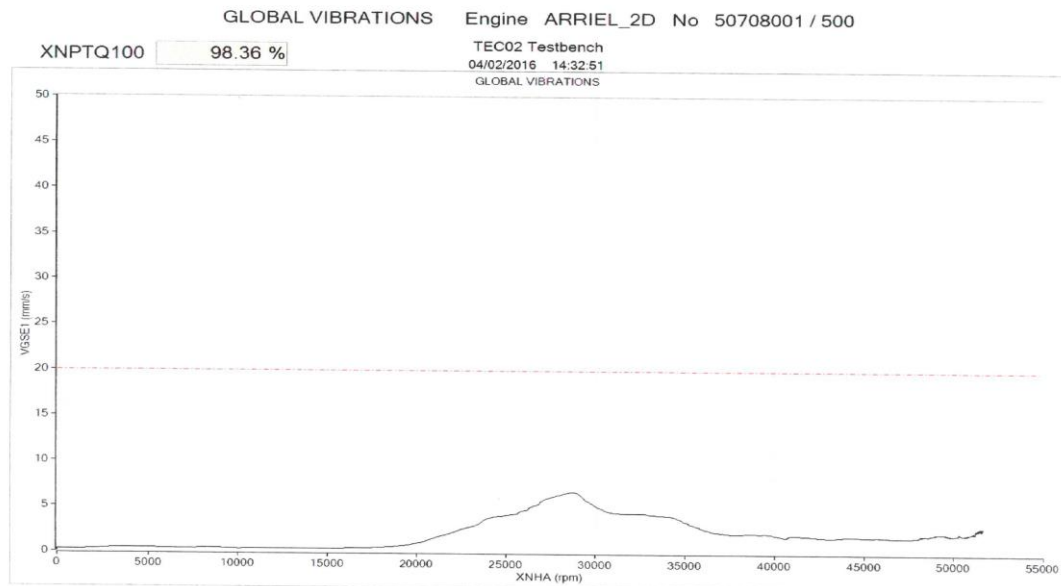


OEM vibration sensor mounting example



524-03) ACCIDENT STARTER

Global vibration results with accident starter installed.

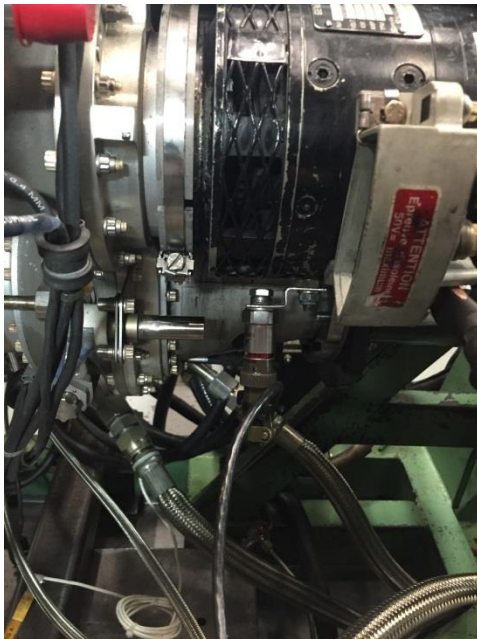


524-03) TEST CELL STARTER

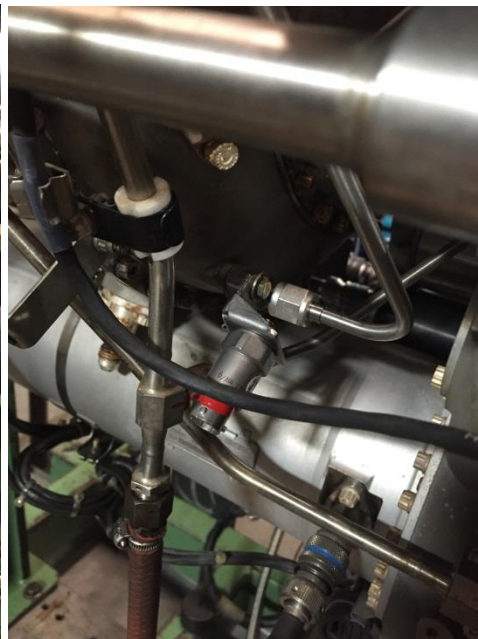
Global vibration results with shuttle starter installed.

Additional tests performed

05FEB2016: Microvib equipment from Airbus Helicopters Inc. was installed on both the starter and injection union to establish a baseline between the shuttle starter and accident starter. It should be noted that this test, mounts, and equipment is not an established procedure and was developed strictly for the purposes of the investigation. The results of these tests have to be considered with care and are for information only. The test was done with the two pipes that are qualified on this engine variant i.e. 0292737310 (originally certified on Arriel 2B and 2B1 and qualified post-certification on Arriel 2D) and 0292730350 (originally certified with the Arriel 2D). The graphs show that there is no significant difference between the two pipes in terms of vibration levels. The graphs also show that there is a significant increase in vibration levels with the accident starter-generator both at starter-generator level and at injection union level.



Starter mount



Injection union mount

Readings were taken at both the starter and injection union in the following configurations:

1. GI / Shuttle starter / Inj pipe p/n 0292737310 @ Starter mount
2. FI / Shuttle starter / Inj pipe p/n 0292737310 @ Starter mount
3. GI / Shuttle starter / Inj pipe p/n 0292737310 @ Injection union mount
4. FI / Shuttle starter / Inj pipe p/n 0292737310 @ Injection union mount

5. GI / Accident starter / Inj pipe p/n 0292737310 @ Starter mount
6. FI / Accident starter / Inj pipe p/n 0292737310 @ Starter mount
7. GI / Accident starter / Inj pipe p/n 0292737310 @ Injection union mount
8. FI / Accident starter / Inj pipe p/n 0292737310 @ Injection union mount

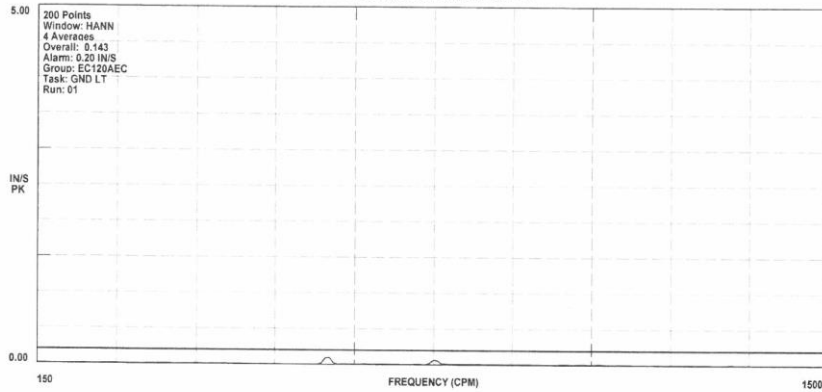
9. GI / Accident starter / Inj pipe p/n 0292730350 @ Starter mount
10. FI / Accident starter / Inj pipe p/n 0292730350 @ Starter mount
11. GI / Accident starter / Inj pipe p/n 0292730350 @ Injection union mount
12. FI / Accident starter / Inj pipe p/n 0292730350 @ Injection union mount

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---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 10:33:46 OPER: Troy Ham
 A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: GND LT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
2493.2	0.011	0.200	OK	---	5590.7	0.107	0.200	OK	---
5265.8	0.010	0.200	OK	---	7603.9	0.072	0.200	OK	---
8002.6	0.012	0.200	OK	---	8442.9	0.013	0.200	OK	---
9342.9	0.010	0.200	OK	---	10012.5	0.013	0.200	OK	---
10386.4	0.014	0.200	OK	---	10699.6	0.012	0.200	OK	---

--- OPERATOR COMMENTS ---

#1 Ground Idle, 1st take, exemplar gen
 GIGEN1.SPC 02/05/2016 10:34:12

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

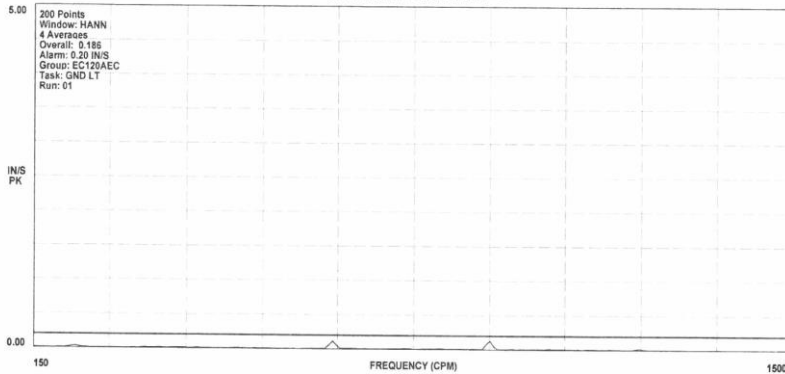
1. Shuttle starter @ starter mount with 0292737310 pipe ground idle

American Eurocopter LLC - Grand Prairie, TX Printed: Fri Feb 05 13:23:16 2016

---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 10:38:10 OPER: Troy Ham
 A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: GND LT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
948.7	0.028	0.200	OK	---	2346.8	0.014	0.200	OK	---
2585.7	0.013	0.200	OK	---	2863.0	0.015	0.200	OK	---
3000.0	0.013	0.200	OK	---	3324.1	0.012	0.200	OK	---
5997.4	0.116	0.200	OK	---	6974.8	0.013	0.200	OK	---
9063.0	0.126	0.200	OK	---	11997.4	0.020	0.200	OK	---

--- OPERATOR COMMENTS ---

#2 Flight Idle, 1st take, exemplar gen
 FIGEN1.SPC 02/05/2016 10:38:34

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

2. Shuttle starter @ starter mount with 0292737310 pipe flight idle

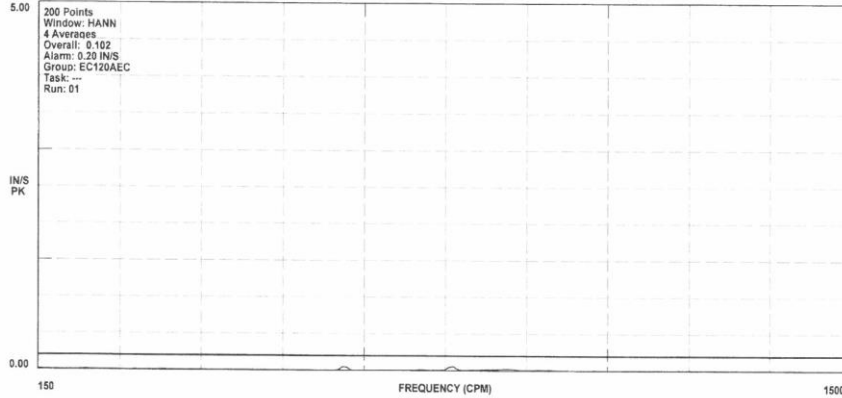
American Eurocopter LLC - Grand Prairie, TX

Printed: Fri Feb 05 13:23:02 2016

---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 10:35:52 OPER: Troy Ham
 A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: ---

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
1001.0	0.010	0.200	OK	---	5731.2	0.052	0.200	OK	---
7145.9	0.011	0.200	OK	---	7702.1	0.062	0.200	OK	---
8100.0	0.010	0.200	OK	---	8359.4	0.016	0.200	OK	---
8625.0	0.019	0.200	OK	---	8738.5	0.023	0.200	OK	---
9264.3	0.013	0.200	OK	---	9489.6	0.009	0.200	OK	---

--- OPERATOR COMMENTS ---

#3 Ground Idle, 1st take, fuel line location, exemplar gen
 G1FUEL1.SPC 02/05/2016 10:36:20

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

3. Shuttle starter @ injection union mount with 0292737310 pipe ground idle

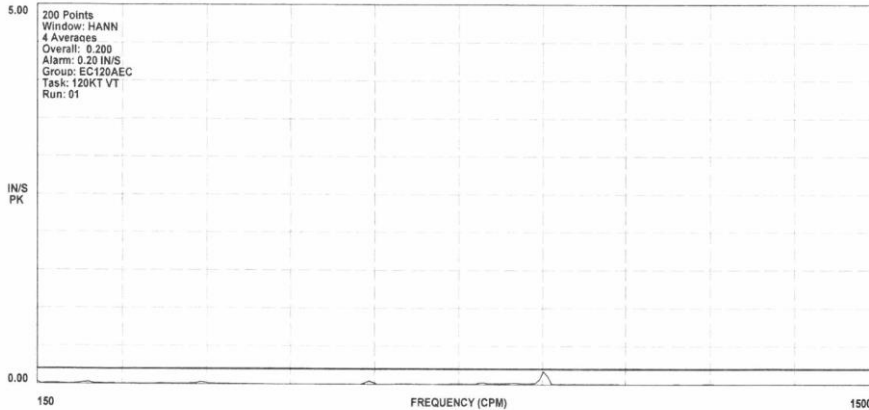
American Eurocopter LLC - Grand Prairie, TX

Printed: Fri Feb 05 13:23:42 2016

---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 10:41:18 OPER: Troy Ham
 A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: 120KT VT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
414.9	0.014	0.200	OK	---	1023.3	0.031	0.200	OK	---
1446.9	0.012	0.200	OK	---	2351.7	0.012	0.200	OK	---
3029.1	0.031	0.200	OK	---	6000.3	0.045	0.200	OK	---
7994.7	0.027	0.200	OK	---	8524.5	0.022	0.200	OK	---
8850.0	0.014	0.200	OK	---	9051.1	0.173	0.200	OK	---

--- OPERATOR COMMENTS ---

#4 Flight Idle, 2nd take, fuel line, exemplar gen
 F1FUEL2.SPC 02/05/2016 10:41:50

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

4. Shuttle starter @ injection union mount with 0292737310 pipe flight idle

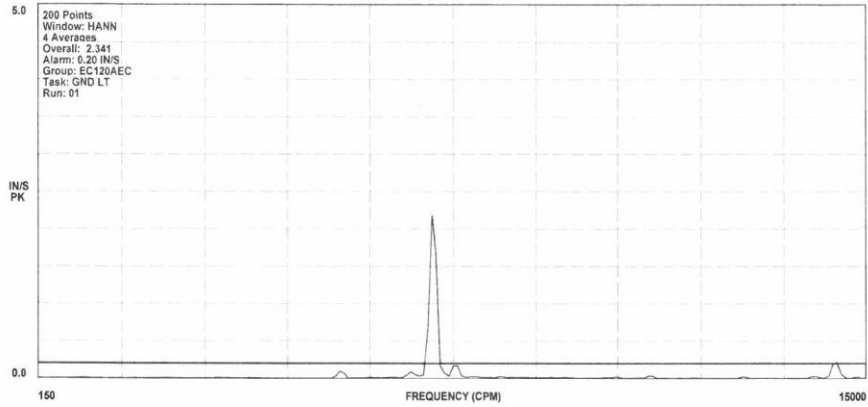
American Eurocopter LLC - Grand Prairie, TX

Printed: Fri Feb 05 13:24:09 2016

---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 11:07:00 OPER: Troy Ham
 A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: GND LT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
5584.9	0.099	0.200	OK	---	8833.7	0.092	0.200	OK	---
7222.8	2.315	0.200	-WARN-	---	7614.1	0.201	0.200	-WARN-	---
7915.8	0.027	0.200	OK	---	8426.1	0.028	0.200	OK	---
10526.1	0.022	0.200	OK	---	11135.9	0.041	0.200	OK	---
14956.0	0.034	0.200	OK	---	14447.3	0.239	0.200	-WARN-	---

--- OPERATOR COMMENTS ---

#5 Ground idle, 1st take, accident gen
 GIGEN1V.SPC 02/05/2016 11:07:24

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

5. Accident starter @ starter mount with 0292737310 pipe ground idle

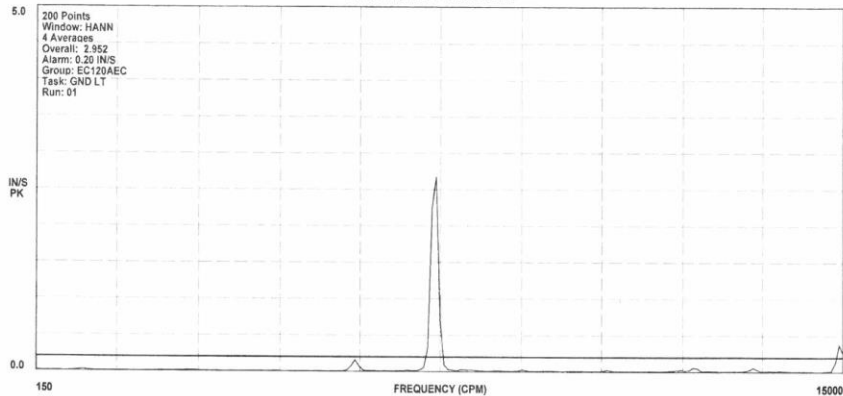
American Eurocopter LLC - Grand Prairie, TX

Printed: Fri Feb 05 13:24:26 2016

---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 11:08:54 OPER: Troy Ham
 A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: GND LT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
5998.5	0.157	0.200	OK	---	7472.2	2.924	0.200	-WARN-	---
7981.0	0.031	0.200	OK	---	8175.0	0.020	0.200	OK	---
9082.4	0.027	0.200	OK	---	10659.9	0.026	0.200	OK	---
11981.8	0.027	0.200	OK	---	12252.8	0.064	0.200	OK	---
13352.9	0.059	0.200	OK	---	14925.0	0.374	0.200	-WARN-	---

--- OPERATOR COMMENTS ---

#6 Flight idle, 1st take, accident gen
 FIGEN1V.SPC 02/05/2016 11:09:16

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

6. Accident starter @ starter mount with 0292737310 pipe flight idle

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Printed: Fri Feb 05 13:23:49 2016

---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 11:04:24

OPER: Troy Ham

A/C:

Mdl: 2D

S/N: 8070

Misc:

Hrs: 0.0

Cmp:

Mdl:

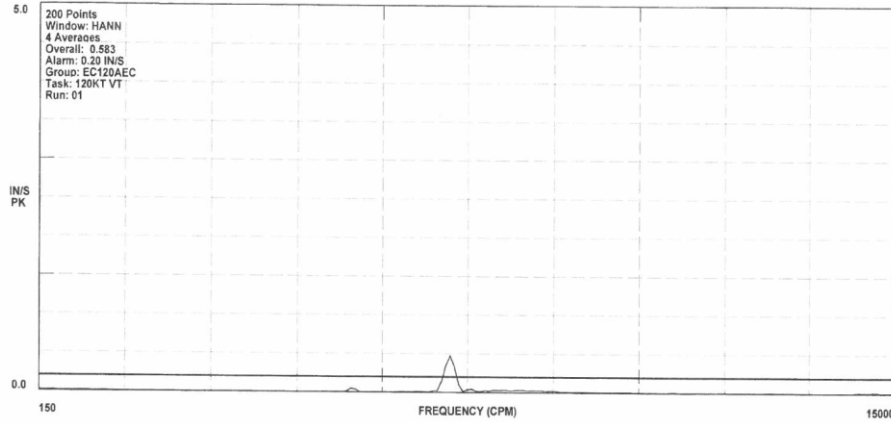
S/N: N/A

Misc:

Hrs: 0.0

Group: EC120AEC Task: 120KT VT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
5574.0	0.050	0.200	OK	---	7253.9	0.496	0.200	-WARN-	---
7618.5	0.047	0.200	OK	---	7575.0	0.024	0.200	OK	---
8025.0	0.029	0.200	OK	---	8211.0	0.035	0.200	OK	---
8439.0	0.036	0.200	OK	---	8700.0	0.028	0.200	OK	---
8850.0	0.023	0.200	OK	---	9000.0	0.021	0.200	OK	---

--- OPERATOR COMMENTS ---

7 Ground Idle, 1st take, fuel line location, accident gen
GIFUEL1V.SPC 02/05/2016 11:05:06

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

7. Accident starter @ injection union mount with 0292737310 pipe ground idle

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Printed: Fri Feb 05 13:36:44 2016

---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 11:10:38

OPER: Troy Ham

A/C:

Mdl: 2D

S/N: 8070

Misc:

Hrs: 0.0

Cmp:

Mdl:

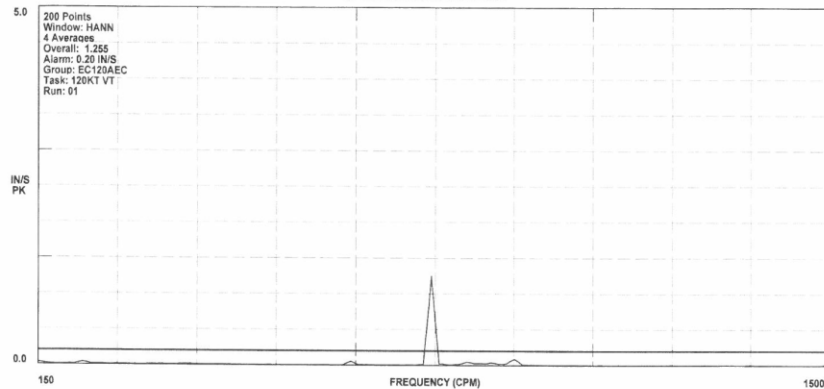
S/N: N/A

Misc:

Hrs: 0.0

Group: EC120AEC Task: 120KT VT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
150.0	0.033	0.200	OK	---	750.0	0.013	0.200	OK	---
997.7	0.040	0.200	OK	---	2972.4	0.015	0.200	OK	---
5996.3	0.053	0.200	OK	---	7500.0	1.250	0.200	-WARN-	---
8200.9	0.051	0.200	OK	---	8400.0	0.027	0.200	OK	---
8649.3	0.039	0.200	OK	---	9056.8	0.091	0.200	OK	---

--- OPERATOR COMMENTS ---

8 Flight Idle, 1st take, fuel line location, accident generator
FIFUEL1V.SPC 02/05/2016 11:11:10

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

8. Accident starter @ injection union mount with 0292737310 pipe flight idle

American Eurocopter LLC - Grand Prairie, TX

Printed: Fri Feb 05 13:25:29 2016

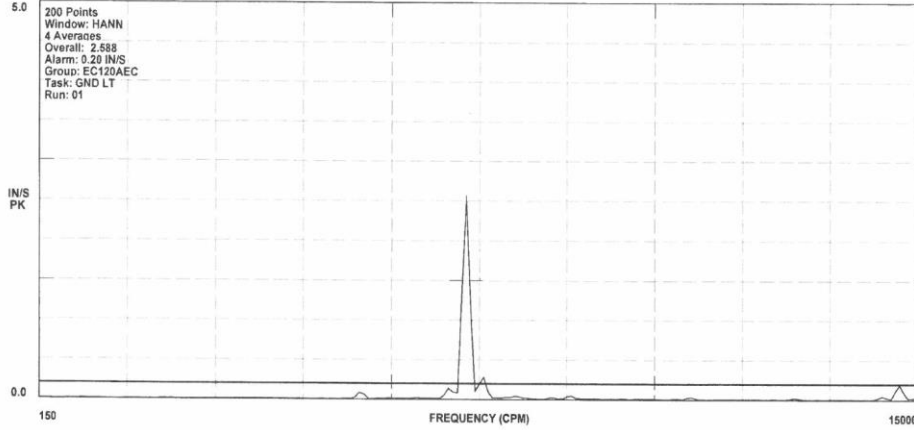
---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 11:31:30

OPER: Troy Ham

A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: GND LT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
5571.6	0.089	0.200	OK	---	7065.4	0.144	0.200	OK	---
7348.1	2.588	0.200	-WARN-	---	7630.0	0.291	0.200	-WARN-	---
8025.0	0.029	0.200	OK	---	8201.3	0.050	0.200	OK	---
9122.1	0.053	0.200	OK	---	11148.7	0.035	0.200	OK	---
14410.8	0.045	0.200	OK	---	14692.2	0.193	0.200	OK	---

--- OPERATOR COMMENTS ---

#9 Ground Idle, 1st take, accident gen, fat fuel line
 GIGN1VFT.SPC 02/05/2016 11:32:20

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

9. Accident starter @ starter mount with 0292730350 pipe ground idle

American Eurocopter LLC - Grand Prairie, TX

Printed: Fri Feb 05 13:25:39 2016

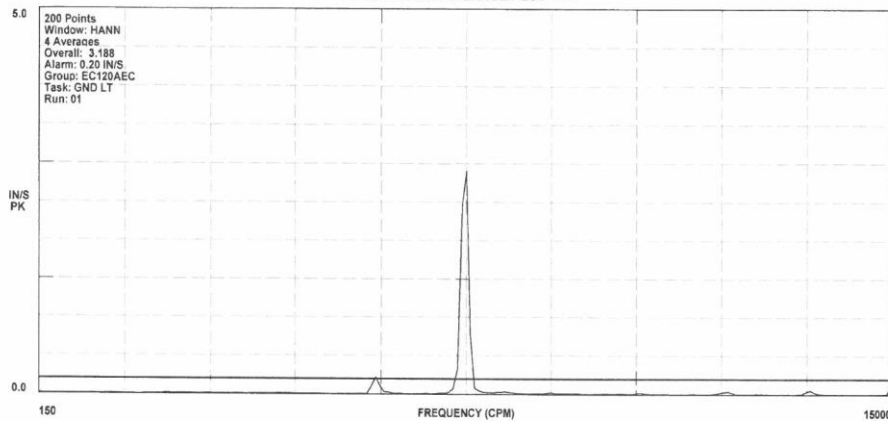
---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 11:34:12

OPER: Troy Ham

A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: GND LT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
5988.3	0.220	0.200	-WARN-	---	7125.0	0.013	0.200	OK	---
7547.0	3.179	0.200	-WARN-	---	8228.3	0.038	0.200	OK	---
8063.3	0.022	0.200	OK	---	8495.4	0.016	0.200	OK	---
10001.4	0.013	0.200	OK	---	10604.6	0.021	0.200	OK	---
12125.2	0.043	0.200	OK	---	13559.5	0.058	0.200	OK	---

--- OPERATOR COMMENTS ---

#10 Flight Idle, 1st take, accident gen, fat fuel line
 FIGN1VFT.SPC 02/05/2016 11:34:46

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

10. Accident starter @ starter mount with 0292730350 pipe flight idle

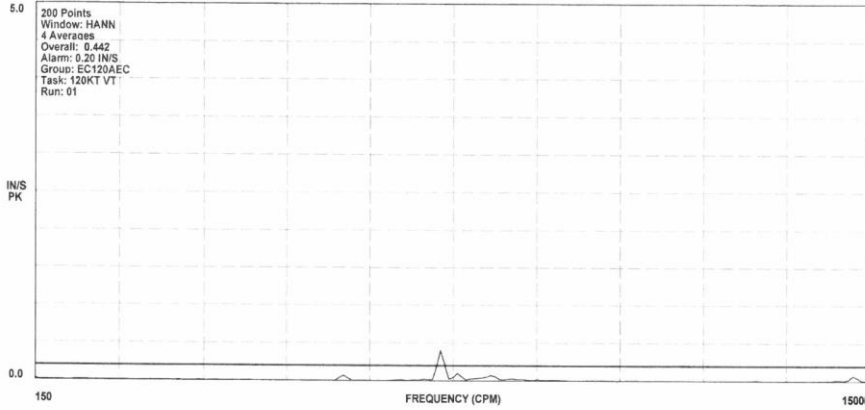
American Eurocopter LLC - Grand Prairie, TX

Printed: Fri Feb 05 13:40:26 2016

---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 11:29:16 OPER: Troy Ham
 A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: 120KT VT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
5620.4	0.067	0.200	OK	---	7063.9	0.021	0.200	OK	---
7355.9	0.401	0.200	-WARN-	---	7635.9	0.098	0.200	OK	---
8270.7	0.078	0.200	OK	---	8601.5	0.031	0.200	OK	---
9097.1	0.018	0.200	OK	---	9340.3	0.015	0.200	OK	---
14426.2	0.017	0.200	OK	---	14716.6	0.073	0.200	OK	---

--- OPERATOR COMMENTS ---

#11 Ground Idle, 1st take, fuel location, accident gen, fat fuel line
 GFL1VFT.SPC 02/05/2016 11:29:56

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

11. Accident starter @ injection union mount with 0292730350 pipe ground idle

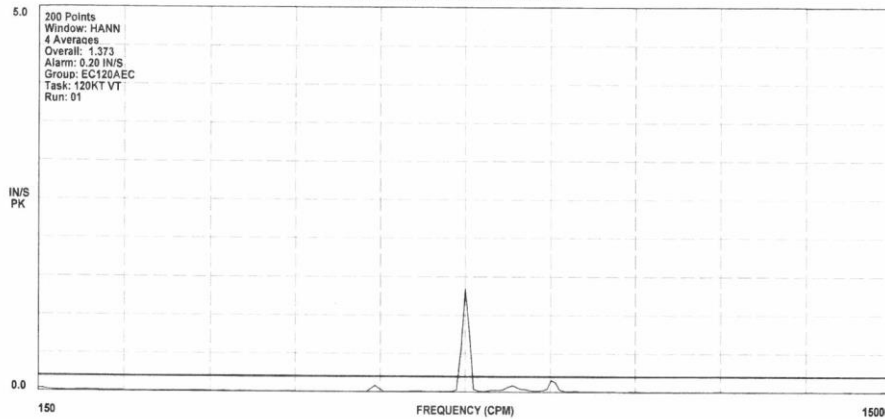
American Eurocopter LLC - Grand Prairie, TX

Printed: Fri Feb 05 13:46:20 2016

---- MICROBASE SPECTRUM ANALYSIS REPORT ----

DATE: 02/05/2016 11:36:12 OPER: Troy Ham
 A/C: Mdl: 2D S/N: 8070 Misc: Hrs: 0.0
 Cmp: Mdl: S/N: N/A Misc: Hrs: 0.0
 Group: EC120AEC Task: 120KT VT

---- SPECTRUM AVERAGE PLOT ----



--- PEAK LISTING - 150 TO 15000 CPM ---

FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION	FREQ (CPM)	MAG (IN/S)	ALARM	STATUS	DESCRIPTION
1014.1	0.019	0.200	OK	---	1555.5	0.011	0.200	OK	---
2815.8	0.011	0.200	OK	---	5997.5	0.082	0.200	OK	---
6772.7	0.013	0.200	OK	---	7583.4	1.355	0.200	-WARN-	---
8100.0	0.023	0.200	OK	---	8378.9	0.092	0.200	OK	---
9102.6	0.168	0.200	OK	---	9484.2	0.014	0.200	OK	---

--- OPERATOR COMMENTS ---

#12 Flight Idle, 1st take, fuel line location, accident generator, fat fuel line
 FIF1VFT.SPC 02/05/2016 11:36:44

Printed By MicroBase Professional (2.01.1250) - Collected By MicroVib II (1.34.101.75) - SN:1454 - Cal:09/02/2015

12. Accident starter @ injection union mount with 0292730350 pipe flight idle



2.2 ADDITIONAL EXAMINATIONS

EDR Download: Refer to EDR report reference RA2016/010

INVESTIGATION REPORT	Preliminary <input type="checkbox"/> Final <input checked="" type="checkbox"/>
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Accident Incident

Reference	RA 2016-010	Commercial File	N/A
Accident / Incident report	A-2016-001 / WPR16LA55	Preliminary Information report A	N/A

Data				
Date of occurrence	Occurrence place	Operator		
17JAN2016	Kauai, Hawaii, USA	Blue Hawaiian Helicopters		
Aircraft type	S/N	Registration		
EC130T2	8070	N11VQ		
Engine type	S/N	TSN	TSO	
Arriel 2D	50708	687.8	N/A	
Accessories				
Designation, P/N	S/N	Work performed	TSN	TSO
Circumstances reported to TURBOMECA				
<p>The pilot reported that, due to a power loss and the low rotor horn, he performed an autorotation which resulted in a hard landing.</p>				
Conclusion				
<p>A second engine exam was convened for the purpose of engine disassembly. The examination did not reveal any significant findings. In particular, the accessory gearbox was thoroughly examined. Examination and measurements of gearbox casings were conforming. Some superficial marks on the gear face of the bevel gear were present and were in line with experience. Sludge was present on the starter magnetic seal and the seal was retained by NTSB in the event further examination is required. The contact surfaces were smooth.</p>				

VALIDATION		APPROVAL	
DATE	D2S/TEA	DATE	Approved by D2S/TEA
15SEP16		26 Sept 2016	

SUMMARY

1 HISTORY

1.1 TECHNICAL DOCUMENTATION

Maintenance:

Date	TSN (TSO)	Task	Operated by	Remarks
6Jan2016	627.2	150HR/12MOS Insp.	Blue Hawaiian	Starter not removed

Modular composition:

Modules	S/N	TSN	TSO	CSN	CSO	Remarks
70BMO10020	19710	687.8	N/A	N/A	N/A	
70BMO20010	20781	687.8	N/A	N/A	N/A	
70BMO30070	33044	687.8	N/A	N/A	N/A	
70BMO40020	24781	687.8	N/A	N/A	N/A	
70BMO50010	22779	687.8	N/A	N/A	N/A	
Items	P/N	S/N	Remarks			
HMU	0292862200	2684				

1.2 UPDATED CIRCUMSTANCES (NTSB PRELIMINARY REPORT)

On January 17, 2016, about 1430 Hawaii standard time, an Airbus EC130 T2, N11VQ, landed hard on a beach 2 miles west of Hanalei on the Hawaiian island of Kauai after a reported loss of engine power. The commercial pilot and 2 passengers sustained minor injuries, and 4 passengers were seriously injured. The helicopter sustained substantial damage to the tailboom and airframe. The helicopter was registered to Nevada Helicopter Leasing LLC, operated by Blue Hawaiian Helicopters under the provisions of 14 Code of Federal Regulations, Part 135, and was conducting an air tour flight at the time of the accident. Visual meteorological conditions prevailed for the flight, and a company visual flight plan had been filed. The local flight originated in Lihue at 1406.

The pilot reported that he was about 1/4 mile off shore northwest of Honopu Sea Arch at 1,300 feet mean sea level (msl) when he heard the low rotor rpm aural warning horn. He immediately entered an autorotation and turned towards the beach. He transmitted over the radio that he had an engine failure. As he approached the shoreline he made a right turn to the south and landed hard on the beach. He applied the rotor brake to slow the rotor, and at that time he noted that the engine was not running. The passengers began to exit and he pulled the engine fuel cutoff.

Updated on Jan 21 2016 5:39PM

1.2.1 Results of field investigation (accident)

- The helicopter had been recovered to a secure hangar previous to the examination.
- All fuel, oil, and air connections between airframe and engine were properly connected, tight, and saftied.
- The only visible damage to the engine were small dents in the linking tube at the rear mount consistent with a hard landing in a vertical direction.

- The gas generator and free turbine both turned easily by hand.
- Proper freewheel operation was confirmed. Continuity was confirmed from the free turbine to the main rotor. Continuity was also confirmed from the gas generator to the starter gear of the accessory gearbox.
- The fuel injection line between the adjusted valve and injection union could be moved away from the b-nut indicating a break of the line underneath the b-nut. The b-nut was removed using a calibrated torque wrench.
- The break-away torque of the b-nut was 126.4 in lbs indicating the nut had been properly torqued. A break of the line was discovered approximately 1/2 - 1 mm from the flare. The line was removed and sent to the NTSB lab for metallurgical analysis.
- The starter generator was removed revealing a large amount of black greasy liquid. The operator indicated that this was unusual to what they normally see.
- The engine and starter were removed and shipped to Turbomeca USA for examination on the test cell. The VEMD, DECU, and EDR were also removed for examination at the same time as the engine. A separate report will be issued for these examinations.

1.3 REVIEW OF INVESTIGATION

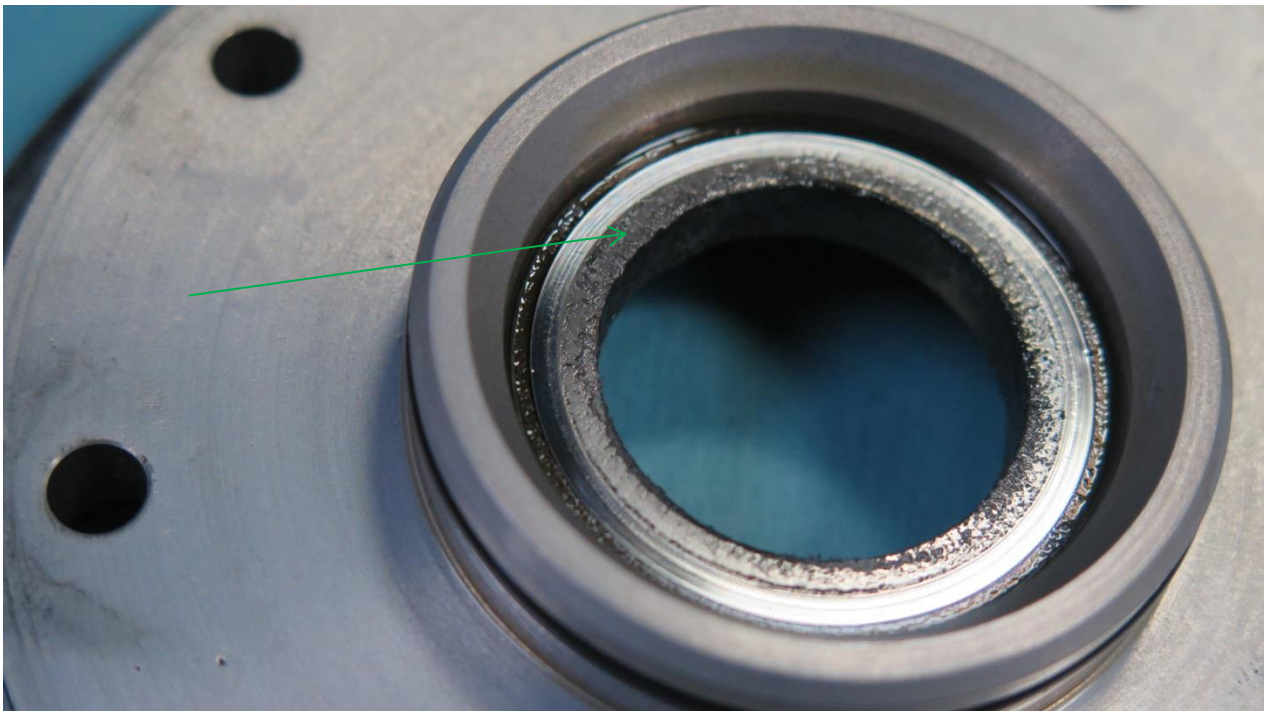
Description of equipment	P/N S/N	Date of review	Work performed	In the presence of
Arriel 2D	02902020030	8,9Sep16	Disassembly	NTSB

1.4 ENGINE EXAMINATION

The engine was removed from the crate. The engine equipment was removed and examined. Outside of corrosion no anomalies were discovered during the visual examination of the engine equipment. The modules were separated. The free turbine nozzle guide vane was removed and a rub approximately 2 inches was observed at the 8 o clock position of the shroud. The module 1 (accessory gearbox) was completely disassembled. The front casing starter bearing race and 41 tooth (bevel gear) race was measured in metrology and found conforming (see photos for results). A dark gray sludge material was present on the starter magnetic seal between the sealing surface and the gear outer diameter. A shiny line was present on approximately half of the starter gear outer diameter where the magnetic seal is installed however nothing could be felt with a stylus at the line. Some contact marks were observed on the bevel gear tooth faces (see photos). The "stripes" are due to oil highlighting the gear grinding marks where the teeth from the two intermeshing gears come in contact. These marks are consistent with what we see on other gears at a similar number of hours. The depth of the bearing seat was measured for the bevel gear in the front casing and found conforming (see photo for results).



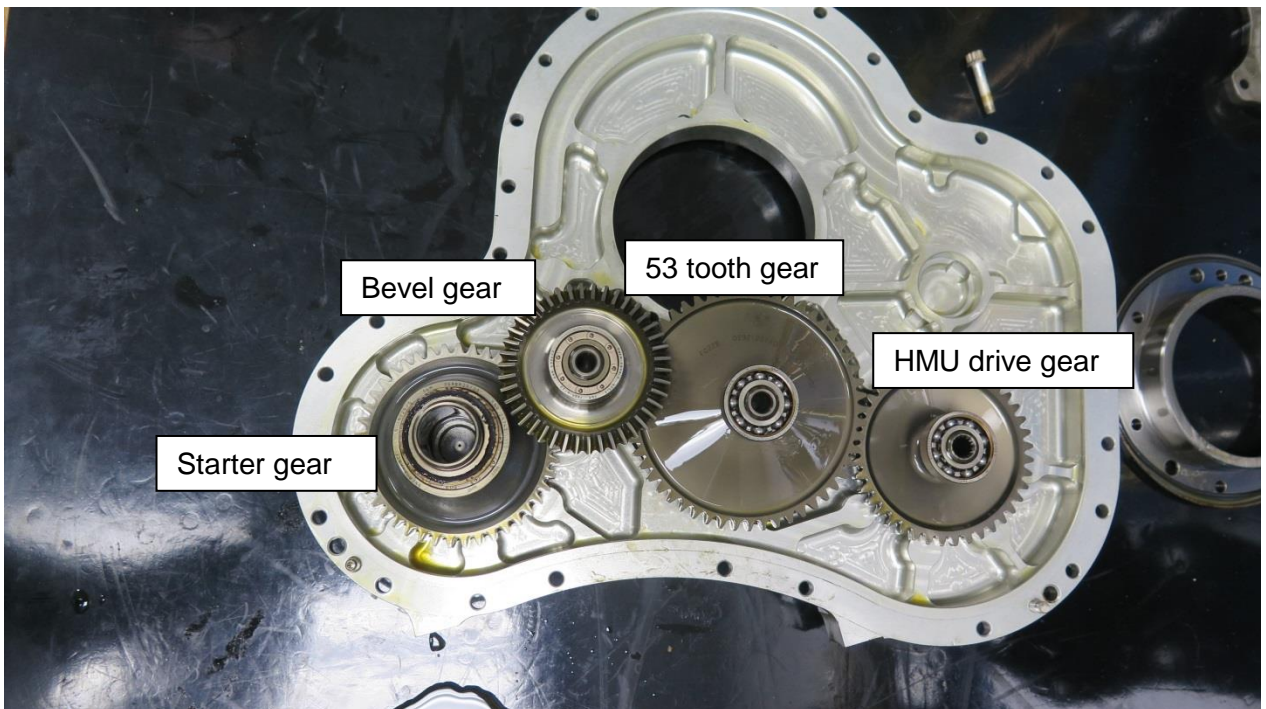
Example of corrosion found on engine equipment (start injector pipe)



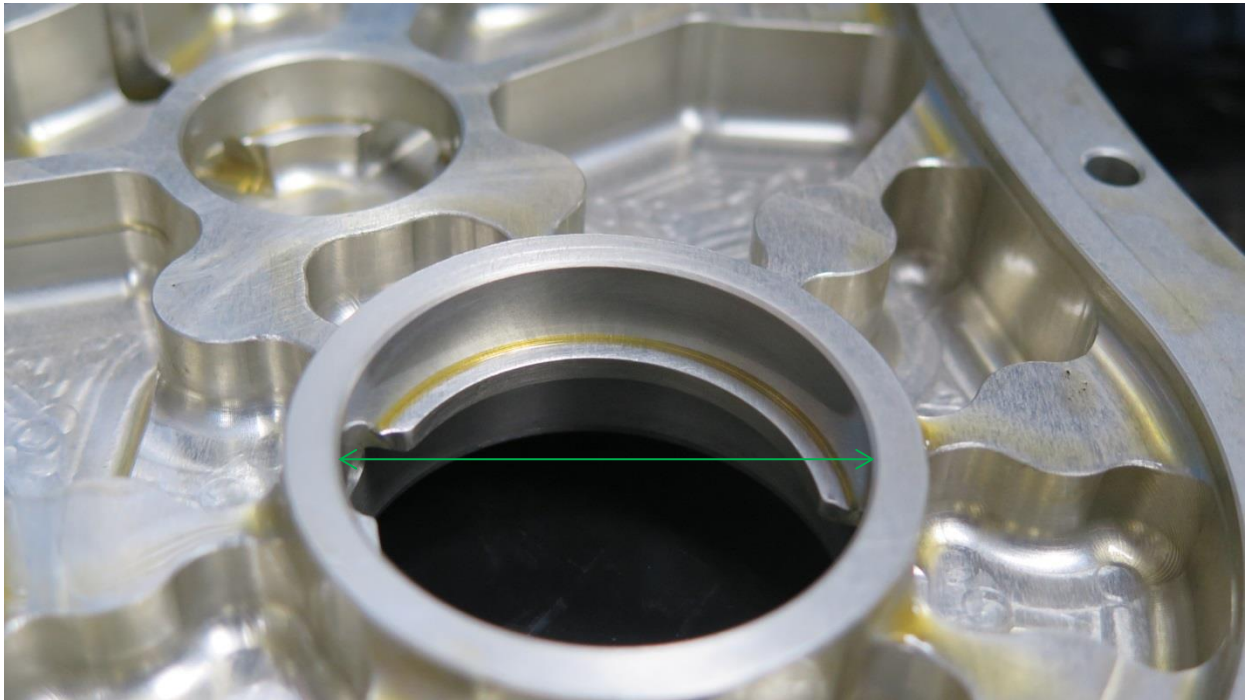
Sludge found on starter magnetic seal



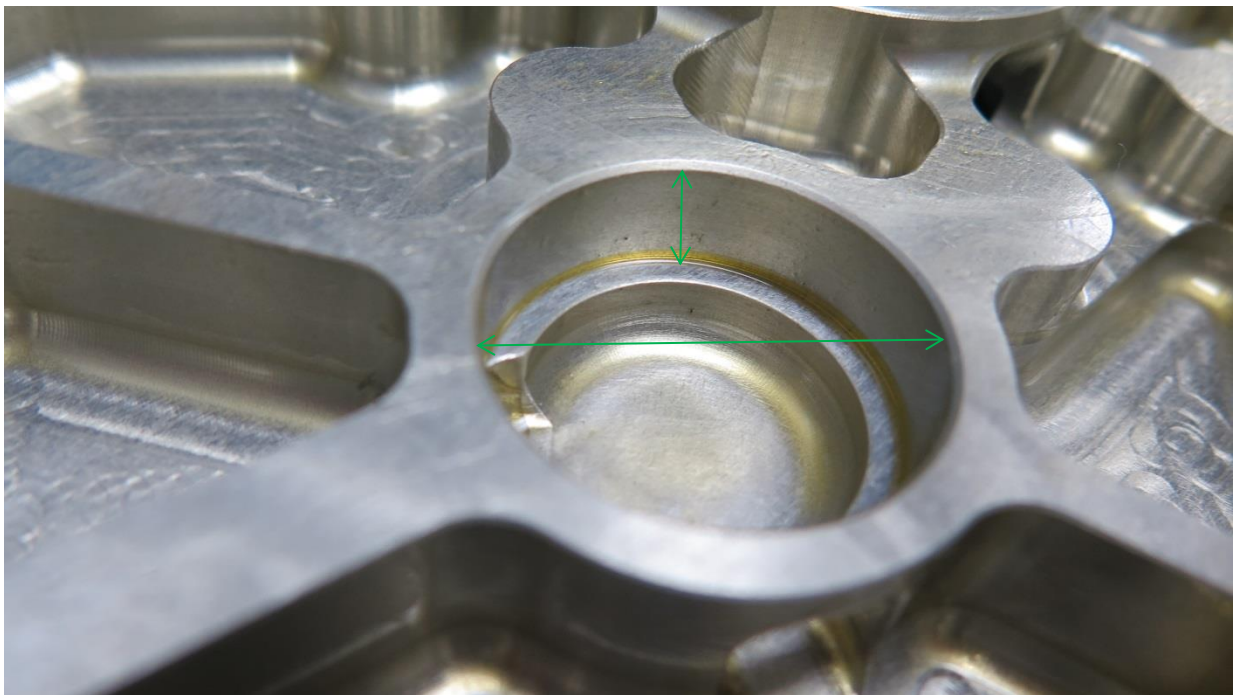
Free turbine shroud rub.



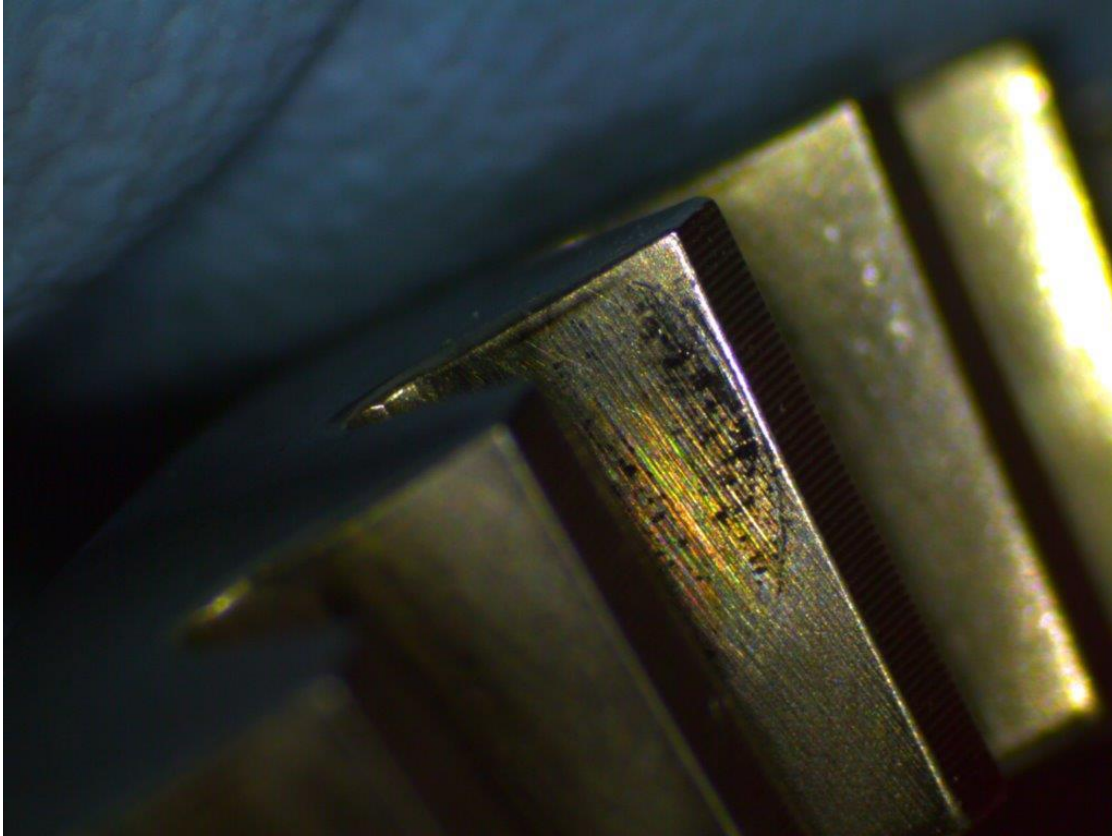
Accessory gearbox gear train.



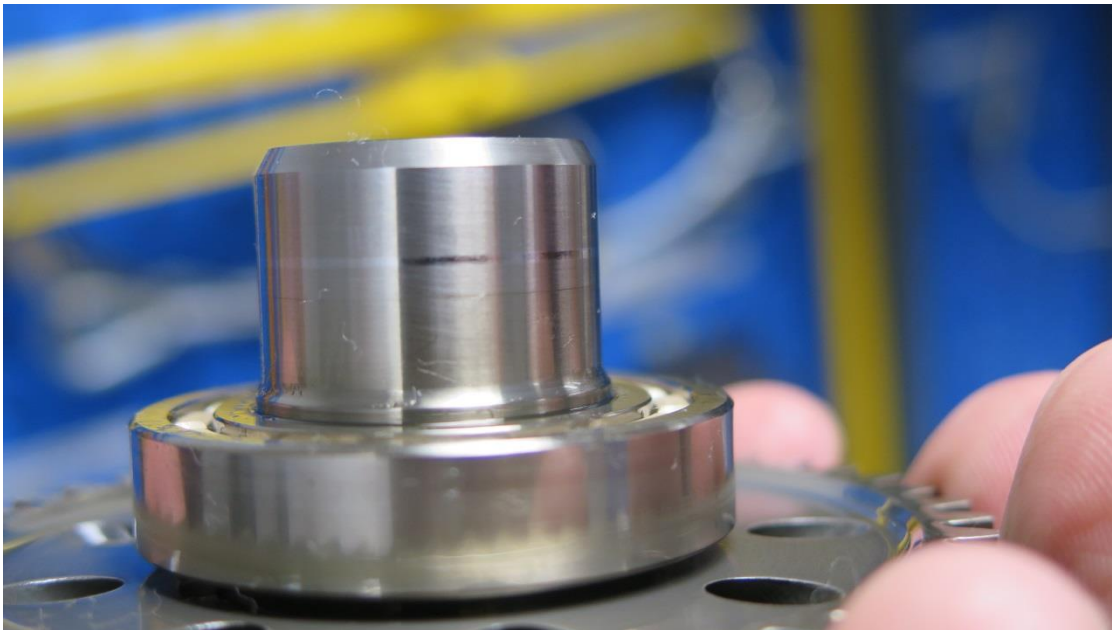
Starter gear bearing race diameter (limits 41.994 - 42.010 mm) (actual 42.005 mm)



Bevel gear bearing race (limits 27.995 – 28.008 mm) (actual 28.005 mm)
Bevel gear seat depth (limits 13.450 – 13.650 mm) (actual 13.570 mm)



Contact marks on bevel gear. Corresponds to the area where the two gears come in contact.



Shiny line on starter gear outer diameter

N11VQ ACCIDENT INVESTIGATION

RUPTURED PIPE

ADDITIONAL EXAMINATIONS & ANALYSES AT SAFRANHE

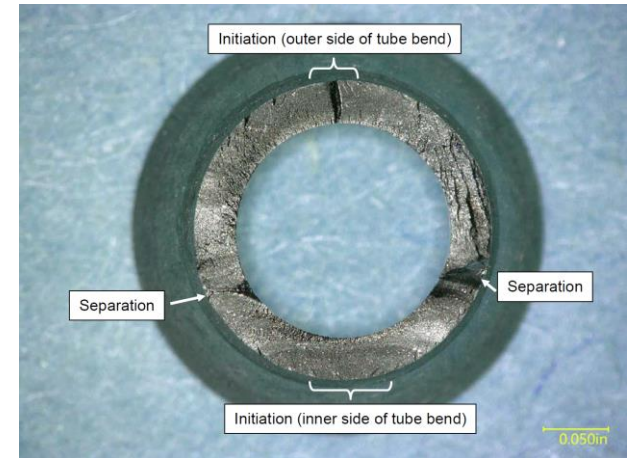
19 May 2017



N11VQ – Ruptured Pipe : Additional Examinations & Analyses at SafranHE

□ Background

- During the examination of the wreckage of N11VQ aircraft, the fuel supply pipe that was fitted to engine Arriel 2D s/n 50708 was found ruptured
- This pipe was collected by NTSB for examination (final report pending)
- Main NTSB findings :
 - “ marks [on the fracture surface] are consistent with reverse bending fatigue fracture initiation on the outside surface of the tube ”
 - “ two diffuse-origin fatigue cracks that initiated on the outside surface of the tube about 180 degrees from each other. These cracks propagated through the thickness of the tube wall and circumferentially around the tube.”
- The pipe was then sent to SafranHE for examination



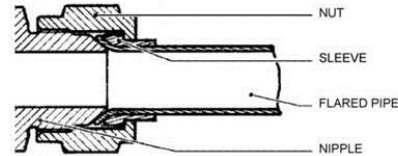
N11VQ – Ruptured Pipe : Additional Examinations & Analyses at SafranHE

❑ Fuel Pipe sent to SafranHE

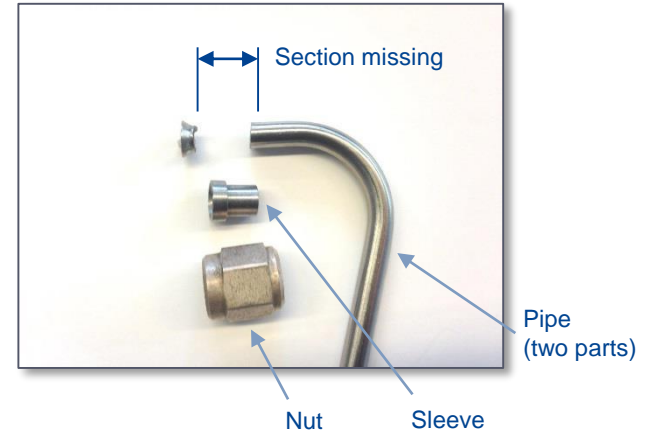
- Pipe details : Pipe P/N 0 292 73 731 0, s/n 2913AER
- The pipe was received with its sleeve and nut. The flared end of the pipe was received. Part of the tube had been sawn off and was missing.



Items received



Cut-through section



N11VQ – Ruptured Pipe : Additional Examinations & Analyses at SafranHE

□ Dimensional Controls

- The pipe was installed on the control jig that is used for the control of new pipes :
Along the whole length, the pipe was in contact with the positioning blocks except at its end where the gap was 2mm for a max theoretical tolerance of 1mm.

→The jig check showed a gap at pipe's end 1mm beyond tolerance

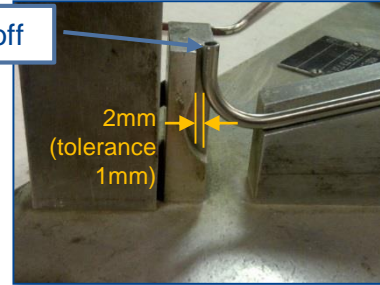
- It is worth noting that the extremity of the pipe had been cut off during controls by NTSB and its end bit was missing.
- Photos of the pipe on the accident engine showed it aligned with the fuel manifold's nipple on engine of N11VQ.
- A video and other photos show that the pipe was manipulated whilst still on the wreckage.

→The origin of the gap could not be determined

- Finite element and fracture surface analyses (see p.7) do not support presence of pre-rupture deformation (i.e. no significant static loading)
- The pipe/sleeve and flare/sleeve mating surfaces did not reveal any local discrepancies (see p.6)

→The presence of a misalignment before the event appears unlikely

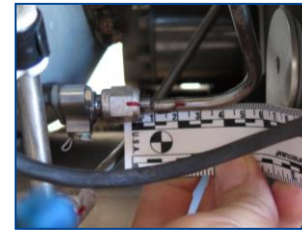
End of pipe cut off



Pipe on control jig



Pipe on control jig



Video and photos taken on wreckage of N11VQ

N11VQ – Ruptured Pipe : Additional Examinations & Analyses at SafranHE

□ Dimensional Controls

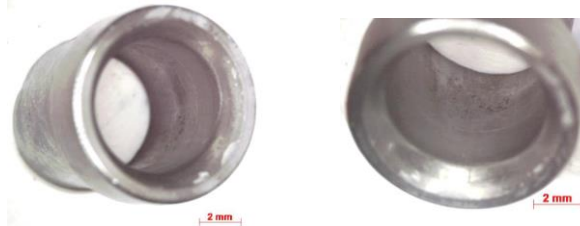
- The dimensional checks of the pipe showed that its diameter and its thickness were within specification.
- The check of the flare showed that its radius was slightly above tolerance whilst remaining smaller than the contact surface with the sleeve.

→ **The other dimensional controls did not reveal any significant discrepancy**

N11VQ – Ruptured Pipe : Additional Examinations & Analyses at SafranHE

❑ Other Controls

- Fracture surface : only one half of the fracture surface was available (the one on the flared end). The examination by SafranHE matched the analysis by NTSB.
- Close examination of the flare showed that the sleeve's contact area was in the conical area as normal.
- The close examination of the sleeve showed light fretting marks which are in line with experience.

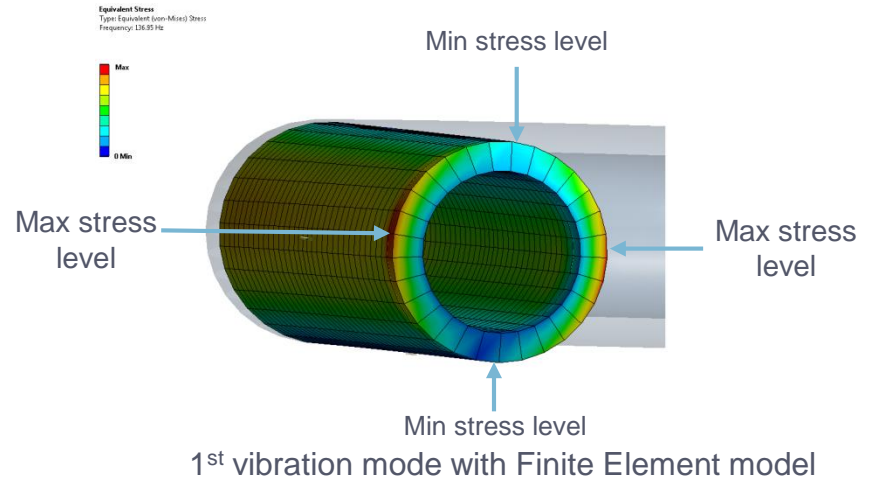
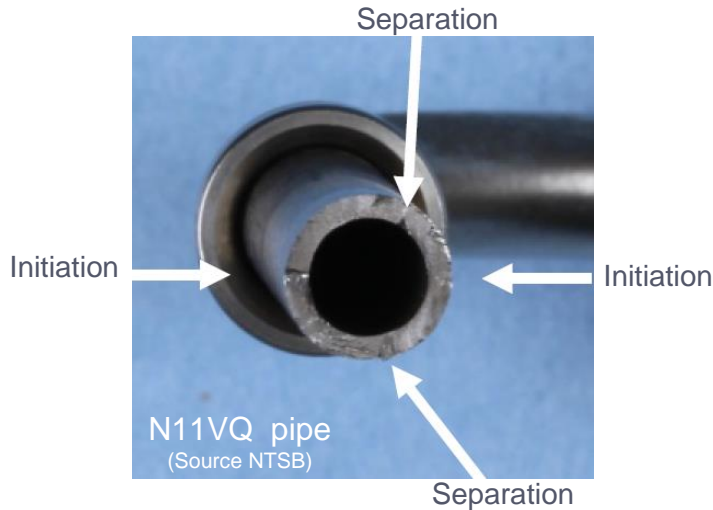


- Metal composition : the material was identified as Z10CNT18-11 which corresponds to the defined metal
- Hardness was measured at 165 HV5 which corresponds to a yield strength of 530 MPa which is within the specified 500 – 700 MPa range.

→ **Other controls did not reveal any significant discrepancy**

N11VQ – Ruptured Pipe : Additional Examinations & Analyses at SafranHE

□ Stress levels : comparison with Finite Element model of pipe



→ Crack initiation locations match maximum stress areas on the pipe's 1st vibration Mode

□ Summary

- Controls on a jig revealed a gap at pipe's end whose origin could not be determined. Analyses showed that a misalignment prior to the event was unlikely.
- Other dimensional controls were unremarkable
- Other controls (material, hardness, sleeve) were unremarkable
- Finite Element Analysis of pipe showed that Crack initiation locations match maximum stress areas on the pipe's 1st vibration Mode
- Fracture surface examination by SafranHE in line with NTSB's examination i.e. reverse bending fatigue fracture

N11VQ – Blue Hawaiian Helicopter Accident Investigation

Additional findings and analyses

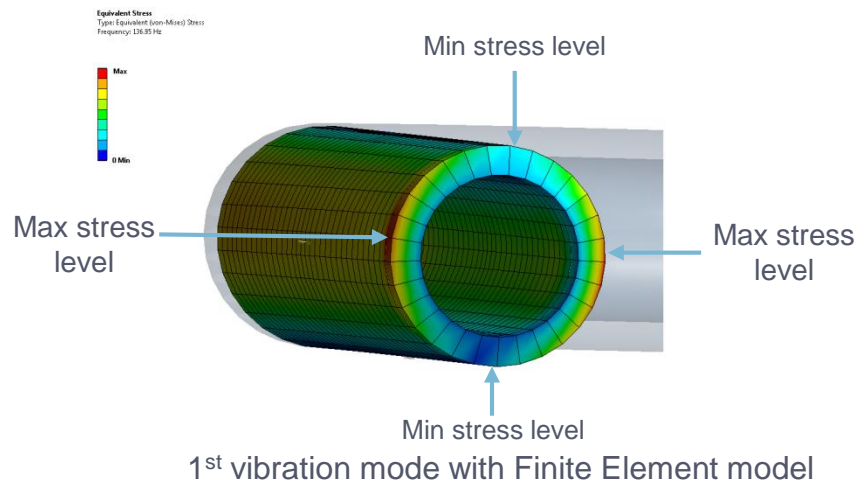
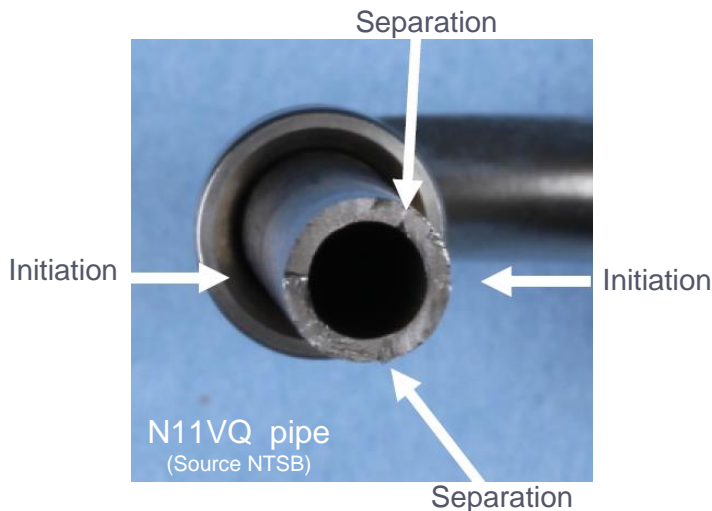
X. Azéma
Accident Investigator
D2S/TEA

1st Feb. 2017



N11VQ – Additional findings and analyses

□ Stress levels : comparison with Finite Element model of pipe



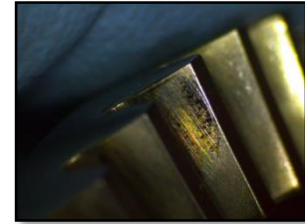
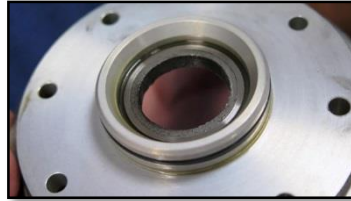
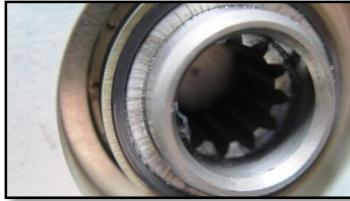
→ Crack initiation locations match maximum stress areas on the pipe's 1st vibration Mode

N11VQ – Additional findings and analyses

□ Engine of N11VQ tear-down at SafranHE USA (Sept. 2016)

- Magnetic seal : presence of sludge between shaft and contact surface. Contact surfaces visually smooth.

Parts being analysed in SafranHE laboratory



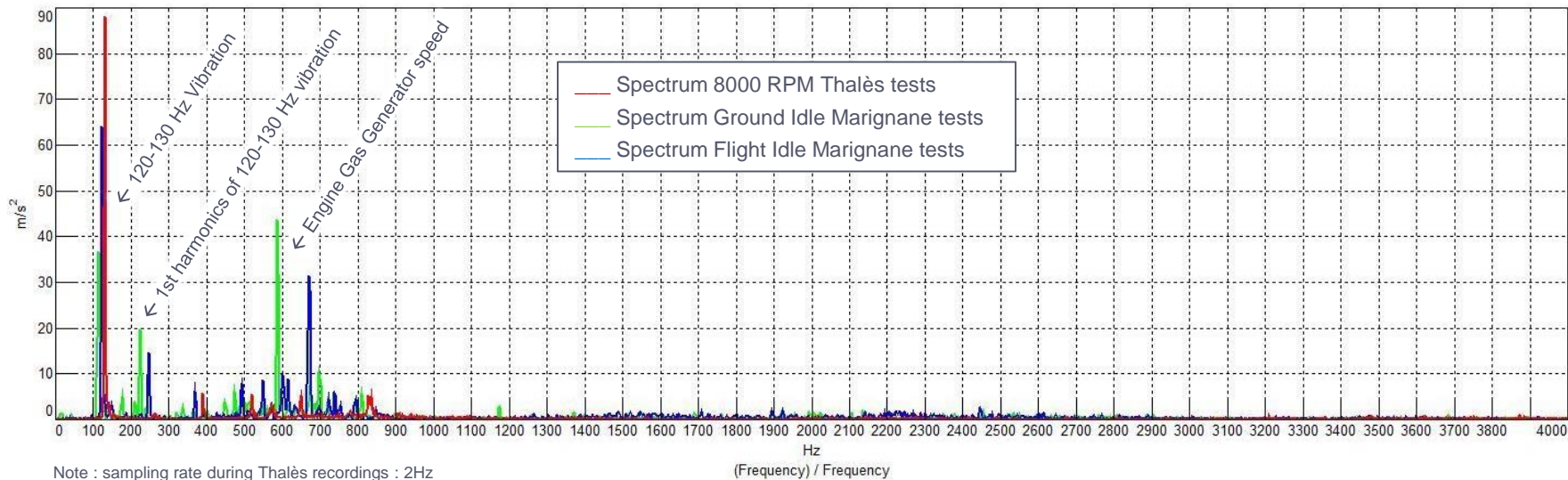
- Surface marks on 41 tooth bevel gear within experience at this TSN :
- Measurements of breather gear's front bearing and of bevel gear's race revealed that they were conform

→ No significant findings on engine

N11VQ – Additional findings and analyses

□ Potential effect of engine's vibrations

Comparison of vibration spectrums of S/G of N11VQ alone and on engine installed on helicopter = no significant difference



→ Engine is not a source of vibration on the Starter/Generator (other than the Gas Generator speed)

N11VQ – Additional findings and analyses

□ Arriel 2 fleet in service (as of end of 2016)

ARRIEL 2	Engines produced	Flight hours (millions)	Number of fuel pipe ruptures
All engines	5300	14.7	1 (N11VQ)
With « 731 » pipe	4500	14.2	1 (N11VQ)
With « 035 » pipe	800	0.5	0

- Air Methods fleet's fuel pipe inspection : no signs of cracks nor rupture detected

→ No other case on these pipes in 14.7 million flight hours